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MILITARY HANDBOOK

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS
DATA COLLECTION WORKBOOK

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MISC

DEPARTMENT OF DEFENSE
WASHINGTON, DC 20360

Life Cycle Cost Model
for
Defense Materiel Systems
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1. This handbook was prepared by the Marine Corps to be used for all Marine Corps materiel system procurements. This publication is not intended to supersede any procurement solicitation requirements. It is intended to be used by both Government and industry analysts in developing life cycle cost estimates for Marine Corps procurements.

2. This publication was approved on 3 February 1984 for printing and inclusion in the military standardization handbook series.

3. This handbook describes the elements to be considered in determining the life cycle cost of a materiel system. These cost elements and cost factors form the input and output structure of the Life Cycle Cost Model for Defense Materiel Systems. The handbook is meant to be a workbook for determining life cycle costs. Normally, a subset of the cost structure contained in this handbook and the Model will be prescribed for any given procurement. The emphasis is on what costs should be considered in developing life cycle cost estimates for controlling and reducing total costs. The handbook and the Model are specifically designed to give the analyst and the program manager complete control over the subset of the Model's cost elements which is applicable to the system being costed and to select the most appropriate cost estimating methodology for each cost element.

4. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be use in improving this handbook should be addressed to:

Commandant of the Marine Corps
Code LMA-1
Washington, DC 20380

by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this handbook or by letter.

FOREWARD

1. The Marine Corps Life Cycle Cost Model for Defense Materiel Systems is the fifth in a series of engineering cost models developed in response to a Marine Corps requirement for a life cycle cost model which can be used in joint Service acquisition programs to insure that each Service's life cycle costs be considered. The current model described by this handbook reflects continuing participation by analysts from all Services and industry to develop a model which is equally appropriate and convenient for all analysts and decision makers who must prepare or use life cycle cost estimates.

2. The Model's basic cost element structure is derived from MIL-STD-881, OSD Cost Analysis Improvement Group (CAIG) O&S Cost Development Guides, the Army 11 series pamphlets on life cycle cost, and the Tri-Tac Cost Effectiveness Program Plan. The model addresses all seven major types of Defense materiel systems: surface vehicle, electronic, aircraft, ship, missile, ordnance and space.

3. The report structure satisfies the requirements of DODI 5000.2, Major Systems Acquisitions Procedures, the DOD CAIG, Department of the Army 11 series Pamphlets and the Fiscal Director of the Marine Corps. The cost reports, with supporting documentation, are appropriate for presentation to all Services' system acquisition review councils and the Defense System Acquisition Review Council (DSARC).

4. The model and this handbook are specifically designed to let the cost analysis community concentrate on the problem of developing cost estimates and determining the economic impact of the many engineering and management decisions which must be made during system acquisition by freeing them from the problem of developing new cost element structures and models for each program.

5. The Model is available to all users through a commercial time sharing arrangement to eliminate conversion problems, minimize software maintenance costs, maintain configuration control of the Model and its Government cost factors and to facilitate the sharing of data between Government and industry by electronic transfer of data bases between users.

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1. SCOPE

1.1 General. This handbook provides information on the cost elements and structure of the Marine Corps Life Cycle Cost Model for Defense Materiel Systems. It makes no attempt to prescribe how the analyst should go about determining the various costs and cost factors which make up individual estimates. A major objective of this handbook is to help Government and industry analysts provide decision makers at all levels with sufficient economic information to determine, within the bounds set by affordability, both the most cost-effective configuration for individual materiel systems and the most cost-effective mix of existing and proposed materiel systems.

1.2 Comparability. The development and presentation of comparable costs for all proposed systems is vital if informed acquisition decisions are to be made by the Services, DoD and Congress. As a minimum, comparability depends upon comparable cost structures. This handbook provides comparable cost structures and methods for all major types of materiel systems.

1.3 Complicating factors. The preparation of life cycle cost estimates is a complex process. Analysts assigned to a number of different organizations in both Government and industry develop portions of each estimate. These analysts often work independently and, in many instances, without full appreciation of the estimate as a whole. Elements beyond the control of any one participant in the process influence other parts of the estimate as well as the total estimate (e.g., schedule, operational use, manning levels, skill levels, maintenance concepts). No single cost estimating methodology (e.g., parametric, price, analogy) is universally appropriate for developing any of the individual costs which make up the total life cycle cost picture. In this context, program managers are expected to define the resources required to develop, produce and successfully operate systems which, in many cases, have no comparable analog in the current state of either engineering or organizational art.

1.4 General approach. This handbook, when used with the Model, is designed to be flexible enough to deal with the wide range of analytical requirements which vary over time and between systems and which depend upon the unpredictable availability of decision relevant data. This flexibility has been achieved in the following ways:

1.4.1. Divide and conquer. The Model allows program managers to divide the cost problem into well defined and logically bounded parts that can be assigned to appropriately skilled analysts belonging to different organizations. For example, design engineers can concentrate on estimating efforts to complete alternative designs; production engineers on producibility resource requirements; logistics engineers on reliability and maintainability objectives; managers on such issues as schedule and cash flow; proponents on operational use and manning requirements; and logisticians on level of repair, training, repairability and supply support. This lets individual analysts concentrate on the subsets of each life cycle cost data set which fall within their area of expertise while the Model keeps track of interdependencies with inputs made by other analysts.

1.4.2. Provide structure, not method. The Model and this handbook provide a structure for cost analysis which accommodates both simple and complex systems developed in either simple or complex acquisition environments. As noted above, the Model allows the program manager total freedom to select those costs which should be developed in any given estimate. The Model allows the analyst the same freedom to select any mixture of cost estimating methodologies appropriate to the analysis, schedule and available data: parametric, analogy, engineering, expert opinion or market price. There are several major advantages to this approach:

a. Independent estimates can be made using the same set of assumptions, thus allowing analysts to focus on estimating methods rather than on structure.

b. The analyst is not forced to use dated or inappropriate parametric cost estimating relationships (CER's) or procedures.

c. Data entry is simplified since only data needed for the analysis is required. Dummy data to make inappropriate CER's work is never required.

d. Competitive sensitive methodologies (Government or industry) are protected.

e. The most relevant cost estimating methodology, at the time of the estimate, can be selected for various parts of the many estimates made during the various phases of the acquisition cycle, allowing the analyst to use a mixture of high and low resolution estimating procedures.

f. Model maintenance costs are minimized.

g. The Model can be used for any type of system during all phases of development, including product improvement programs.

h. The Model is easy to use since the cost estimating methodology is selected by the analyst, not the Model.

i. The Model does not require revalidation before each new application since parametrics, if used, are selected and validated by the analyst and not within the context of the Model.

1.4.3. Fit the level of detail to the decision requirement. The decisions which use life cycle cost estimates are as disparate as they are complex. For example, engineering trades generally require a focused level of detail which is sensitive to the variables being examined, generally at the subsystem or component level. Program management decisions are generally concerned with broader, less detailed estimates. The Model allows analysts to select the amount and level of reporting detail which best fits their own decision space. The objective is to provide decision makers with necessary and sufficient decision support data without requiring them to search through masses of detail.

1.4.4. Produce comparable results. Since the Model treats all classes of materiel systems from tanks to ships comparably, the results of the analyses conducted by different program managers can also be used to make trade-offs between competing materiel systems at the Service, DoD and Congressional decision levels.

1.5 Model data bases. The analyst has complete control over the contents of all data bases except the files which contain OSD inflation rates and manpower cost factors such as pay and allowances, base operating support, medical, and retirement liability which are set by the individual Services. Each of the Model's data bases is discussed briefly in the following paragraphs. Section 5 of this handbook contains definitions and worksheets for each of the Model's data elements.

1.5.1 System: (Research and Development (R&D), Production). System level cost elements are those costs attributable to the system as a whole and not to any one of the hardware configuration items. These include such elements as: program management, system test and evaluation, data, facilities and training during R&D and production. These costs may be entered in detail or at summary levels, depending upon the availability of data. Government and contractor activities are entered separately. Analysts may also enter percent values in lieu of dollar values for any given activity and the Model will calculate the activity cost based on the percent value entered. See 5.2 and 5.3 for R&D and production system cost element worksheets.

1.5.2 System: (Operating and support (O & S), Assumptions). The O & S data base is used to develop system costs for maintenance and operational transportation, facilities (operational, maintenance and supply), software support (operational software and test program sets), contract support requirements and technical data revisions. An assumptions data base is provided for factors which apply to all work breakdown structure (WBS) items in the materiel system such as years of operation, manpower productivity factors, supply pipeline times and transportation costs by mode. See 5.4 and 5.5 for O&S and Assumption worksheets.

1.5.3 Hardware/software WBS. The WBS data base is the key to the versatility of the Model since the system/commodity peculiar data is resident in this file. Hardware and software items are classified according 3.3 using the project summary WBS in MIL-STD-881 and the DA 11 series pamphlets. The creation of the WBS data base is covered in 5.7.

1.5.3.1 Level of detail. The hardware/software WBS structure data base may be created at any level of detail down to the piece parts used in the system. There is no limit to the number of records which may be entered in the WBS data base. As a practical matter, the level of detail in the WBS data base should be a function of the decisions over which the management and design team has control. Excess detail in the WBS data base may lead to errors and increases the cost of the analysis without a corresponding benefit to the program being costed.

1.5.3.2 Cost realism. This data base provides information essential to judging cost realism for R&D and production efforts as well as operating and support costs.

1.5.3.3 Cost estimating methodologies. The Model accepts parametric formulas, dollar values, ratios, manhours or manloading for labor by type (e.g., engineering, manufacturing and management), tooling, and material (e.g., raw material, purchased parts and Government furnished equipment (GFE)) needed to design, develop and build prototype, preproduction and production hardware and software configuration items. Parametric libraries may be created from these data bases for future use to simplify subsequent cost estimates.

1.5.3.4 Learning curves. Separate learning rates may be specified for each WBS item and different learning rates may be used for labor and material. The Model computes the effect of learning based on lot size, production schedule and production history. Either cumulative-average or unit cost theory may be selected for different end items and subassemblies.

1.5.3.5 Maintenance and operational profiles. Each item in the hardware and software data base may be assigned either a unique or common maintenance profile. The Model can be used to refine maintenance concepts for end items, secondary reparables and discardable items using any mix of the maintenance concepts employed by the Services. For complex systems or systems integrated into other systems, the items being costed frequently have a variety of operational and maintenance profiles which are a function of the type command and Service. The Model allows the analyst to separately describe each of the operational and maintenance profiles applicable to each end item and its components. This allows analysts to conduct trade studies which are sensitive to the entire range of operational and maintenance profiles applicable to the system rather than a pseudo profile created solely for analytical purposes.

1.5.3.6 Supply. The Model calculates demands for major classes of supply based on the operational scenario: repair parts, POL, ammunition, electricity and all other supply items applicable to the system. The demand curve created by the schedule builds up supply system requirements as the system is deployed to using units.

1.5.4 Schedule. The schedule data base, covered in 5.10, is used to determine cash flow requirements from Milestone 0 to disposal. This data base is also used to build up the operational equipment density table to insure accurate projections for O&M costs during equipment phase-in and phase-out, as well as to schedule depot overhauls. Production schedules are entered separately for each lot; this allows inflation factors to be applied to each production run to insure that changes in schedule and individual Service procurements are properly costed when presented in then-year (inflated) dollars.

1.5.5 Inflation. The inflation data base, covered in 5.11, contains password-protected DoD TOA and outlay deflators for the following budget categories: R&D, Production, O&M, Other Procurement, MILCON and Military Personnel. Program-specific deflators may be optionally entered and used for each of these categories. Analysts may also enter Bureau of Labor Statistics (BLS) or other negotiated deflators for equipment furnished under contract. The inflation data base allows the analyst to enter costs for WBS items in different year dollars. (This is especially useful for GFE, which is often reported in a variety of different year dollars). The Model uses the inflation rate tables to normalize all input costs to the system base year. Reports may be produced in constant and current (inflated) dollars using this data base with the schedule data base.

1.5.6 Personnel. Personnel are entered as Tables of Organization (T/O's) classified by Service, grade, MOS, job function and number. T/O's may be created for each phase of the life cycle: R&D, Production, Operating and

Support and post-production program management. Creation of the personnel data base is covered in 5.8. The Model calculates manhour demand for up to 28 functional areas and converts these to billet costs using both DoD and Service billet cost tables for DoD personnel (military and civilian) and manufacturer's pay scales for contractor personnel. Personnel may be dedicated to the system (i.e., fully charged regardless of demand) or shared (i.e., only charged for work demanded by the Model). Multiple Services may be entered. The analyst may allocate subsets of the T/O to operate or maintain specific equipment subsystems. There is no limit to the number or size of the T/O's which may be entered.

1.5.7 Training. Both course cost and training track data bases may be created by the analyst. See 5.9 for details. Costs for the training track may be substituted for MOS training costs in the Model's data bases for any lines in the T/O. Costs for selected formal Service schools are included in the Model's data bases. Analysts may create training tracks which are a combination of current Service schools, civilian schools and proposed Service schools. On-the-job training is normally not charged to the system.

1.6 Editors. The Model contains powerful editors which perform three essential functions: perform preliminary quality control checks on data as it is entered, allow rapid changes to existing data for sensitivity analyses and updates to existing records, and creation of new records by copying all or selected parts of existing records. These editors allow the analyst to take advantage of the redundancies found in any life cycle cost data base (e.g., common maintenance profiles) to reduce the amount of data which must be entered through a terminal.

1.6.1 Creating new systems. The editors also make it a relatively easy task to create a new system by copying selected parts of existing data bases, assembling these parts into a new data base and then making appropriate revisions to reflect those factors which distinguish the new system from the existing system.

1.7 Sensitivity. The Model is sensitive to equipment design, manufacturing methods, reliability and maintainability, operational use, maintenance profile, manpower requirements and schedule. The Model can be used to predict both cost element and life cycle cost implications of changes in:

a. Manufacturing technology
b. Design (hardware/software)
c. Operational use
d. Maintenance concept
e. Manpower requirements
f. Training requirements
g. Schedule (R&D, production, deployment)
h. POM/budget requirements
i. Inflation
j. Risk
k. Production quantities and rates

1.8 Security. All users are assigned password-protected user numbers. All user-created files may be password-protected by the user. Except by special permission, files may only be accessed by using the same user number which was used to create the file. No user has access to another user's files except by special permission of the owning user for purposes of transferring data electronically. All files are backed up to tape daily, weekly and monthly. Data files are stored in binary code so that they cannot be listed except by the Model.

1.9 Responsiveness. Complex systems can be entered in 8 to 12 hours. The Model is interactive and the normal compute time is 7 to 20 seconds. The Model may be run in either interactive or batch modes. Batch processing reduces the costs for system resources by approximately 50 percent.

1.10 Updates to model data bases. Personnel costs, training costs and DoD deflators are available to all users in data bases maintained with Government data. Inflation indices are updated every six months and the personnel data bases are updated annually.

1.11 Configuration management. The Model is written in FORTRAN. The same copy of the compiled Model is shared by all users. No user can make changes to the Model itself. User reported errors are investigated and corrected upon verification. Users are advised by electronic mail through their user numbers of all changes which could impact on their results. Change pages to reference documentation are forwarded to all users. Major revisions to the Model are released as new versions after extensive testing and verification.

1.12 Inputs. The following is a summary of the input classes which can be used with the Model. The user can elect to use any or all of these inputs, but generally only a subset of each is required for an acquisition program.

a. R&D activity costs, schedule and spending rates
b. Production activity costs, schedule and spending rates
c. WBS item R&D, production, operating and maintenance costs and descriptions to any level of indenture
d. Operational deployment schedules
e. Up to 25 tables of organization/equipment of unlimited size
f. Distribution of maintenance workload from operator to depot for each equipment down to the piece part level
g. Manpower requirements (grade, MOS, Service, numbers)

    (1) R&D and production activities
    (2) Operators/crew
    (3) Indirect command personnel
    (4) Organizational maintenance
    (5) Intermediate/DSU maintenance (including contact teams)
    (6) GSU maintenance (including contact teams)
    (7) Software maintenance (maintenance and operational software)

h. Manufacturer's manpower cost structure (optional)
i. Transportation (operations, maintenance)
j. Inflation (DoD, Service specific, and Bureau of Labor Statistics (BLS) commodity deflators)

k. Facilities

(1) R&D, Industrial, Test
(2) Operational
(3) Maintenance
(4) Software
(5) Supply

l. Free text comments for each life cycle phase (optional)

1.13 Reports. The analyst can select any or all of the following reports:

a. Budget reports by appropriation, life cycle phase and year
b. R&D costs (hardware and software)

(1) Government
(2) Contractor

c. Production costs (hardware/software)

(1) Government (recurring and nonrecurring)
(2) Contractor (recurring and nonrecurring)

d. Unit production costs
e. Operations and maintenance costs
f. Material consumption costs
g. Energy consumption costs
h. Operator/crew costs
i. Operational transportation costs
j. Software maintenance costs (maintenance & diagnostic software and operational software)
k. Equipment maintenance costs

(1) Facilities
(2) Spares
(3) Repair parts and material by level of maintenance & WBS class
(4) Personnel
(5) Transportation

l. Supply personnel and facility costs
m. Personnel support costs
n. Life cycles cost by phase by year
o. Comparison of inflated vs constant dollars by phase & year
p. Number of annual failures for each WBS item
q. Number of maintenance manhours by level for each WBS item
r. Excesses and shortfalls for the projected maintenance T/O
s. Material consumption by class of supply
t. Report of cost elements which differ between any two runs
u. Analyst created footnotes for each report
v. GFE data base to include cost and maintenance concept
w. Mission profile data base for all major type force units
x. Comparisons between any two UPC or LCC reports including the computed differences between the reports for each cost element
z. Depot overhaul

2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this handbook to the extent specified herein or in the invitation for bids.

STANDARDS

MILITARY

MIL-STD-756	-	Reliability Modeling & Prediction
MIL-STD-785	-	Reliability Program for Systems and Equipment Development and Production
MIL-STD-881	-	Work Breakdown Structure for Defense Material Items
MIL-STD-1260	-	Uniform Cost Accounting and Reporting System (UCARS)
MIL-STD-1388	-	Logistic Support Analysis
MIL-STD-1390	-	Level of Repair

2.2 Other publications. The following documents form a part of this handbook to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

OMB Circular A-94	-	Discount Rates to be Used on Evaluating Time-distributed Costs and Benefits
OMB Circular A-109	-	Major System Acquisitions
DOD Directive 4105.62	-	Selection of Contractual Sources for Major Defense Systems
DOD Directive 4245.3	-	Design to Cost
DOD Directive 5000.1	-	Major System Acquisitions
DOD Directive 5000.3	-	Test and Evaluation
DOD Directive 5000.4	-	OSD Cost Analysis Improvement Group (CAIG)
DOD Directive 5000.26	-	Defense Systems Acquisition Review Council (DSARC)
DOD Directive 5000.37	-	Acquisition and Distribution of Commercial Products
DOD Directive 5000.39	-	Acquisition and Management of Integrated Logistic Support for Systems and Equipment for Resource Management
DOD Instruction 5000.2	-	Major System Acquisition Procedures
DOD Instruction 5000.33	-	Uniform Budget/Cost Terms and Definitions
DOD Instruction 7000.2	-	Performance Measurement of Selected Acquisitions
DOD Instruction 7000.3	-	Selected Acquisition Reports (SAR)
DOD Instruction 7000.10	-	Contract Cost Performance, Funds Status and Cost/Schedule Status Reports
DOD Instruction 7000.11	-	Contractor Cost Data Reporting (CCDR)
DOD Instruction 7041.3	-	Economic Analysis and Program Evaluation
DOD 5000.19-L (VOL II)	-	Acquisition Management Systems & Data Requirements Control List.
DOD 7110-1M	-	Department of Defense Budget Guidance Manual
SECNAVINST 4000.31	-	Life Cycle Costing
SECNAVINST 5000.1	-	System Acquisition in the Department of the Navy

SECNAVINST 7000.14	-	Economic Analysis and Program Evaluation for Navy Resource Management
OPNAVINST 3960.10	-	Test and Evaluation
OPNAVINST 4720.9	-	Approval of Systems and Equipments for Service Use
OPNAVINST 5000.42	-	Weapon Systems Selection and Planning
NAVMC-2644	-	Integrated Logistic Support Implementation Guide for DoD Systems and Equipments
MCO P5000.10	-	Systems Acquisition Management
MCO P7000.14	-	Marine Corps Cost Factors Manual
NAVMATINST 4000.20	-	Integrated Logistic Support Planning Policy
NAVMATINST 4105.3	-	Integrated Logistic Support (ILS) Review and Appraisal
NAVMATINST 4200.49	-	Selection of Contractual Sources for Major Defense Systems
NAVMATINST 4720.1	-	Approval for Service Use of Systems, Equipments, Conventional Weapons and Expendable Ordnance
NAVMATINST 5000.23	-	Defense Systems Acquisition Review Council (DSARC)
NAVMATINST 5420.172	-	Establishment of the Department of the Navy Systems Acquisition Review Council (DNSARC)
TTO-AM-032-81-V3	-	Cost Effectiveness Program Plan for Joint Tactical Communications
MIL-HDBK-259	-	Life Cycle Cost in Navy Acquisitions
DOD	-	Economic Analysis Handbook
DOD LCC-1	-	Life Cycle Costing Procurement Guide
DOD LCC-2	-	Casebook Life Cycle Costing in Equipment Procurement
DOD LCC-3	-	Life Cycle Costing Guide for System Acquisitions
DA PAM 11-2	-	Research & Development Cost Guide for Army Materiel Systems
DA PAM 11-3	-	Investment Cost Guide for Army Materiel Systems
DA PAM 11-4	-	Operations & Support Cost Guide for Army Materiel Systems
DA PAM 11-5	-	Standards for Presentation & Documentation of Life Cycle Cost Estimates for Army Materiel Systems
AFPCH	-	Army Force Planning Cost Handbook
AFR 173-13	-	USAF Cost and Planning Factors

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 General. These economic and acquisition management related terms are defined in the context of system and equipment acquisitions. They are intended to be adequate for the development of life cycle cost estimates for most acquisition programs. Additional clarification, if needed, may be found in the documents listed in section 2 of this handbook. While many of the documents listed in section 2 of this handbook are not specifically referenced herein, the list is provided to assist program managers in Government and industry in developing a library of documents which may have impact upon their programs and which provide the rationale for developing various aspects of each life cycle cost estimate.

3.2 WBS. A WBS is a product oriented family tree composed of hardware, services, and data which result from the identification of acquisition tasks during the development and production of a system or equipment, and which completely describes the program or project. A WBS displays and defines the product to be developed or produced and relates elements of work to be done to each other and to the end product.

3.2.1 Program/project WBS (PWBS). The PWBS is the complete WBS for the program or project covering the acquisition phase. It usually contains one or more contract work breakdown structures as subsets.

3.2.2 Contract WBS (CWBS). The CWBS is the complete WBS covering a particular contractor based on the contract work statement.

3.2.3 Summary WBS. A summary WBS consists of the upper three levels of a WBS prescribed by this handbook and having uniform element terminology, definition, and placement in the family-tree structure. The upper three levels of a summary WBS have been organized within the following categories of defense materiel items.

a. Aircraft systems

b. Electronics systems

c. Missile systems

d. Ordnance systems

e. Ship systems

f. Space systems

g. Surface vehicle systems

3.2.3.1 *Level identification*. The three levels specified in 3.2.3 are defined as follows:

Level 1. Level 1 is the entire defense materiel item; for example, the Minuteman ICBM System, the LHA Ship System, or the M-109A1 Self Propelled Howitzer System. Level 1 is usually directly identified in the DoD programming/budget system either as an integral program element or as a project within an aggregated program element.

Level 2. Level 2 elements are major elements of the defense materiel item; for example, a ship, an air vehicle, a tracked vehicle, or aggregations of services, (e.g., systems test and evaluation); and data.

Level 3. Level 3 elements are elements subordinate to level 2 major elements; for example, an electric plant, an airframe, the power package/drive train, or type of service, (e.g., development test and evaluation); or item of data (e.g., technical publications).

3.2.4 Configuration-item (CI). An aggregation of hardware/computer programs or any of of its discrete portions, which satisfies an end-use function and is designated by the Government for configuration management. CI's may vary widely in complexity, size and type, from an aircraft, electronic or ship system to a test meter or round of ammunition. During development and manufacture of the initial (prototype) production configuration, CI's are those specification items whose functions and performance parameters must be defined (specified) and controlled to achieve the overall end-use function and performance. Any item required for logistic support and designated for separate procurement is a CI.

3.3 Summary WBS's. The following definitions are taken from MIL-STD-881 and are provided to classify system components for the WBS data base. The WBS numbers for the WBS elements are shown in front of the element name headings,e.g.,"11.2 Sensors."

3.3.1 **Electronics system (level 1).** The electronics system element refers to the complex of equipment, data services, and facilities required to develop and produce the capability of electronics systems as represented by Command Centers/Fire Control Systems - 425L, FADAC; Communications - 490L, Tactical Radios; Sensor Systems - SONUS; Navigation/Guidance Systems - ILAAS; Electronic Warfare Systems AN/QRC-54 Jammer; Support Systems - Multi-System Test Equipment.

3.3.1.1 11 Prime mission equipment (level 2). The prime mission equipment element refers to the equipments and associated computer programs used to accomplish the prime mission of the defense materiel item. Those support equipments and services vital to the operation and maintenance of the system are included. When the electronic system is comprised of several prime mission products, each will be listed separately at level 2. This element includes all effort associated with the design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use). It also includes such items as interconnecting cabling and harnesses.

3.3.1.2 11.1 Integration and assembly (level 3). The integration and assembly element refers to all effort required for the in-plant integration and assembly of other level 3 elements into a prime mission product, within a suppliers' facilities. This element includes all materials and parts or other mating equipments furnished by/to an integrating agency or contractor.

It includes, for example, vans, storage and transportation devices; cables, conduits, connectors; and other devices associated with the operational system to provide the complete electronics mission equipment. All effort directly related to other level 3 elements is excluded. It also excludes all effort associated with system assembly, installation and checkout on site.

3.3.1.3 11.2 Sensors. The sensors element refers to those equipments which are used to extend man's natural senses and equipment which detects and indicates terrain configuration, the presence of military targets, and other natural and man-made objects and activities by means of energy emitted or reflected by such targets or objects. The energy may be nuclear, electromagnetic-magnetic, including the visible and invisible portions of the spectrum; chemical, biological, thermal or mechanical; including sound, blast, and earth violence. This element includes, for example, radome, antenna, structural facilities, transmitter, receiver, information processor, exciter, and power supply.

3.3.1.4 11.3 Communications. The communications element refers to those equipments used to receive and transmit messages of data from one person or place to another. This element includes, for example radome, antennae, transmitter, receiver, terminal equipment, internal facility trunking, modem, cryptographic equipment, power supply, and interface equipment. It also includes internal communications such as public address, intercom, and radio used to transmit and receive the messages within the vehicle structure or complex, and leased-lines used for communication purposes.

3.3.1.5 11.4 Automatic data processing equipment. The automatic data processing equipment element refers to a machine or group of interconnected machines consisting of input, storage, computing, control, and output devices which use electronic circuitry in the main computing element to automatically perform arithmetic and other logical operations by means of internally stored or externally controlled programmed instructions. This element includes: central processors, large capacity storage data channels, input/output, peripheral equipment in operational support of data processing equipment and devices that are designed to convey data from its original state to a data-processing media. These equipments can be mechanical, electromechanical, electrical, or optical in nature, and are generally at the terminal ends of data communication lines. (For example, transmission devices, image transmission and reception systems, and data interface equipment.)

3.3.1.6 11.5 Computer programs. The computer programs element refers to those programs and routines consisting of a deck of punched cards, magnetic or paper tapes, read-only memory (ROM) units (plug in type), or other physical medium containing a sequence of instructions and data in a form suitable for insertion into the computer and used to direct the computer to perform a desired operation or sequence of operations. These involve among other things, the analysis of the problem, preparation of flow diagrams, preparing details, developing subroutines, allocation of storage locations, specification of input and output formats, testing, and producing the physical medium (i.e., tapes, punched cards) to provide operational computer programs. This element includes, for example, executive (compiler/source), diagnostic, maintenance (built-in fault isolation, dry tapes) and operational (object) programs. This element excludes all effort for entering the program into the computer, computer operations, and all system test and evaluation performed during development, test and evaluation. It also excludes computer programs used for administrative purposes or not associated with operational systems/ equipments and computer programs for use with training or peculiar support equipment.

3.3.1.7 11.6 Data displays. The data displays element refers to the visual presentation of processed data by specially designed electronic or electromagnetic-mechanical devices through interconnection (either on or off line) with digital computers or component equipment. This element includes, for example, the project screens, large-screen projectors, data image simulation displays, flat panel displays, small scale individual displays, three dimensional displays, and image data storage and retrieval equipment. Although line printers and punch cards may display data, they are not usually categorized as displays but as output equipments.

3.3.1.8 11.7 Auxiliary equipment. The auxiliary equipment element refers to those common or multi-usage equipments used to augment the functional performance of several level 3 elements. This element includes, for example, power generator, power distribution, security system, and other equipments that are not homogeneous to the designated level 3 elements. All items that are an integral part of specific level 3 elements or to the integration assembly/installation and checkout are excluded.

3.3.1.9 11.8 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.1.10 11.9 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes, for example, vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.1.11 11.10 Other. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.2 **11. Surface vehicle system (level 1).** The surface vehicle system element refers to the complex of equipment, data services, and facilities required to develop and produce a vehicle system with the capability to navigate over the surface. This element includes cargo and logistics vehicles, mobile work units, and combat vehicles. It also includes combat vehicles serving as armor, weapons platforms, reconnaissance vehicles, and amphibians.

3.3.2.1 <u>11.1 Primary vehicle (level 2)</u>. The primary vehicle element refers to the mobile element of the system embodying means for performing operational missions. This element includes means of propulsion and structure for adaption of mission equipment or accommodations for disposable loads. It also includes all efforts associated with the design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use).

3.3.2.1.1 <u>11.1.1 Integration and assembly</u>. The integration and assembly element refers to all efforts of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipments, parts, and materials required to assemble the other level 3 equipment elements into a level 2 mission equipment as a whole as well as that portion of the surface vehicle system furnished by the integration contractor to provide interface sections/materials necessary to permit the integration and assembly of the other level 3 equipments, to provide a complete surface vehicle. All effort directly related to integration and assembly of other level 3 elements of the primary vehicle equipments is excluded.

3.3.2.1.2 <u>11.1.2 Hull/frame</u>. The hull/frame element refers to the vehicle primary structure which provides resistance to all operational loading conditions and accommodates other subsystems. It may consist of monolithic cast or built-up hull, or vehicle frame. It includes all structural subassemblies and appendages which attach directly to the primary structure. This element includes, for example, towing and lifting fittings, bumpers, hatches, and grilles. It also includes provision to accommodate other subsystems such as mountings for suspension, weapons, turret, truck body, cab, and special equipment loads.

3.3.2.1.3 <u>11.1.3 Suspension/steering</u>. The suspension/steering element refers to the means for generating tractive effort, thrust, lift, and steering forces generally at or in proximity to the earth's surface and adapting the vehicle to the irregularities of the surface. This element includes, for example, wheels, tracks, brakes, and steering gears for traction and control functions, and rudder thrust devices and trim vanes for amphibians. It also includes springs, shock absorbers, skirts, and other suspension members.

3.3.2.1.4 <u>11.1.4 Power package/drive train</u>. The power package/drive train element refers to the means for generating power and delivering power in the required quantities and driving rates to the driving member. This element includes, for example, engine-mounted auxiliaries such as air ducting and manifolds, controls and instrumentation, exhaust systems, and cooling means. It also includes such power transport components as clutches, transmission, shafting assemblies, torque converters, differentials, final drives, and power takeoffs. It may include brakes and steering when these are integral to power transmissions rather than in the suspension/steering element.

3.3.2.1.5 11.1.5 Auxiliary automotive systems. The auxiliary automotive systems element refers to the group of subsystems which provide services to the primary automotive subsystems, as distinguished from the special equipment subsystems, and which outfit the chassis. This element includes, for example, the vehicle electrical system, fire extinguisher system and controls; chassis-mounted accessories such as the winch and power takeoff, tools and equipment; and on-vehicle materials. When not otherwise provided for, it includes crew accommodations.

3.3.2.1.6 11.1.6 Turret assembly. The turret assembly element refers to the structure and equipment installations required to provide the fighting-compartment element of combatant vehicles. This element includes, for example, armor and radiological shielding, attachments and appendages such as hatches and cupolas, the turret electrical system, and accommodations for personnel, weapons, and command and control. The fire control stabilization system is excluded.

3.3.2.1.7 11.1.7 Fire control. The fire control element refers to that equipment installed in the vehicles which provides intelligence necessary for weapons delivery such as launching and firing. This element includes, for example, radars and other sensors necessary for search, rendezvous and tracking, displays, sights or scopes, computer, computer programs, etc.

3.3.2.1.8 11.1.8 Armament. The armament element refers to the means for combatant vehicles to deliver fire on hostile targets and for logistics, and other vehicles to exercise self-defense. This element includes, for example, the main gun, launchers, and secondary armament. Fire control systems are excluded.

3.3.2.1.9 11.1.9 Body/cab. The body/cab element refers to the major component to be mated to a chassis to provide a complete vehicle having a defined mission capability. This element includes accommodations for personnel, cargo and such subsystems as need to be placed in proximity to operators.

3.3.2.1.10 11.1.10 Special equipment. The special equipment element refers to that special equipment to be mated to a chassis or a chassis/body/cab assembly to enable the achievement of a specific mission capability. It includes all items required to convert basic vehicle configurations to special-purpose configurations. This element includes, for example, blades, booms, winches, etc., to equip wreckers, recovery vehicles, and other field work units. It also includes the furnishings and equipment for command, shop, medical, and other special-purpose vehicles.

3.3.2.1.11 11.1.11 Communications and navigation equipment. The communications and navigation equipment element refers to the means provided within the system for implementation of command and control. This element includes radio receivers and transmitters for the command function and intercom and external phone systems. It also includes supplementary communication means such as visual signaling devices. It may include navigation system and data displays when these are not integral with the equipment of crew stations of the turret assembly or the driver's automotive instrumentation or displays.

3.3.2.1.12 11.1.12 Ammunition. This element refers to efforts to develop or procure ammunition for the subject vehicle. Normally, only changes in authorized stock levels are costed to the system.

3.3.2.1.13 11.1.13 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.2.1.14 11.1.14 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes, for example, vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.2.1.15 11.1.15 Other. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.2.2 11.2 Secondary vehicle. The secondary vehicle element refers to those vehicles required to supplement, expand, or otherwise contribute to the capabilities of primary vehicles to provide the vehicle system with the required operational characteristics. Secondary vehicles are not necessarily self-contained operational units capable of operating outside the system. This element includes, for example, cargo and tank trailers of truck-trailer and tractor-trailer systems, carriers and tanker units of articulated train-type systems, and transporters as employed in systems when the primary vehicle has limited roadability. It also includes all efforts associated with design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use). The breakdown structure and definitions for secondary vehicles will be the same as specified for primary vehicles.

3.3.3 11. Ordnance system (level 1). The ordnance system element refers to the complex of equipment, data services, and facilities required to develop and produce the capability for applying munitions (including atomic, biological, chemical, psychological, and pyrotechnic) to a target. This element includes the munitions and the means of launching or firing the munitions, such as MK 48 torpedo system, SNAKEYE BOMB, 8-inch Howitzer, and caliber .223 ammunition.

3.3.3.1 11.1 Complete round (level 2) The complete round element refers to all the components making up the ammunition necessary for firing one shot, such as mines, bombs, rockets, torpedoes, rifle and artillery ammunition. This element includes, for example, structural elements, warhead or payload, fuze, safety/arming devices, guidance equipment, and propulsion equipment or propellant. For artillery ammunition, the complete round consists of the projectile (including structure, warhead, fuze, and safety/arming devices), and the propelling charge. It also includes all efforts associated with the design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specifications(s), regardless of their end use).

3.3.3.1.1 11.1.1 Integration and assembly (level 3). The integration and assembly element refers to all efforts required for the in-plant integration and assembly of other level 3 elements into a prime mission product within a contractor's facilities. This element includes all materials and parts or other mating equipment furnished by/to an integrating agency or contractor. This element includes mating projection to cases, installation of fuzes, arming devices, and primers. All effort directly related to other level 3 complete round equipment is excluded.

3.3.3.1.2 11.1.2 Propellant/propulsion. The propellant/propulsion element refers to chemical or mechanical devices which provide the force to transport the warhead from the launch position to the target such as explosive powder charges, rocket motors, and torpedo motors. For artillery ammunition, this element includes the cartridge case, if applicable, and primer as well as the explosive charge itself.

3.3.3.1.3 11.1.3 Structure. The structure element refers to that portion of the round which carries the warhead to the target, such as the basic housing of a bomb or rocket, casing of a projectile, body of a torpedo, etc. This element includes those structural devices which provide stability and control such as fins, parachutes, and anchors.

3.3.3.1.4 11.1.4 Warhead. The warhead element refers to the assembly making up the payload of the round. This element includes high-explosive, chemical, and biological agents, nuclear devices, pyrotechnics, etc. It also includes an exercise head, when applicable. Where the projectile is solid, as in small arms ammunition and inert A/P shells, the warhead will comprise the entire projectile.

3.3.3.1.5 11.1.5 Fuze. The fuze element refers to the mechanical or electronic device designed to detonate, under desired conditions, the charge or primer in a bomb, rocket, mine, etc., or to set forces into action to detonate one or the other, such as impact fuzes, proximity fuzes, or hydrostatic fuzes.

3.3.3.1.6 11.1.6 Safety/arm. The safety/arm element refers to the device or combination of devices which control the capability of initiating the explosive sequence. Such devices may be mechanical, hydrostatic, inertial, counters, or timers.

3.3.3.1.7 11.1.7 Guidance and control. The guidance and control element refers to the complex of equipment which, after launch, evaluates and correlates the path of the round with target information, and which performs the necessary functions to enable the round to intercept the target. This element includes, for example, homing devices, communication links, inertial platforms, control systems, and devices controlling parachute and anchor actuations.

3.3.3.1.8 11.1.8 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.3.1.9 11.1.9 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes, for example, vehicles, equipment, tools, etc., used to fuel, service, transport, hoist, repair, overhaul, assemble, disassemble, test, inspect, or otherwise maintain the mission equipment. It includes all effort associated with the design, development, and production of peculiar support equipment.

3.3.3.1.10 11.1.10 Other. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.3.2 11.2 Launch system (level 2). The launch system element refers to the complex of equipment for controlling and releasing, or sending forth, munitions on a desired course or trajectory, the ordnance system less the complete round. Launch systems are defined as rifles, artillery pieces, naval guns, mortar cannons, and machine guns, as well as that equipment for launching torpedoes and rockets or dropping bombs. This element includes, for example, the launcher, fire control equipment, and the development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use).

3.3.3.2.1 11.2.1 Integration and assembly. The integration and assembly element refers to all efforts required for the in-plant integration and assembly of other level 3 elements into a prime mission product within a contractor's facilities. This element includes all materials and parts or other mating equipment furnished by/to an integrating agency or contractor. This element includes, for example, adaptors, cables, connectors, and other miscellaneous materials which are homogeneous to the integration effort for providing a launch system. All efforts directly related to other level 3 elements of the launch equipment are excluded.

3.3.3.2.2 11.2.2 Launcher. The launcher element refers to a structural device designed to support and hold munitions in position for firing or release. This element includes, for example, suspension and release systems, rocket pods, mine racks or dispensers, torpedo tubes. For guns and artillery, it includes tubes, recoil assemblies, breech mechanisms, mounts, rifle stocks, etc.

3.3.3.2.3 11.2.3 Carriage. The carriage element refers to the primary structure which serves as a platform to accommodate other level 3 elements and provides mobility to the complete launch system. It is not generally considered a self-propelled vehicle. This element includes T-frame, hull/chassis, wheels, tires, tubes, brakes, secondary power (batteries, generators, etc.), and hydraulics, which are an integral part of the carriage itself and not directly a part of other level 3 elements.

3.3.3.2.4 11.2.4 Fire control equipment. The fire control equipment element refers to equipment for controlling the direction, volume, and time of fire or release of munitions through the use of electrical, electronic, optical, or mechanical system, devices, or aids. For rifles and small arms, this element includes sighting devices and trigger mechanisms. For artillery, naval guns, and heavy mortars, it additionally includes aiming mechanisms in traverse and elevation, radar and other sensors, computers, and other equipment for performing fire control computations. For air-dropped munitions, this element includes gunsights, intervalometers, and other sensor and computational devices for controlling the release of the munition. For torpedoes, it includes sonar and other sensors, computers, control consoles, and devices for presetting torpedo speed and direction.

3.3.3.2.5 11.2.5 Ready magazine. The ready magazine element refers to a structure or compartment for storing ammunition or explosives in a ready-for-use condition or position. This element includes part of a gun or firearm which holds the ammunition ready for chambering and feed mechanisms for placing the ammunition in a position ready for chambering.

3.3.3.2.6 11.2.6 Adaptor kits. The adaptor kits element refers to engineering and hardware for adapting the launch system to particular applications. This element includes vehicle adaptor kits, kits for adaption to different aircraft models, and kits for backpacking.

3.3.3.2.7 11.2.7 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.3.2.8 11.2.8 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes, for example, vehicles, equipment, tools, etc., used to fuel, service, transport, hoist, repair, overhaul, assemble, disassemble, test, inspect, or otherwise maintain the mission equipment. It includes all effort associated with the design, development, and production of peculiar support equipment.

3.3.3.2.9 <u>11.2.9 Other</u>. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.4 <u>11 Aircraft system (level 1)</u>. The aircraft system element refers to the complex of equipment, data, services, and facilities required to develop and produce the capability of employing those fixed or movable wing, rotary wing, or compound wing, manned air vehicles designed for powered or unpowered (glider) guided flight in the atmosphere. (Represented by A-7, C-5, B-1, UH-1D, AAFSS, XC-142, etc.)

3.3.4.1 <u>11 Air vehicle (level 2)</u>. The air vehicle element refers to the complete flyaway, including airframe, engines, and all other installed equipment. This element includes all effort associated with the design, development and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use). It also includes the installation and checkout of all remaining level 3 elements into the airframe to form the complete air vehicle.

3.3.4.1.1 <u>11.1.1 Airframe (level 3)</u>. The integration and assembly element refers to all efforts of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipments, parts, and materials required to assemble the other level 3 equipment elements into a level 2 mission equipment as a whole as well as that portion of the airframe furnished by the integration contractor to provide interface sections/materials necessary to permit the integration and assembly of other level 3 equipments, to provide a complete air vehicle. It includes the basic structure (wing, empennage, fuselage, and associated manual flight control system), the air induction system, starters, exhausts, the fuel control system, inlet control system, alighting gear (tires, tubes, wheels, brakes, hydraulics, etc.), secondary power, furnishings (cargo, passenger, troop, etc), engine controls, instruments (flight, navigation, engine, etc.), environmental control, racks, mounts, intersystem cables and distribution boxes, etc., which are inherent to, and nonseparable from, the assembled structure, dynamic systems, rotor group, and other equipment homogeneous to the airframe. All efforts directly related to other level 3 elements are excluded.

3.3.4.2 <u>11.1.2 Propulsion unit</u>. The propulsion unit element refers to that portion of the air vehicle that pertains to installed engines to provide power/thrust to propel the aircraft through all phases of powered flight. This element includes the engine as a propulsion unit within itself, of reciprocating or turbo type with afterburner when appropriate, thrust reverser, thrust vector devices, transmissions, gear boxes, if furnished as an integral part of the propulsion unit, suitable for integration with the airframe. All ancillary equipments that are not an integral part of the engine required to provide an operational primary power source (i.e., air inlets, instruments, controls, etc.) are excluded.

3.3.4.3 <u>11.1.3 Other propulsion</u>. The other propulsion element refers to that portion of the operational power/thrust source required in addition to the engine to insure the performance requirements of powered flight. This element includes propellers, booster units, thrust reversers, thrust vector devices, transmissions, and gear boxes, if not furnished as an integral part of the engine. This element excludes instruments, controls, air inlets, exhausts, starters, and other ancillary items required for operational performance that are included in the airframe.

3.3.4.4 11.1.4 Communications. The communications element refers to those equipments installed in the air vehicle for communication and identification purposes. This element includes intercom, radio system(s), IFF, data link, and control boxes associated with the specific equipment. When an integrated communication, navigation, and identification package is used, it will be included here.

3.3.4.5 11.1.5 Navigation/guidance. The navigation/guidance element refers to those equipments installed in the air vehicle to perform the navigation/ guidance function. This element includes radar, radio or other essential navigation equipment, radar altimeter, direction finding set, doppler compass, computer, and other equipment homogeneous to the navigation/guidance function. Panel instruments are excluded.

3.3.4.6 11.1.6 Fire control. The fire control element refers to that equipment installed in the air vehicle which provides the intelligence necessary for weapons delivery such as bombing, launching, and firing. This element includes radars and other sensors necessary for search, rendezvous and tracking, self-contained navigation and air data system, displays, scopes, or sights, bombing computer and control and safety devices.

3.3.4.7 11.1.7 Penetration aids. The penetration aids element refers to those equipments installed in the air vehicle which assist in penetration for mission accomplishment. This element includes ferret and search receivers, warning devices and other electronic devices, electronic countermeasures, jamming transmitters, chaff, infrared jammers, terrain-following radar, and other devices homogeneous to this mission function.

3.3.4.8 11.1.8 Reconnaissance equipment. The reconnaissance equipment element refers to those equipments installed in the air vehicle necessary to the reconnaissance mission. This element includes photographic and electronics, infrared, and other sensors; search receivers, recorders, warning devices, magazines, and data link. Gun cameras are excluded.

3.3.4.9 11.1.9 Automatic flight control. The automatic flight control element refers to equipments installed in the air vehicle to provide the unpiloted automatic modes of flight path control. This element includes the automatic pilot, flight control mechanisms and connectors, mechanical and electrical parts for the signal transmission and application of power, reference sensors, stability augmentation equipment, and air data computer. Control linkages, control surfaces, or other structural parts of the airframe are excluded.

3.3.4.10 11.1.10 Central integrated checkout. The central integrated checkout element refers to that equipment installed in the air vehicle for malfunction detection and reporting. This element includes transducers, computer and dry tapes, recorders, displays, and stimuli.

3.3.4.11 11.1.11 Antisubmarine warfare(ASW). The ASW element refers to that equipment installed in the air vehicle peculiar to the ASW mission. This element includes, for example, sensors, computer, and displays.

3.3.4.12 11.1.12 Auxiliary electronics equipment. The auxiliary electronics equipment element refers to auxiliary or other electronics equipment not allocable to individual electronic element equipments. This element includes peculiar equipments which are not homogeneous to the prescribed electronic elements. It includes such multi-use equipments as antennae, control boxes, power supplies, environmental control, racks, mountings, etc.

3.3.4.13 11.1.13 Armament. The armament element refers to that equipment installed in the air vehicle to provide the fire-power functions. This element includes guns, mounts, turrets, weapon direction equipment, ammunition feed and ejection mechanisms, and gun cameras.

3.3.4.14 11.1.14 Weapons delivery equipment. The weapons delivery equipment element refers to that equipment installed in the air vehicle to provide the weapons delivery capability. This element includes launcher, pods, bomb racks, pylons, integral release mechanism, and other mechanical or electro-mechanical equipments specifically oriented to the weapons delivery function. This element excludes the bombing/navigation system which is included in fire control (11.1.6).

3.3.4.15 11.1.15 Auxiliary armament/weapons delivery equipment. The auxiliary armament/weapons delivery equipment element refers to that equipment required to provide the ancillary functions to the applicable mission equipments. This element includes flares and ejection mechanisms, ejector cartridges, and other items homogeneous to the mission function that are not identifiable to the armament (11.1.13) or weapons delivery (11.1.14).

3.3.4.16 11.1.16 Ammunition. This element refers to efforts to develop or procure ammunition for the subject vehicle. Normally, only changes in authorized stock levels are costed to the system.

3.3.4.17 11.1.17 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.4.18 11.1.18 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.4.19 11.1.19 Other equipment. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.5 11 **Missile system** (level 1). The missile system element refers to the complex of equipment, data services, and facilities required to develop and produce the capability of employing a missile weapon in an operational environment to produce the desired destructive effect on selected targets. (Represented by Poseidon, Minuteman II, Nike-X, SRA, Phoenix, etc.).

3.3.5.1 11.1 Air vehicle (level 2). The air vehicle element refers to the means for delivering the destructive effect to the target, including the capability to generate or receive intelligence to navigate and penetrate to the target area, and to detonate the warhead. This element includes the design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specifications(s), regardless of their end use).

3.3.5.1.1 11.1.1 Integration and assembly (level 3). The integration and assembly element refers to all efforts of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipments, parts, and materials required to assemble the other level 3 equipment elements into a level 2 mission equipment as a whole as well as that portion of the air vehicle system furnished by the integration contractor to provide interface sections/materials necessary to permit the integration and assembly of the other level 3 equipments, to provide a complete air vehicle. This element includes external appendages for stable and controllable flight, interstage sections, structure, framework, skirts, umbilical receptacles and cables, umbilical raceways, scoops, covers, self-destruction system, and other miscellaneous items which are homogeneous to the integration effort. All effort directly related to the other level 3 elements of the air vehicle equipments are excluded. It also excludes all effort associated with system assembly, installation and checkout on site.

3.3.5.1.2 11.1.2 Propulsion. The propulsion element refers to the means for generating propelling forces on single-stage missiles. This element includes the engine, structure, propellant and fuel, distribution and control of propellant and fuel, starting means, safety devices, and internal environmental control when grouped as a functional entity.

3.3.5.1.3 11.1.3 Stage 1. The stage 1 element refers to the first separable propulsion section of a multistage propulsion system to propel the aerospace vehicle on its intended flight. This element includes the structure, engines, tanks, case, case liner, nozzle controls, propellants and fuels, and other equipments homogeneous to the complete stage 1 element of the aerospace vehicle as an entity within itself.

3.3.5.1.4 11.1.4 Stage 2. The stage 2 element refers to the second separable section of a multistage propulsion system to propel the aerospace vehicle on its intended flight. This element includes the structure, engines, tanks, propellant and fuel, case, case liner, nozzles, nozzle controls, and other equipments homogeneous to the completed stage 2 element of the aerospace vehicle as an entity within itself.

3.3.5.1.5 11.1.5 Stage 3. The stage 3 element refers to the third separable stage of a multistage propulsion system to propel the aerospace vehicle on its intended flight. This element includes the structure, engines, tanks, propellant and fuel, case, case liner, nozzles, nozzle controls, and other equipments homogeneous to the completed stage 3 element of the aerospace vehicle as an entity within itself.

3.3.5.1.6 11.1.6 Stage 4. The stage 4 element refers to the fourth separable stage of a multistage propulsion system to propel the aerospace vehicle on its intended flight. This element includes the structure, engines, tanks, propellant and fuel, case, case liner, nozzles, nozzle controls, and other equipments homogeneous to the completed stage 4 element of the aerospace vehicle as an entity within itself.

3.3.5.1.7 11.1.7 Guidance and control equipment. The guidance and control equipment element refers to the means for generating or receiving guidance intelligence, conditioning the intelligence to produce signals, and generating appropriate control forces. Controllers may interface with the structure by actuating movable area surfaces or with the propulsion system to produce control movable reaction forces, or may independently produce reaction forces for control. If design is such that electronics are packaged into a single rack or housing as an assembly, this rack or housing will be considered part of the guidance and control system, but the circuit boards and cathode ray tube will be considered as parts of the appropriate subsystems. This element includes the guidance intelligence system, computer, sensing elements, and autopilot.

3.3.5.1.8 11.1.8 Launched payload. The launched payload element refers to the means employed to produce the destructive effect on the target at the terminal point of flight. This element includes case/nosecone, warhead and associated devices for making safe/arming, and igniting the explosive elements, plus all items deployed or carried along to improve penetration to the target.

3.3.5.1.9 11.1.9 Payload shroud. The payload shroud element refers to that equipment constituting a protective enclosure for safeguarding the payload during the severe environments of launch and flight through the earth's atmosphere. This element includes structure, mounting provisions, access ports, antenna windows, separation and ejection subsystems, and other equipment homogeneous to the shroud. It also includes all design, development, production, and assembly effort to provide this entity. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into an air vehicle is excluded.

3.3.5.1.10 11.1.10 Airborne test equipment. The airborne test equipment element refers to an exercise warhead that is interchangeable with the live warhead and suitable for developmental firing. This element includes destruct systems, recovery systems, special instrumentation and telemetry equipment.

3.3.5.1.11 <u>11.1.11 Airborne training equipment</u>. The airborne training equipment element refers to an exercise warhead that is interchangeable with the live warhead and suitable for training firing. This element includes destruct systems, recovery systems, special instrumentation and telemetry equipment associated with the training mission.

3.3.5.1.12 <u>11.1.12 Auxiliary equipment</u>. The auxiliary equipment element refers to that additional equipment generally excluded from other specific level 3 elements. It includes equipment required to supplement or provide service to other level 3 elements within the air vehicle. This element includes power supply, power distribution, environmental control, shock alleviation, safety and protective subsystems, destruct system, etc. It also includes equipment of a single purpose and function which is necessary for accomplishing the assigned mission.

3.3.5.1.13 <u>11.1.13 Common support equipment</u>. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.5.1.14 <u>11.1.14 Peculiar support equipment</u>. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.5.1.15 <u>11.1.15 Other equipment</u>. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.5.2 <u>11.2 Command and launch equipment (level 2)</u>. The command and launch equipment element refers to the subsystems installed at a launch site or aboard launch vehicles required to store, make ready, and launch the air vehicles of the missile system. This element includes those equipments required to acquire and condition the necessary intelligence of select targets, reach launch decisions, command the launch, and provide guidance and control where such capability is not self-contained aboard the air vehicle. This element includes design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use).

3.3.5.2.1 <u>11.2.1 Integration and assembly</u>. The integration and assembly element refers to all efforts of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipments, parts, and materials required to assemble the other level 3 equipment elements into a level 2 mission equipment as a whole as well as that portion of the command and launch equipment system furnished by the integration contractor to provide interface sections/materials necessary to permit the integration and assembly of the other level 3 equipments, to provide complete command and launch equipment. It includes vans, storage and transportation devices; cables, conduits, connectors; and other devices associated with the operational system. All effort directly related to other level 3 elements of the command and launch equipments is excluded. It also excludes all effort associated with system assembly, installation and checkout on site.

3.3.5.2.2 11.2.2 Surveillance, identification, and tracking sensors. The surveillance identification, and tracking sensors element refers to those sensors required to support defensive missile systems by maintaining surveillance against incoming targets and providing the data required for targeting, launch, midcourse guidance, and homing where such capability is not self-contained aboard the missile system air vehicle. For all classes of missile systems, they may include tracking of the missile system air vehicles as required for guidance and control or range safety. (Subsystems involved in safety and destruct or test and training are not included, unless they are required operational items. Otherwise they are included under test and evaluation.) This element may include sensors of any spectrum whether radar, optical or infrared.

3.3.5.2.3 11.2.3 Launch and guidance control. The launch and guidance control element refers to the means to enable targeting of missile air vehicles, launch decisions to be made, and to command launch. This element includes supplementary means for guidance of those missile air vehicles not having self-contained guidance and control and means to command destruct. This element also includes control and checkout consoles, data displays and mission records.

3.3.5.2.4 11.2.4 Communications. The communications element refers to the means for distribution of intelligence within the missile system. This element includes intercommunication subsystems of launch sites for tactical and administrative message flow and ties between sensor, data processing, and launch and guidance control subsystems. Communications may interface with existing fixed-communications facilities or communications subsystems of launch platforms which are associated systems to the missile system. (Subsystems involved in safety and destruct or test and training are not included, unless they are required operational items. Otherwise they are included under test and evaluation support under systems test and evaluation.)

3.3.5.2.5 11.2.5 Data processing. The data processing element refers to the means to condition data generated at the launch site or aboard the launch vehicle of those systems employing mobile launch, or data received from associated systems so as to accommodate the needs of launch and guidance control. This element includes the computer and peripheral equipment. Items that are an integral part of launch and guidance control are excluded.

3.3.5.2.6 11.2.6 Launcher equipment. The launcher equipment element refers to the means to launch the missile air vehicle from stationary sites or mobile launch platforms. This element may include stowage facilities and checkout stations for readiness verification when these are integral to the launcher. It may include safety and protective elements when these are not integral to the launch platform or site facilities. (Subsystems involved in safety and destruct or test and training are not included, unless they are required operational items. Otherwise they are included under test and evaluation support under systems test and evaluation.)

3.3.5.2.7 11.2.7 Auxiliary equipment. The auxiliary equipment element refers to the general-purpose ground equipment utilized to supplement the various operational equipments of the command-and-launch system. This element includes power generator, power distribution system, environmental control, cabling, malfunction detection, fire prevention, security systems, and other common-usage equipments.

3.3.5.2.8 11.2.8 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.5.2.9 11.2.9 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.5.2.10 11.2.10 Other equipment. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.6 **Ship system (level 1).** The ship system element refers to the complex of ships, equipment, data services, and facilities required to develop and produce the capability of operating or supporting the operation of naval weapons, or performing other naval tasks at sea.

3.3.6.1 11. Ship (level 2). The ship element refers to the waterborne vehicle of a ship system. It includes all types of surface and subsurface water vehicles such as combatants, auxiliaries, amphibious, and special purpose ships. This element includes all material and effort associated with the design, development, production, testing, and delivery of complete ships (prototype and operationally configured ships which satisfy the requirements of their applicable specifications(s), regardless of their end use). It also includes spares, repair parts, and support equipment carried onboard the ship.

3.3.6.2 11.1 Hull structure (level 3). The hull structure element refers to the assembled main hull body with all structural subdivisions. This element includes shell plating, longitudinal and transverse framing, platforms and decks, superstructure, foundations, structural bulkheads, enclosures and sponsors; castings, forgings and weldments; fixed ballast; doors and closures; kingposts, masts, and service platforms; and sonar domes. It also includes compartment testing.

3.3.6.3 11.1.2 Propulsion plant. The propulsion plant element refers to those major components installed primarily for propulsion and the systems necessary to make these components operable. This element includes boilers and energy converters, propulsion units, main condensers and air ejectors, shafting, bearings, and propellers, combustion air supply system, uptakes, propulsion control equipment, main stream, feedwater and condensate, circulating and cooling water, fuel oil service and lubricating oil systems, and onboard spares, repair parts, and tools. It also includes nuclear steam generators, reactors, reactor coolant and auxiliary systems, nuclear power plant control, and radiation shielding. (Hardware testing and checkout is included with the specific element involved).

3.3.6.4 11.1.3 Electric plant. The electric plant element refers to the power generating and distributing system installed primarily for ship service and emergency power and lighting. This element includes the electric power generation, power distribution switchboards, power distribution system, lighting system, and onboard spares, repair parts, and tools. (Hardware testing and checkout is included with the related element.)

3.3.6.5 11.1.4 Communication and control. The communication and control element refers to all equipments and associated systems installed to receive information from off-ship sources, to transmit to off-ship receivers, and to distribute information throughout the ship. It also includes sensing and data systems required for navigation and weapon fire control. This element includes, for example, navigation equipment, interior communication systems and equipment, gun fire control system, nonelectronic countermeasure systems, electronic countermeasure systems (ECM); missile fire control systems, ASW fire control and torpedo fire control systems; radar systems, radio communication systems, electronic navigation systems, space vehicle electronic tracking systems, sonar systems, electronic tactical data systems; onboard spares, repair parts and tools, and related testing and checkout.

3.3.6.6 11.1.5 Auxiliary systems. The auxiliary systems element refers to those systems required for ship control, safety, provisioning, and habitability. It includes the auxiliary machinery and piping systems; the hull mechanical handling systems; and ship control surfaces such as rudders, hydrofoils, and driving planes. This element includes heating, ventilation air-conditioning systems; refrigerating spaces; plant and equipment; gasoline, JP-5, all liquid cargo piping, oxygen-nitrogen and aviation lubricating oil systems; plumbing installations, salt-water service systems, fire extinguishing systems, drainage, ballast, trimming, heating and stabilizer tank systems; fresh water system, scuppers and deck drains; fuel and diesel oil filling, venting, stowage and transfer systems; tank heating systems, compressed air system, auxiliary steam, exhaust steam and steam drains, buoyancy control system, distilling plant; and steering systems, mooring, towing, anchor and aircraft handling systems, deck machinery, elevators, moving stairways, stores strike-down and stores handling equipment, operating gear for retracting and elevating units, aircraft elevators; aircraft arresting gear, barriers, and barricades; catapults and jet blast deflectors, replenishment at sea and cargo handling systems; onboard spares, repair parts, and tools; and related testing and checkout.

3.3.6.7 11.1.6 Outfit and furnishings. The outfit and furnishings element refers to those outfit equipments and furnishings required for habitability and operability which are not specifically included in other ship elements. This element includes hull fittings; boats, boat stowage and handling; rigging and canvas; ladders and gratings; nonstructural bulkheads and doors; painting, deck covering, hull insulation; storerooms, stowages and lockers; equipment for utility spaces, workshops, laboratories, test areas, galley, pantry, scullery and commissary outfit; furnishings for living spaces, offices, control centers, machinery spaces, medical, dental and pharmaceutical spaces; nonpropulsion space shielding; onboard spares, repair parts and tools; and related testing and checkout.

3.3.6.8 11.1.7 Armament. The armament element refers to the complex of armament and related ammunition handling, stowage, and support facilities; and cargo munition handling, stowage, and support facilities. This element includes guns and gun mounts; ammunition handling systems and stowage; special weapons handling and storage; rocket and missile launching devices, handling systems, and stowage; torpedo tubes handling and stowage; small arms and pyrotechnic stowage, air launched weapons handling systems and stowage; cargo munition handling and stowage; onboard spares, repair parts, and tools; and related testing and checkout.

3.3.6.9 11.1.8 Integration/engineering. The integration/engineering element refers to that engineering effort and related material associated with the design, development, and rework to provide the ship as a whole, exclusive of that included under the systems/project management element. This element includes construction drawings, engineering calculations, weighing and weight calculations, photographs, models, and ship builder's information drawings.

3.3.6.10 11.1.9 Ship assembly. The ship assembly element refers to those efforts and material associated with the construction and test of the ship as a whole and which cannot be logically and practicably identified with, or related to, other level 3 elements. This element includes staging, scaffolding and cribbing; temporary utilities and services; molds, templates, jigs, fixtures, and special production tools, drydocking, inspection, insurance launching, trials, and delivery.

3.3.6.11 11.1.10 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 availablility of this equipment for support of the particular defense materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.6.12 11.1.11 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.6.13 11.12 Other equipment. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.7 **11 Space system (level 1).** The space system element refers to the complex of hardware, data services, and facilities required to develop and produce the capability for the placement, operation, and recovery of manned and unmanned vehicles in space. This element includes launch/stage vehicles, space vehicles, support equipments, and other elements necessary to provide an operational space system. (Represented by Titan III, Program 369-SATCOM, START, AGENA, and MOL.)

3.3.7.1 11.1 Launch Vehicle (level 2). The launch vehicle element refers to the prime means for providing initial thrust on placing a space vehicle into its operational environment. The launch vehicle is the prime propulsion portion of the complete flyaway, for launch purposes (no payload). This element includes, for example, the structure, propulsion, guidance and control, and all other installed equipment integral to the launch vehicle as an entity within itself. It also includes the design, development, and production of complete units (prototype or operationally configured units which satisfy the requirements of their applicable specifications(s), regardless of their end use).

3.3.7.1.1 11.1.1 Integration and assembly (level 3). The integration and assembly element refers to all efforts of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipments, parts, and materials required to assemble the other level 3 equipment elements into a level 2 mission equipment as a whole as well as that portion of the launch vehicle system furnished by the integration contractor to provide interface sections/materials necessary to permit the integration and assembly of the other level 3 equipments, to provide a complete launch vehicle. This element includes, for example, structure/ airframe as appropriate, control surfaces, adapters, power supply; umbilical raceways, covers, cables and connectors; case liner, and other installed equipment integral to the integration and assembly of the remaining level 3 elements to provide the launch vehicle. All effort directly related to the other level 3 elements of the launch vehicle equipment is excluded.

3.3.7.1.2 11.1.2 Stage 1. The stage 1 element refers to the initial launch vehicle stage which provides the lift-off propulsive thrust for the complete flyaway for placing a space vehicle into its operational environment. This element includes the structure, propulsion, controls, instrumentation, interfaces, separation subsystems, and all other installed equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly of complete units. All efforts directly related to the remaining level 3 elements and the integration and assembly of this element into a launch vehicle is excluded.

3.3.7.1.3 11.1.3 Stage 2. The stage 2 element refers to the second launch vehicle stage which provides continuing boost propulsive thrust, following separation of the first stage, for placing a space vehicle into its operational environment. This element includes the structure, propulsion, controls, instrumentation, interfaces, separation subsystems, and all other installed equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly of complete units. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into a launch vehicle is excluded.

3.3.7.1.4 11.1.4 Stage 3. The stage 3 element refers to the third launch vehicle stage which provides continuing boost propulsive thrust, following separation of the second stage, for placing a space vehicle into its operational environment. This element includes the structure, propulsion, controls, instrumentation, interfaces, separation subsystems, and all other installed equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly of complete units. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into a launch vehicle is excluded.

3.3.7.1.5 11.1.5 Stage 4 The stage 4 element refers to the fourth launch vehicle stage which provides continuing boost propulsive thrust, following separation of the third stage, for placing a space vehicle into its operational environment. This element includes the structure, propulsion, controls, instrumentation, interfaces, separation subsystems, and all other installed equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly of complete units. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into a launch vehicle is excluded.

3.3.7.1.6 11.1.6 Strap-on unit. The strap-on unit element refers to the solid or liquid propulsion assemblies that provide additional thrust to assist the main propulsion thrust during initial launch of the aerospace vehicle. This element includes case, propellant/fuel nozzle, ignition, mounting structure, etc. It also includes the design, development, production and assembly of complete units. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into a launch vehicle is excluded.

3.3.7.1.7 11.1.7 Guidance and control. The guidance and control element refers to the means for generating or receiving guidance intelligence, conditioning the intelligence to produce control signals, and generating appropriate control forces. Controllers may interface with the structure by actuating movable aero surfaces or with the propulsion system to produce control reaction forces or may independently produce reaction forces for control. If design is such that electronics are packaged into a single rack or housing as an assembly, this rack or housing will be considered part of the guidance and control system. This element includes the guidance intelligence system, computer and sensing elements.

3.3.7.1.8 11.1.8 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.7.1.9 11.1.9 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.7.1.10 11.1.10 Other equipment. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.7.2 11.2 Stage vehicle (level 2). The stage vehicle element refers to the next stage of energy-producing means, following launch vehicle separation, for placing the space vehicles in their operational environment. The stage vehicle is the post-launch propulsion portion of the complete flyaway for boost purposes (no payload), and may be of single-stage or multiple-stage configuration. This element includes the structure, propulsion, guidance and control, and all other installed equipment integral to the stage vehicle as an entity within itself. It also includes the design, development, and production of complete units (prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use).

3.3.7.2.1 11.2.1 Integration and assembly (level 3). The integration and assembly element refers to all efforts of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipments, parts, and materials required to assemble the other level 3 equipment elements into a level 2 mission equipment as a whole as well as that portion of the stage vehicle system furnished by the integration contractor to provide interface sections/materials necessary to permit the integration and assembly of the other level 3 equipments, to provide a complete stage vehicle. This element includes, for example, structure/airframe as appropriate, control surfaces, adapters, power supply; umbilical raceways, covers, cables and connectors; case liner, and other installed equipment integral to the integration and assembly of the remaining level 3 elements to provide the launch vehicle. All effort directly related to the other level 3 elements of the launch vehicle equipment is excluded.

3.3.7.2.2 11.2.2 Propulsion. The propulsion element refers to the means for generation of propelling forces for the stage vehicle. It may consist of single-stage or multiple-stage configuration. This element includes the structure, engine, propellant and fuel, distribution and control of propellant and fuel, starting means, safety devices, and environmental control when grouped as a functional entity.

3.3.7.2.3 11.2.3 Guidance and control. The guidance and control element refers to the means for generating or receiving guidance intelligence, conditioning the intelligence to produce control signals, and generating appropriate control forces. Controllers may interface with the structure by actuating movable aero surfaces or with the propulsion system to produce control reaction forces or may independently produce reaction forces for control. If design is such that electronics are packaged into a single rack or housing as an assembly, this rack or housing will be considered part of the guidance and control system. This element includes the guidance intelligence system, computer, sensing elements, and autopilot.

3.3.7.2.4 11.2.4 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.7.2.5 11.2.5 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.7.2.6 11.2.6 Other equipment. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.7.3 11.3 Space vehicle (level 2). The space vehicle element refers to a complete vehicle or group of vehicles placed in space. It includes the design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s) regardless of their end use). This element includes, for example, spacecraft/reentry vehicle (as appropriate), payload, payload shroud, propulsion module, and orbit injection/dispenser.

3.3.7.3.1 11.3.1 Integration and assembly (level 3). The integration and assembly element refers to all efforts of technical and functional activities associated with the design, development, and production of mating surface, structures, equipments, parts, and materials required to assemble the other level 3 equipment elements into a level 2 mission equipment as a whole as well as that portion of the space vehicle system furnished by the integration contractor to provide interface sections/materials necessary to permit the integration and assembly of the other level 3 equipments, to provide a complete space vehicle. This element includes, for example, structure/airframe as appropriate, control surfaces, adapters, power supply; umbilical raceways, covers, cables and connectors; case liner, and other installed equipment integral to the integration and assembly of the remaining level 3 elements to provide the space vehicle. All effort directly related to the other level 3 elements of the space vehicle equipment is excluded.

3.3.7.3.2 11.3.2 Spacecraft. The spacecraft element refers to the principal operating space vehicle which serves as a housing or platform for carrying a payload and other mission-oriented equipments into space. This element includes, for example, the structure/spaceframe, electrical power and distribution, attitude controls, command and control, and other equipments homogeneous to the spacecraft. It also includes all design, development, production, and assembly effort to provide the spacecraft as a basic structure for integration of other level 3 hardware elements. All effort directly related to the remaining level 3 elements and the integration and assembly of these elements into a space vehicle is excluded.

3.3.7.3.3 11.3.3 Reentry vehicle. The reentry vehicle element refers to the principal operating space vehicle specifically designed to safely re-enter the atmosphere in order to land a payload (experimental equipment or crew). This element includes navigation and guidance, power supply, command and control, attitude control, environmental control, propulsion, and other equipments homogeneous to the reentry vehicle. It also includes all design, development, production, and assembly efforts to provide the reentry vehicle as a basic structure for integration of other level 3 hardware elements. All effort directly related to the remaining level 3 elements and the integration and assembly of these elements into a space vehicle is excluded.

3.3.7.3.4 11.3.4 Payload. The payload element refers to that equipment provided for special purposes in addition to the normal equipment integral to the spacecraft or reentry vehicle. This element includes experimental equipment placed onboard the vehicle, flight crew equipment (space suits, life support, and safety equipment), communications, displays and instrumentation, telemetry equipment and other equipments that are specifically mission-oriented to collecting data for future planning and projection purposes. It also includes all design, development, and production and assembly effort to provide the payload equipments as discrete entities for integration with other level 3 hardware elements. All effort directly related to the remaining level 3 elements and the integration and assembly of this element with/into a space vehicle is excluded.

3.3.7.3.5 11.3.5 Orbit injection/dispenser. The orbit injection/dispenser element refers to that equipment which performs the function of placing orbiting objects in the planned orbital path. This element includes the structure, propulsion, instrumentation and stage interface, separation subsystem, and other equipment necessary to provide the orbit injection/ dispenser as an entity within itself for integration with other level 3 elements. It also includes all design, development, and production and assembly effort to provide this entity. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into a space vehicle is excluded.

3.3.7.3.6 11.3.6 Propulsion module. The propulsion module refers to that equipment which provides in-space propulsive thrust to the spacecraft/reentry vehicle and its payload to meet mission requirements for changes of direction and velocity. This element includes the structure, propulsion, instrumentation, stage interface, attitude control, separation subsystems, and other equipment homogeneous to the propulsion module. It also includes all design, development, and production and assembly effort to provide this entity. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into a space vehicle is excluded.

3.3.7.3.7 11.3.7 Payload shroud. The payload shroud element refers to that equipment constituting a protective enclosure for safeguarding the payload/spacecraft during the severe environments of launch and flight through the earth's atmosphere. This element includes the structure, mounting provisions, access ports, antenna windows, separation and ejection subsystems, and other equipments homogeneous to the shroud. It also includes all design, development, production and assembly effort to provide this entity. All effort directly related to the remaining level 3 elements and the integration and assembly of this element into a space vehicle is excluded.

3.3.7.3.8 11.3.8 Common support equipment. The common support equipment element refers to those items required to support and maintain the system or portions of the system while not directly engaged in the performance of its mission, and which are not 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.7.3.9 11.3.9 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.7.3.10 11.3.10 Other equipment. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.3.7.4 11.4 Ground communications, command and control equipment (peculiar) (level 2). The ground communications, command and control equipment (peculiar) element refers to those ground-based operating equipments essential to the performance of space vehicles. This element includes communications between control and tracking facilities, and the spacecraft major equipments and computer programs installed in control and tracking facilities such as sensors, special antennae, EDP, displays, personnel accommodations, and special launch platform equipment or modifications. It also includes the design, development, and production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use).

3.3.7.4.1 11.4.1 Surveillance, identification and tracking sensors (level 3). The surveillance, identification, and tracking sensors element refers to those sensors required to support space systems by maintaining surveillance and providing the data required for targeting, launch, guidance, and homing where such means are not entirely self-contained aboard the space system. Space systems may include tracking of the space vehicle as required for guidance and control or range safety. This element includes sensors of any spectrum whether radar, optical, or infrared.

3.3.7.4.2 11.4.2 Command and control. The command and control element refers to the means to enable launch decisions to be made and to command launch of the aerospace vehicle. This element includes supplementary means for guidance of those aerospace vehicles not having completely self-contained guidance and control and means to command destruct. It also includes control and checkout consoles, data displays, and mission records.

3.3.7.4.3 11.4.3 Communications. The communications element refers to the means for distribution of intelligence within the space system. This element includes intercommunication subsystems of launch sites for tactical and administrative message flow and ties between sensor, data processing, and launch and guidance control subsystems. Communications may interface with existing fixed-communications facilities or communications subsystems of launch platforms which are associated systems to the space system.

3.3.7.4.4 11.4.4 Data processing equipment. The data processing equipment element refers to the means to condition data generated at the launch site or aboard the space vehicle, or data received from associated systems so as to accommodate the needs of command and control. This element includes computer, peripheral equipment, and programs.

3.3.7.4.5 11.4.5 Launch equipment. The launch equipment element refers to the means to launch the aerospace vehicle from stationary sites. This element may include stowage facilities and checkout stations for readiness verification when these are integral to the launcher. It may also include safety and protective elements when these are not integral to the launch platform or site facilities.

3.3.7.4.6 11.4.6 Auxiliary equipment. The auxiliary equipment element refers to the general purpose/multiusage ground equipment utilized to support the various operational capabilities of the command and launch equipments. This element includes, for example, power generators, power distribution systems, environmental control, cabling, malfunction detection, fire prevention, security systems, and other common-usage items not applicable to specific elements of the ground-based equipment.

3.3.7.4.7 11.4.7 Common support equipment. The common support equipment element refers to those items required to support and maintain 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 materiel item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense materiel item into operational service.

3.3.7.4.8 11.4.8 Peculiar support equipment. The peculiar support equipment element refers to those items required to support and maintain 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 materiel item. This element includes vehicles, equipment, tools, etc., used to service, transport, 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.

3.3.7.4.9 11.4.9 Other equipment. This element is provided for any equipment associated with the system which is not otherwise accounted for above, or to place emphasis upon an item which is of particular management concern.

3.4 Acronyms. The following acronyms are used in this handbook.

ADP	-	automatic data processing
AFPCH	-	Army force planning handbook
AF	-	Air Force
AFR	-	Air Force regulation
AMSDL	-	Acquisition Management and Systems Data Requirements Control List
AP	-	acquisition plan
APP	-	advanced procurement plan
ASDD	-	assembly personnel, demonstration and validation
ASFD	-	assembly personnel, full scale development
ASPD	-	assembly personnel, production
ASU	-	approval for services use
BLS	-	Bureau of Labor Statistics

CAIG - Cost Analysis Improvement Group
CCDR - Contractor Cost Data Reporting
CER - cost estimating relationship
CES - cost element structure
CFE - contractor furnished equipment
CI - configuration item
CIN - course identification number
COEA - cost and operational effectiveness analysis
CPR - Cost Performance Reports
CUM - cumulative average learning theory
CWBS - contract work breakdown structure
DA - Department of the Army
DCP - decision coordinating paper
DCTD - direct support contact team, dedicated
DCTS - direct support contact team, shared
DID - data item description
DNSARC - Department of the Navy Systems Acquisition Review Council
DoD - Department of Defense
DSARC - Defense Systems Acquisition Review Council
DSU - direct support unit
DSUD - direct support unit maintenance personnel, dedicated
DSUS - direct support unit maintenance personnel, shared
DTC - design-to-cost (design-to-life-cycle-cost)
DVAL - demonstration and validation
ECO - engineering change order
ECP - engineering change proposal
ENDD - engineering personnel, demonstration and validation
ENFD - engineering personnel, full scale development
ENPD - engineering personnel, production, design assurance
FADD - fabrication personnel, demonstration and validation
FAFD - fabrication personnel, full scale development
FAPD - fabrication personnel, production
FMS - foreign military sales
FSD - full scale development
FSN - Federal stock number
FYDP - five year defense program
G&A - general and administration
GCT - general support contact team
GCTD - general support contact team, dedicated
GCTS - general support contact team, shared
GFE - government furnished equipment
GSU - general support unit
GSUD - general support unit dedicated
GSUS - general support unit shared
ILS - integrated logistic support
ILSP - integrated logistic support plan
ILMD - intermediate level maintenance personnel, dedicated
ILMS - intermediate level maintenance personnel, shared
INDD - indirect personnel, dedicated
IT&E - inspection, test and evaluation
JMSNS - justification for major system new starts
LCC - life cycle cost
LOR - level of repair
LORA - level of repair analysis

LRG - logistics review group
LRU - lowest replaceable unit
LSA - logistic support analysis
LSAR - logistic support analysis record
MCO - military construction appropriation
MM - month
MOS - military occupational specialty
MP - military personnel appropriation
MON - manufacturer's part number
MSARC - Marine Systems Acquisition Review Council
MTBF - mean time between failures
MTTR - mean time to repair
NAVAIR - Naval Air Systems Command
NAVELEX - Naval Electronics Systems Command
NAVMAT - Naval Material Command
NAVSEA - Naval Sea Systems Command
NSN - Navy stock number
N-R - nonrecurring
OASD - Office of Assistant Secretary of Defense
OLMD - Organizational level maintenance personnel, dedicated
OLMS - Organizational level maintenance personnel, shared
O&M - operations and maintenance
O&S - operating and support
OMB - Office of Management and Budget
OPRD - dedicated operator
OPRS - shared operator
OSD - Office of the Secretary of Defense
PCS - permanent change of station
PEDD - producibility engineering and planning personnel, demonstration and validation
PEFD - producibility engineering and planning personnel, full scale development
PEPD - production engineering
PEP - producibility engineering and planning
PILSP - preliminary integrated logistic support plan
PMDD - program management personnel, demonstration and validation
PMFD - program management personnel, full scale development
PMPD - program management personnel, production
PMOD - program management personnel, post production
POL - petroleum, oil, lubricant
POM - program objective memorandum
PPBS - programming, planning, and budgeting system
PROC - procurement
PWBS - Program/project work breakdown structure
PWRS - prepositioned war reserve stocks
QC - quality control
QCDD - quality control personnel, demonstration and validation
QCFD - quality control personnel, full scale development
QCPD - quality control personnel, production
RAM - reliability, availability, maintainability
R&D - research and development
RDT&E - research, development, test and evaluation appropriation
RFP - request for proposal

ROC - required operational capability
RIW - reliability improvement warranty
RTR - replacement turnover rate
SAR - Selected Acquisition Report
SecNav - Secretary of Navy
SSEB - source selection evaluation board
SMPD - maintenance and diagnostic software personnel
SWPD - operational software personnel
T/O - table of organization
TDY - temporary duty
TODD - tooling personnel, demonstration and validation
TOFD - tooling personnel, full scale development
TOPD - tooling personnel, production
TRACE - total risk-assessing cost estimate
UNI - unit cost learning theory
UPC - unit production cost
USR - user
VAMOSC - Visibility and Management of Operating and Support Cost
WBS - work breakdown structure
YY - year

4. GENERAL REQUIREMENTS

4.1 General. Life cycle costing is the systematic, analytical process of determining and listing the total cost of developing, producing, owning, operating, supporting, and disposing of materiel or weapons systems. This process must begin as early as possible (preferably in the concept formulation and validation phase) since the opportunity to minimize the cost of ownership diminishes rapidly as the design and development of a weapons system proceeds through the acquisition cycle. Figure 1 depicts a funding pattern for the life cycle cost of a representative manned weapon system. The actual funding pattern for any given system will depend on the number of assigned operator and maintenance personnel and annual usage factors.

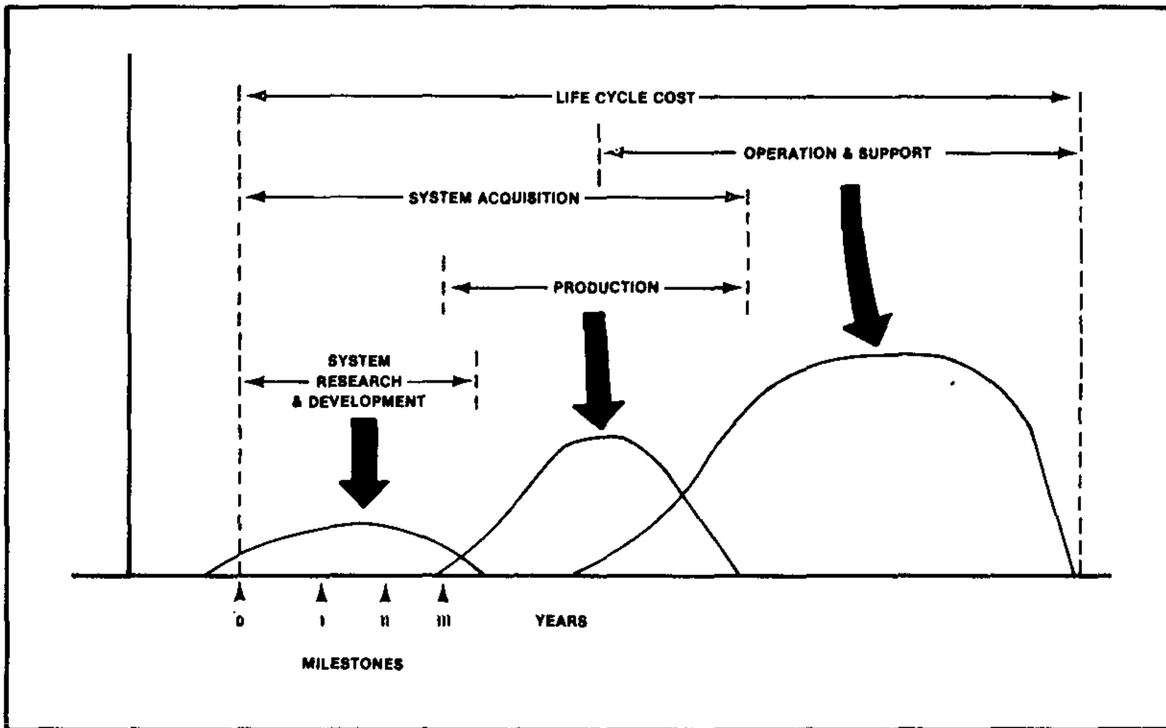


Figure 1. System Life Cycle Cost

It has been estimated that up to 75 percent of a system's life cycle cost has been determined by design and program decisions made prior to the very early stages of full scale development as shown in Figure 2. Experience has shown that it is much more cost effective to design in affordability than it is to redesign for affordability. One of the major objectives of this handbook and the Model is to assist the program manager in defining the variables which drive life cycle cost as early as possible in the system's life cycle, preferably prior to milestone 0. Early definition is critical to the success of life cycle cost as a program management tool. Ideally, the preliminary cost driver data base should be provided to development contractors as part of the initial R&D RFP.

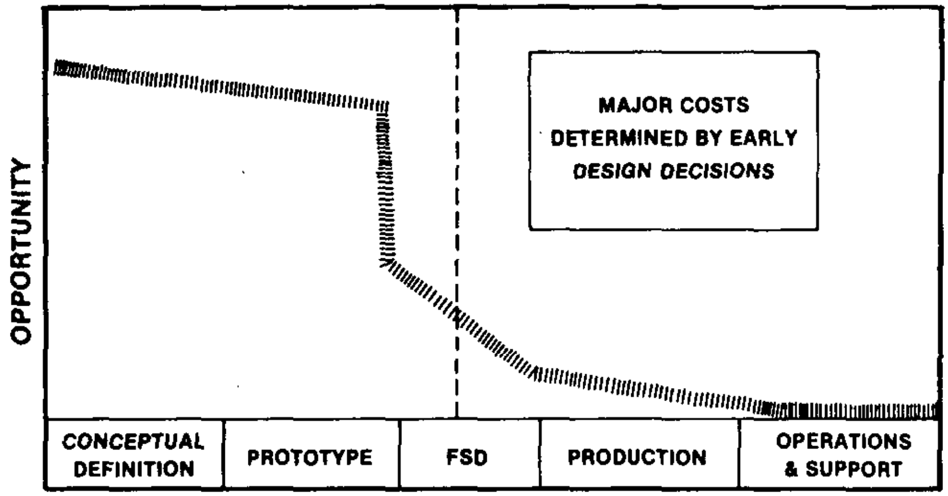


Figure 2. O&S Cost Reduction Opportunity

4.1.1 Affordability. DoD Directive 5000.1 directs all military departments to achieve the most cost-effective balance between acquisition and ownership costs and system effectiveness, and to consider affordability at every milestone. DoD Instruction 5000.2 defines affordability as the ability of the Service to provide adequate resources to acquire and operate new systems. These directives, in conjunction with OMB Circular A-109, make it clear that the decision to procure a new weapon system, no matter how desirable the weapon system may be, shall be dependent upon the Government's ability to fund both the procurement and the operation of the system.

4.1.2 Limitations on resources. Developmental systems must compete for limited resources at all decision levels starting with sponsors and proceeding through the Congressional budget process (PPBS). Affordability issues can be expected to be closely examined many times in the developmental cycle of a system -- both in terms of the system's cost for various configurations, capabilities, uses and maintenance concepts, and in terms of the system as one of many competing systems vying for Service, DoD and Congressional budget dollars. The expected costs for all proposed systems at any given time far exceed available resources.

4.1.3 Complexity of decision spaces. The decision environment in which the system acquisition process operates is exceedingly complex. Decisions must be made by people from many organizations, often with conflicting goals and priorities. Decisions are strongly influenced by the degree of confidence each participant has in the available decision information, especially performance and economic data. A major objective of life cycle costing is to provide decision makers at all levels with sufficient credible economic information to determine the most cost-effective configuration for a materiel system within the bounds set by affordability.

4.1.4 Comparability. The development and presentation of comparable costs for all proposed systems is vital if informed acquisition decisions are to be made by the Services, DoD and Congress. The derivation of cost estimates must be subject to review and agreement by the decision makers who must choose which systems will continue and which will be terminated. Cost estimates prepared using the same life cycle cost structure and the same estimating methods facilitate agreement about the relative economic burden of competing systems. Estimates which understate the true cost of procurement or ownership may result in acquisition decisions detrimental to the operating forces as a whole.

4.2 Applications of life cycle cost analyses. Life cycle cost analyses are applicable to the whole spectrum of engineering and acquisition management issues which influence resource consumption. These estimates provide focus and perspective to acquisition decisions, add discipline and structure to the acquisition process, highlight economic risks and facilitate communication between all members of the acquisition team, many of whom cross organizational boundries while participating on a part time basis in the acquisition decision process.

4.2.1 Engineering issues. The research, development and production phases can be characterized as dynamic processes with both Government and industry participants continually proposing design alternatives to satisfy performance, reliability and maintainability goals within the bounds of affordability. Life cycle cost evaluations are essential to determine the economic impact of these alternatives. Typical engineering issues include:

a. The use of existing military modules vs use of off-the-shelf commercial modules vs development of entirely new modules

b. The selection of end items with which to configure a suite of equipments

c. Equipment reliability and maintainability

d. Purchase of advanced tooling vs unit production cost

4.2.1.1 Reliability and maintainability. Investments to increase reliability or maintainability should yield comparable operating cost savings. Without the discipline of life cycle cost analyses, engineers can be expected to minimize production costs. Life cycle cost analyses can aid in overcoming the tendency to suboptimize on production costs at the expense of operating and support costs since they can provide the engineer with direct feedback of all the economic consequences of design alternatives.

4.2.2 Acquisition management issues. Total system life cycle cost estimates are accomplished early in the concept definition phase and form essential inputs to the cost and operational effectiveness analyses (COEA) which support decisions to continue or terminate a program. Most subsequent life cycle cost analyses focus on those costs which have yet to be incurred. Issues include schedule, production rates, investment in industrial base to reduce recurring production costs, financial planning (POM, FYDP, budgets) and affordability. As programs mature, annual and committed future costs grow and the opportunity to control those costs through alternative acquisition strategies declines.

4.2.2.1 Competition for available funds. As near term cash flow requirements increase, programs begin to compete for larger portions of available procurement and operating dollars. In this arena, comparable life cycle cost estimates for all competing systems are essential to the winnowing process conducted by the Services, DoD and Congress. Without comparable estimates, programs cannot be evaluated in terms of their economic impact on overall combat readiness. The evaluation of the economic impact on total combat readiness is especially important since resources committed to a new system cannot be used for current systems or other new systems.

4.2.2.2 Logistic support alternatives. Life cycle cost analyses are used by both Government and industry analysts to examine logistic support alternatives. The economic impact of maintenance concepts (e.g., repair vs. discard) and personnel costs to support each concept must be evaluated. To provide structure for these analyses, the Government should develop a baseline maintenance concept and provide that concept to the development contractor as part of the procurement package. This facilitates the source selection process and makes it possible for the development contractor(s) to integrate supportability into the design at the initiation of a program, preferably during the proposal process.

4.2.2.3 Operational concepts. The Government must be able to examine proposed operational scenarios for accuracy and affordability. Operator costs, training costs, fuel, transportation and equipment densities must be examined. As in the case with logistic support concepts, the Government should develop a baseline concept for peacetime operations and provide this baseline to the developing contractors as early as possible in the procurement process, preferably as part of the procurement package. If cost constraints are established, life cycle cost analyses can assist planners in examining equipment deployment scenarios which gain the greatest production/ O&S savings with the least impact on combat effectiveness.

4.2.3 Required life cycle cost presentations. Life cycle cost estimation in Defense programs is an iterative process in which the range of uncertainty is narrowed as the development effort nears completion and production planning is refined. Cost estimates are required at four distinct milestones, as illustrated in Figure 3 below:

a. Initial cost estimates are contained in the ROC/JMSNS and provide the minimum essential cost information upon which to assess the affordability of the required capability.

b. A baseline cost estimate is a refinement of the initial estimate which includes detailed acquisition and ownership costs based on the MIL-STD-881 summary work breakdown structure. Traceability of cost estimates and cost factors begins with this estimate.

c. A development cost estimate is a detailed refinement/updating of the baseline estimate and is required to support a decision to enter full scale development.

d. A production cost estimate is an update and revision of the earlier estimates. The production estimate forms the basis for the production decision.

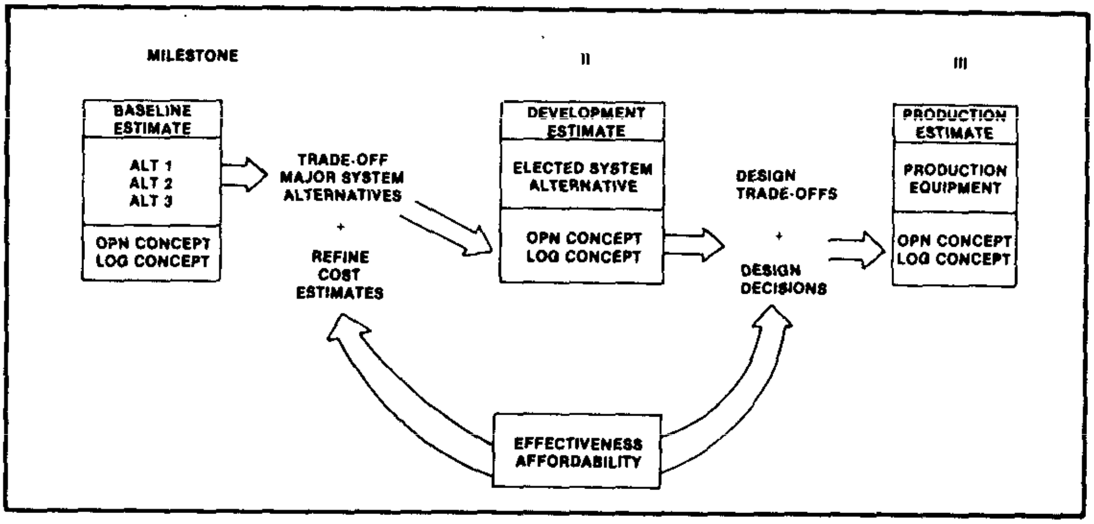


Figure 3. Flow of LCC in Acquisition

4.2.4 Refinement of estimates. Initial equipment cost estimates generally utilize a mixture of parametric estimates, analogy, and expert opinion. These techniques must be based on similarities to existing hardware. As engineering solutions are developed and uncertainties are resolved, these "best guess" estimates are replaced by engineering estimates (see Figure 4). Engineering estimates are based on costed parts lists and standard manufacturing rates and practices. While they are normally considered more reliable than the preliminary parametric/analogy methods, they must be carefully reviewed for completeness and accuracy of source data. Parametric estimates are frequently used as a check against which to measure engineering estimates.

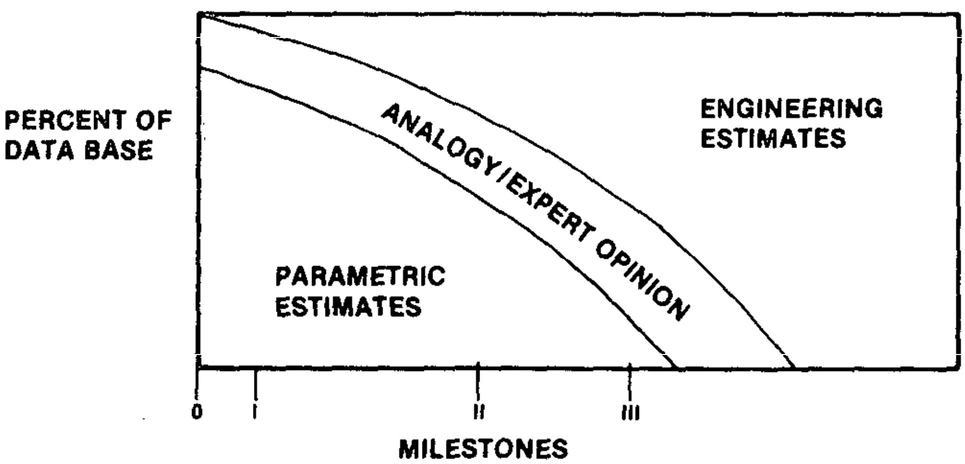


Figure 4. Refinement of Cost Data During the Development Cycle

5. LIFE CYCLE COSTING METHODOLOGY

5.1 General. This section presents a basic 8-step methodology for life cycle costing (summarized in Figure 5). This methodology is presented as a general approach to the development of a life cycle estimate. It is not meant to constrain the flexibility of either the program manager or cost analysts.

5.1.1 Worksheets. This section also presents each of the cost elements and cost factors applicable to the Model. Worksheets for the major cost elements are grouped in figures beginning with research and development system level costs (5.2). These worksheets may be used directly to develop and report the derivation of costs as appendices to life cycle cost reports. They are provided to assist in the collection and development of life cycle cost data by analysts from dyffgrent organizations.

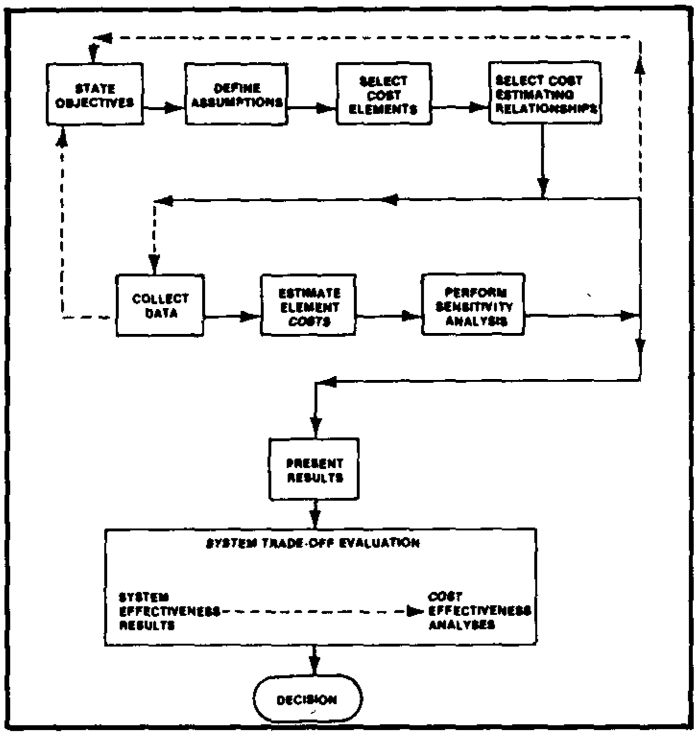


Figure 5. Life Cycle Costing Methodology

5.1.2 State objectives. The first step of the methodology is to identify, formulate, and state the objectives of the analysis or study which originally generated the need for the life cycle cost estimate. The statement of objectives must clearly identify the decisions which are to be based on the analysis, and the factors to be developed as a result of the analysis which are required to make these decisions. Properly formulated objectives define and limit the scope of the cost analysis effort and help insure that the life cycle cost estimate is relevant to the program decisions which depend upon the estimate.

5.1.2.1 Limitations on objectives. Objectives must frequently be limited because of data inadequacies, schedule and manpower limitations, degree of accuracy required, amount of estimate rationale and justification required, and uncertainties as to the appropriate method of modeling certain aspects of the problem.

5.1.3 Define assumptions. The identification and adoption of consensible assumptions which influence the estimating process in life cycle costing is critical if the exercise is to yield useful results. A consensible assumption is one that is not so obscure or ambiguous that analysts are unable either to whole-heartedly agree with it or offer well-founded objections to it. Assumptions give boundaries to the analysis.

5.1.3.1 Validity. It is imperative that every assumption be given a critical examination for its validity in a "real world" environment. This examination includes operational, engineering, organizational and political dimensions. Most questions regardinq the validity of a given analysis result from improper selection or inadequate documentation of the assumptions which underpin the results.

5.1.3.2 Boundary assumptions. Boundary assumptions for materiel system analyses usually fall into the following categories:

a. Procurement quantity
b. Rate of production, schedule
c. Learning curve
d. Concept of operation
e. Logistic support concepts
f. Operating life of the equipment/system
g. Residual value
h. Disposal costs
i. Inflation rate
j. Discount rate
k. Sunk costs
l. Acquisition strategy

In the following discussion of each of the above categories, ground rules are presented which are based on Government and industry experiences conducting weapon system life cycle cost analyses. Boundary assumptions are based on policy decisions which are beyond the discretion of the analyst. Values used should be developed in close coordination with the program manager and should reflect current Service and DoD policy.

5.1.3.2.1 Procurement quantity. The procurement quantity specifies the total number of systems or equipments to be purchased (e.g., worldwide minimum essential requirements including initial stock level, maintenance float, pipeline, war reserves, and training establishment). The quantity specified must reflect as closely as possible actual time-phased procurement intentions. An invalid assumption will directly influence production and operating and support cost estimates.

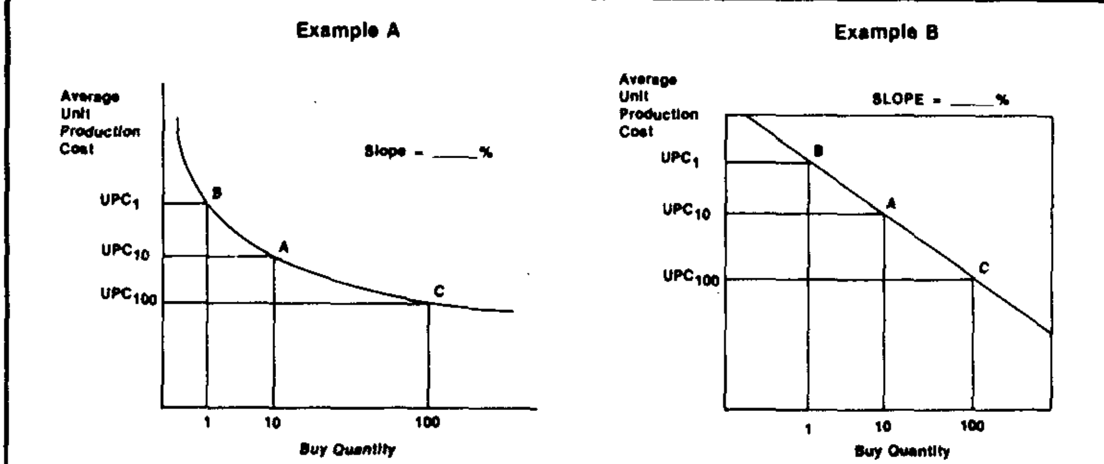
5.1.3.2.2 Production rate. The rate of production is the rate at which the system/equipment will be produced and delivered. This assumption has an impact on production and operating and support costs. Nonrecurring production costs are affected, particularly tooling and production facilities costs. Each production line has an optimum rate of production which minimizes unit production costs. Larger and smaller production rates often result in larger unit costs. Time-phased operations and support costs are dependent upon the delivery rate which depends upon the production rate.

5.1.3.2.3 Learning curve. The learning curve is based on historical evidence that, as the total quantity of units produced increases, the manhours or cost to produce that quantity decrease by some constant rate. Some of the factors contributing to this decline in costs are:

a. Increase in worker familiarity with job.
b. Development of more efficient tools and machines.
c. Improvement in organization and management.
d. Solution of production engineering problems.

Costs included in learning curve calculations are composed of contractor quantity related recurring costs to include general and administrative (G&A), and fee or profit. Normally excluded are any contractor nonrecurring or nonquantity-related recurring costs, e.g., project management, system test and evaluation, training, in-house Government production costs, or the cost of Government furnished equipment (GFE), data, peculiar and common support equipment, initial spares and repair parts, or operational/site activation.

When costs and buy quantities are plotted on graph paper, the learning curve looks like that in Example A of Figure 6. When these same figures are plotted on log-log paper as in Example B of Figure 6, the curve becomes a straight line. The use of a straight line as opposed to a curve permits an easier and more exact extrapolation of costs.



NOTE: Given the slope of the learning curve, the quantity used for the base unit production cost estimate and the base unit production cost estimate, the user can compute unit production costs given the associated buy quantity.

Figure 6. The Learning Curve

The rate of "learning" represents a constant decrease in unit costs for each doubling of production quantities. Two forms of the learning curve are used depending on whether the rate of change is more accurately reflected in the changes in the:

a. average unit costs for all units produced, referred to as the cumulative average curve

b. costs of the last unit produced in each lot, referred to as the unit curve.

The slope and form of the learning curve varies between products, manufacturing technologies for the same product, contractors, and even multiple production lines within the same contractor facility. Therefore, it is necessary to exercise due care in using historical data to estimate these slopes and selecting unit cost or cumulative average theory.

Experience has shown that some analysts tend to mix the use of the cumulative log-linear curve and the unit log-linear curve. This typically occurs when the analyst attempts to use the unit costs derived from unit theory to determine the average unit cost and then using the cumulative average log-linear curve formula to determine lot costs.

This is incorrect and will generate erroneous results. Both curves will not exhibit the same "straight-line" characteristic for the same slope. The relationship between a unit curve and a cumulative average curve with the same slope is shown in Figure 7. Figure 7 makes it clear that given the same data points, the incorrect selection of one theory when the other best represents the data will cause errors in lot cost computations. Unit cost theory will yield a lower lot cost estimate than will cumulative average cost theory given equal size lots and equal first unit costs as shown in Figure 7. Lot cost is shown in the Figure 7 as the area under each curve.

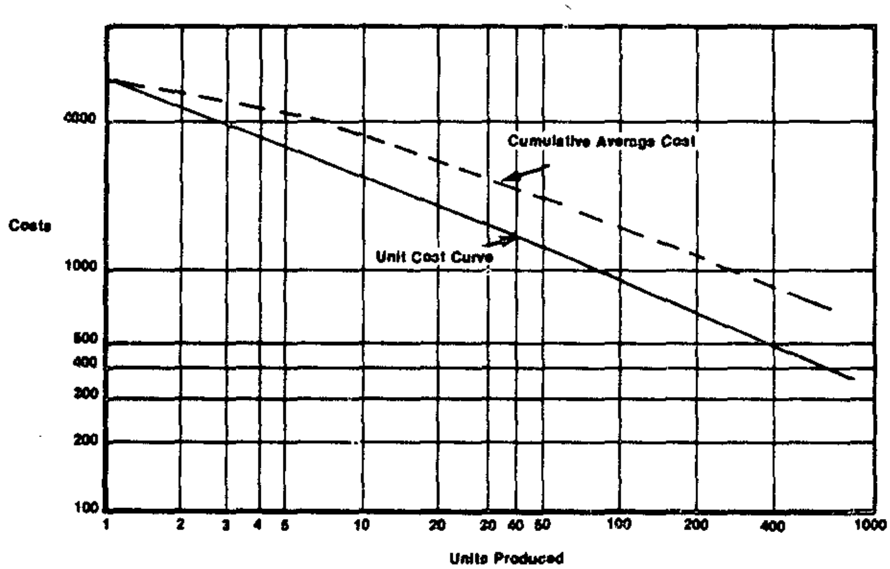


Figure 7. The Log-Log Unit Cost Curve and Cumulative Average Curve

Analysts frequently compute theoretical first unit costs for a variety of existing equipments and use these to postulate CER's which predict the theoretical first unit cost for new items. When dealing with historical lot costs, it is critical that the analyst determine both the rate of learning and the form of the theory which most closely represent the actual quantity related changes in lot costs when computing theoretical first unit costs.

An error in theory selection will cause an error in estimating the theoretical first unit costs from actual cost data. This leads to errors in the formulation of the CER's which predict first unit costs and lot costs for the new item. A theoretical first unit cost cannot be validated until the selection of either unit cost or cumulative average cost theory has been resolved.

Given no history for predicting the learning behavior of a new item, the analyst should use the learning theory that best fits similar items. When in doubt, the cumulative average theory will yield a higher estimate of lot costs given the same first unit cost and learning curves. A more detailed discussion of the two learning curve theories, with an example to show how each is applied, is presented in 5.7.5.

5.1.3.2.4 Concept of operations. The concept of operations describes the way the system or equipment is to be operated in the peacetime operation and training environment. Wartime usage is not relevant to life cycle cost estimates. Specifically, the analyst must determine the number, manning levels, productivity, types, skill levels and turnover rates of the personnel required for operation; consumables and their consumption rates; operational transportation and operational facility requirements, if any. See 5.5.3, 5.6 and 5.8 for further information about manpower.

The number of systems to be operated and the annual operating cycles (i.e., hours, rounds fired, kilometers or miles driven) are major cost drivers for operating costs. It is important that the most realistic figure obtainable be used. Training use should also be included for on-the-job-training and formal skills training. The concept of operations should be verified by the commanding officers of the units scheduled to receive the system being costed. See also 5.7.6.

5.1.3.2.5 Logistic support concept. The logistic support concept describes, among other things, how, where, and at what levels the equipment will be supported after deployment. The logistic support assumptions should describe the numbers, manning levels, productivity rates, types, skill levels and turnover rates of the maintenance personnel; the facilities required; repair strategies; and stock level requirements.

In the initial planning stages the tentative logistic support concept is normally described in the Preliminary Integrated Logistic Support Plan (PILSP). If a logistic support concept has not been specified, a concept should be postulated based on the ILS planning factors.

The life cycle costs based on the support concept and other criteria such as operational availability can aid the Government in the selection of the optimum logistic support concept. As in the case of the operational concept, operational commands must participate in this process to help identify cost drivers and limiting factors.

5.1.3.2.6 Operating life. The life of the equipment can be specified in three ways:

a. The physical life is the estimated number of years that the equipment can physically be used based on projected annual usage rates for the function for which it was procured.

b. The technological life is the estimated number of years before technology will make the existing or proposed equipment obsolete or unsupportable because the production base will have ceased to exist.

c. The economic life is the period of time over which the benefits to be gained from the equipment can reasonably be expected to accrue. The economic life used for life cycle cost analysis is a function of Service policy and the equipment being costed. 20 years is commonly used although periods of 10 to 30 years are often used depending on the equipment being procured and projected product improvements and rebuilds.

5.1.3.2.7 Residual value. The residual value represents any gain from the sale of the system/equipment at the end of its economic life. If the residual value is positive at this point in time, some of the resources expended for the system/equipment can be recovered through its sale. This is especially important for equipment which may enter the foreign military sales program or be transferred to reserve forces. In these cases, residual values are important since they may nearly equal procurement costs.

5.1.3.2.8 Disposal cost. The disposal cost is the estimated cost that will be incurred in the disposal of the equipment at the end of its economic life. These costs might accrue through dismantling, selling, or scrapping the system or equipment. Since residual value is a positive value and disposal cost is a negative value, it is often advantageous and realistic for equipment which is to be scrapped to assume that they are equal. If it is assumed that residual value and disposal costs are expected to be approximately equal, neither are presented.

5.1.3.2.9 Inflation rates. The preparation of cost estimates for systems and programs involving the acquisition of major equipments should involve the consideration of economic escalation associated with the costs used in the estimate. It is the policy of the DoD that all cost estimates for weapons systems will reflect the expected ultimate cost to acquire the system. All cost estimates should reflect the best estimate of the amounts ultimately to be paid, specifically incorporating anticipated changes in future price levels, i.e., inflation. DoD Instruction 7041.3 gives the following guidelines for the treatment of inflation:

a. For comparative studies, all estimates of costs and financial benefits for each year of the planning period will first be made in terms of constant dollars, that is, in terms of the general purchasing power of the dollar at the time of the decision. These estimates should not include any forecasted change in the general price level during the planning period.

b. Cost projections may be changed over the period of analysis to reflect only real changes in costs due to changes in resource consumption (e.g., an increase in the expected number of repairs), or price changes effected since the beginning of the period of analysis.

c. Cost projections may also be changed due to economies or diseconomies of scale resulting from an increase or decrease in the quantity of goods and services purchased.

d. When inflation is considered important to the conclusion of the study, a second computation will be made in terms of of current (inflated) dollars. Using the constant dollar estimates as a baseline, inflation should then be included by using the Office of the Assistant Secretary of Defense (OASD) (Comptroller) price indices for Procurement; Research, Development, Test and Engineering (RDT&E); Family Housing and Military Construction; Operations and Maintenance; and Military Personnel. The only exception is when there are specific contractual arrangements.

To avoid overestimating and double counting for the effects of inflation, DoD Instruction 7041.3 requires that consideration be given to contractual provisions which include provision for inflation, labor agreements, and the extent to which material is already on hand or will be furnished under fixed price contracts.

When projecting figures that have previously been inflated, the analyst needs to deflate the figures to the base year (year estimate made), using the inflation rates used originally, and then reinflate using current inflation rates.

The Model allows the analyst to quickly and easily change base years and inflate using DoD or contractual rates because OASD inflation indices are stored in the Model's data base and are undated semiannually. See 5.13.

5.1.3.2.10 Discount rate. Discounting future cash flows is based on the realization that the deferral of expenditures allows the present use of money in alternative investments to yield some beneficial returns. If funds must be expended in the present, their use in alternative investments is lost. DoD Instruction 7041.3 prescribes the present DoD policy for the use of discounting (or present value analyses) for the economic analysis of DoD programs.

At the present time, the standard discount rate specified by the DoD is 10 percent per year compounded annually. This value is an assumption in the analysts data base and can be changed by the analyst. The Model allows analysts to discount both constant and inflated estimates.

Current policy is that discounting should not be used in cost estimates for the following:

a. Decisions concerning the acquisition of commercial type services by Government or contractor operation

b. Proposed programs/projects which, if adopted, would commit the DoD to a series of measurable costs that in aggregate would not extend over 3 years or that result in a series of cash benefits which do not extend more than 3 years from the inception date

c. Program evaluation studies which deal only with historical costs and contain no cost comparisons.

Discounting has fallen into disuse recently and the analyst should verify current Service policy before using it in an analysis.

5.1.3.2.11 Sunk costs. Sunk costs designate those costs irrevocably committed to a program. Since sunk costs are already committed, there will be no variation for those costs between alternative systems or equipments. For comparative studies, only the relative cost differences of future expenditures are economically important. However, sunk costs do serve to give perspective to the relative cost differences of remaining alternatives and are frequently included for this purpose.

The analyst should always bear in mind that the political import of sunk costs may be far greater than the engineering or economic import.

5.1.3.2.12 Acquisition strategy. The acquisition strategy addresses the contractual strategy and the type of production contract to be awarded. Production costs will be influenced by whether the contract is sole source or competitive, whether it is a single year or multiyear contract and whether there will be one or more producers.

5.1.4 Select cost elements. The next step in the LCC analysis is to develop a formally structured table of the cost elements to be estimated. The purpose of this structure is to insure that:

a. all costs are taken into account
b. none are double counted
c. individual cost elements are consistently and clearly defined

The Cost Element Structure (CES) is a basic tool for organizing the analysis in keeping with its prescribed objectives and scope. The importance of completely defining the individual cost elements stems from inadequacies in defining what is included in the estimate. Historically, many cost overruns can be traced to the use of incomplete cost structures for initial estimates. Additionally, comparable independent cost estimates cannot be made if both estimates are not based on the same CES.

5.1.4.1 Model cost element structure. The cost element structure and definitions were chosen to integrate all applicable cost regulations, directives, policies and OSD guidance at the time of publication. The CES is organized sequentially into the three major phases of a system's life cycle: Research and Development, Production, and Operating and Support. The cost elements for each phase are listed in Figures 9, 72 and Table II in 5.5 respectively. For R&D and production costing, there are 5 levels of cost elements available to the analyst. This level of detail encompasses the major activities which must be considered in a system acquisition program. Not all of these cost elements apply to every program. The analyst is expected to determine which cost elements are appropriate to each program. The analyst should select cost elements as required for the specific analysis using the following guidelines:

a. Select cost elements from the cost structure contained herein. This cost structure has been created from standard definitions of cost elements for Defense programs. The use of a consistent cost structure will aid in the compilation of cost histories suitable for future analyses.

b. Select cost elements in as much detail as practicable for the analysis. When costs cannot be broken out into separate cost elements, estimate costs at the next higher cost category. Aggregate estimates should be refined in later analyses as further information becomes available.

5.1.5 Select cost estimating relationships. The preceding steps have established a framework which defines the scope and detail of the LCC analysis.

The next step is to develop a cost estimate for each element of the cost element structure. Some insight into the overall nature of the complexity of the cost estimating and cost analysis problem can be gained by examining typical "cost drivers" representative of equipment programs. Table I presents a summary list of generalized cost drivers and is not intended to be comprehensive. It is a rough indication of the variety of hardware, software, program, and ILS characteristics which impact R&D, Production, O&S, and life cycle costs of equipment programs.

Some factors have greater cost impact than others. These have been ranked in their typical order of impact on the cost for each life cycle cost phase from (1) most important, (2) second in importance, and (3) third in importance. The variety of these typical technical and nontechnical cost drivers must be accounted for when postulating cost estimating relationships for each cost element.

Cost sensitivity studies depend upon the selection of cost estimating relationships which reflect these cost drivers. To the extent that major cost drivers are not accounted for in the cost estimating approach, the impact of changes in the cost drivers on the program cannot be estimated or controlled by program managers. Many of these cost drivers have been built into the Model's cost estimating structure.

5.1.5.1 Cost estimating techniques. There are four major types of cost estimating techniques. Each technique requires determining factors and their relationships which can be used to predict the value of each cost element.

The four major techniques for determining cost estimating relationships (CER's) are:

a. Parametric
b. Industrial engineering
c. Analogy
d. Expert opinion

Table I. Generalized cost drivers.

	Parameter Ranking[1/] R&D	PROD	O&S	Total LCC
1 - Hardware Design Characteristics & Requirements				
a - Power Requirement				
b - Weight Requirement		3		
c - Size Requirement				
d - Environmental Operating Conditions		2		
e - Electronic/Mechanical Complexity	1			
f - Packaging Density				
g - Reliability Requirements	2	1	2	
h - Automatic vs Manual Operation			1	
i - Survivability/Vulnerability Requirements	3			
j - External Interface Requirements				
k - Component Technology				
l - Tempest & EMI/EMC Requirements				
m - Maintainability Requirements			3	
n - Built-in-Test Equipment				
2 - Software Design Characteristics				
a - Functional Requirements	1		1	
b - Diagnostic/Built-in-Test Requirements				
c - Program Size Requirement	2			
d - Programming Tools Required/Available			2	
e - Coding Language	3		3	
f - Complexity of Coding				
g - Percent New Code				
3 - Program Characteristics				
a - Number of Units to be Produced and Delivery Rate		1	1	2
b - Length of Total Program	2	3	2	
c - User Documentation Requirements				
d - Beginning & Ending Dates of Each Phase of the Program	1			
e - ECP's		2		
4 - ILS Characteristics				
a - Operator/Crew Requirements			1	1
b - Maintenance Personnel Requirements			2	3
c - Repair/Replacement/Discard Policy	3			
d - Repair Parts Requirements		2		
e - Initial and Annual Training Policies				
f - Automatic & Manual Diagnostics	2	3		
g - Availability Requirements	1	1		
h - Equipment Operating Rates			3	

1/ These are typical parameter rankings; parameter rankings for a specific program would probably be quite different.

Cost equations and cost estimating relationships have a logical structure which identify the variables and the constants which combine to yield cost. Cost equations are algebraic expressions which postulate simple arithmetic relationships between cost and cost-generating variables. For instance, if a weapons system will use a Government furnished computer costing $32,000, the cost for that computer would be the product of the buy quantity (the variable) and the unit cost (the constant). This type of formula [Total Cost = Unit Cost X Buy Quantity] is often referred to as a cost equation as distinguished from a CER.

As opposed to cost equations, CER's are algebraic expressions whose values are derived through the application of statistical techniques such as regression analysis. These techniques are used to test the hypothesis put forward by the analyst that a relationship exists between cost and the selected independent variables. The difference between CERs and cost equations lies not in the final formula, but in the methods used to determine the values of the constants used in each equation.

To illustrate the differences between cost equations and CER's, consider fuel consumption. A cost equation might postulate cost of fuel = operating miles/year * fuel consumption rate (gallons/mile). A CER might postulate fuel cost = operating miles/year * fuel consumption (gallons/hp-hour) * horsepower. Both equations are simple algebraic expressions. Both yield annual fuel consumption. Both should be based on verifiable test data. In fact, the cost equation in this case is a simplification of the CER. However, the CER offers the design engineer the advantage of yielding cost as a function of a design variable: the horsepower of the engine required to power the vehicle at its average operating speed.

When postulating a CER, the analyst must bear in mind that the values for the independent variables must be available in some reliable form for the CER to work. The fuel consumption CER would be of little use if the analyst had no reliable data on fuel consumption rates for candidate engines or no reliable way to predict the horsepower required by the candidate vehicle.

The Model has been designed to allow analysts to generate and input their own CER's or input costs directly at any level in the WBS.

5.1.5.1.1 Parametric cost estimating relationships. Parametric costing uses regression analysis to establish statistically significant functional relationships between independent variables (performance and physical characteristics are most commonly used) and the dependent variable (cost in some form). Parametric costing is the only mathematically rigorous method which can be used to make an estimate from the limited data available during concept formulation, i.e., when only mission and performance envelopes are defined. In addition, parametric methods provide the analyst with an inexpensive means of examining the impact on cost of a variety of changes in system performance requirements--information of particular importance during the early phases of the development process.

Particular emphasis is given to the principle that a specific functional relationship between independent variables (performance and physical characteristics) and a dependent variable (cost) should be hypothesized on the basis of technical understanding or an understanding of the historical data of the program being analyzed. The analyst strives to identify a cause and effect relationship between selected independent and dependent variables. Linear, curvilinear, logarithmic, and exponential are the most commonly applied regression techniques.

The importance of technical understanding and design relevance cannot be overemphasized. Many statistically significant relationships can be established between existing data and performance and physical attributes of a system. But these relationships must reflect the engineering and physics of the system being costed. Relationships with variables over which the design team has no control or no way of predicting are of no value, regardless of their statistical validity. Regression analysis is a very powerful tool but it has no way to test the "common sense" of the postulated relationship.

A properly developed parametric relationship can be used to estimate the costs associated with the new system by direct substitution into the equation of the system's performance and physical characteristics.

5.1.5.1.1.1 Boundaries and limitations. Boundary conditions play an important role in parametric CER's. Variables should stay within specific ranges of existing data for the relationships to remain statistically valid. For example, a data base on the costs for small arms manufacture which shows a relationship between calibre, barrel length and unit cost would not be appropriate for estimating the unit cost of a 16 inch naval gun. Variables which are outside the range of existing data cannot be expected to produce reliable results.

Another restriction in the process of identifying cost-determining parameters is availability. Cost predicting characteristics of the proposed system should be reasonably available before completion of design and which are easily and unambiguously measurable. Historical data may not be available, or may be available in differing work breakdown or accounting structures. Also, there are frequently inconsistencies and irregularities in historical data which must be resolved in order to insure a consistent and comparable data base. One valuable source of data for Government (but not industry) analysts are contractor cost data reports required by DoD Instruction 7000.11 for selected systems.

No sophisticated mathematical techniques can make up for inadequate data. The use of sophisticated mathematical techniques with inadequate data serves only to confound the decision environment and may cause some reviewers to place undue confidence in the results and thus underestimating risk.

5.1.5.1.1.2 Advantages. Parametric estimates have the advantage of being developed from a set of the sample points which reflect the delays, problems, mistakes, redirections, and changing characteristics of developing comparable systems. The use of parametric CER's to estimate new programs takes into account the statistical average of such experience on prior programs. Parametric techniques, because they depend upon fewer variables which are less subject to change over time, generally provide a more stable cost estimate for new systems than do engineering techniques.

5.1.5.1.1.3 Disadvantages. Parametric procedures also have some well known limitations. To be fully effective, they require an extensive base of past cost and performance data. Their use implies that the relationships which existed in the samples upon which the estimating equations were based will continue to exist in the future.

Extrapolations which involve systems that advance the state-of-the-art become increasingly hazardous as they depart from the technology which existed at the time the sample programs were procured. Costs for systems using largely different state-of-the-art components or manufacturing processes should not be estimated using parametric methods unless data exist which clearly show the cost relationship between the old technology and the new technology.

The Model is designed to accept analyst derived parametric estimating relationships for each R&D task associated with developing each WBS item as well as the production cost for each item. See also 5.7.3.6 and 5.7.4.5.

5.1.5.1.2 Engineering cost estimating relationships. In the past, the principal technique used to support cost estimates has been the industrial engineering approach. This approach relies on a detailed accounting of all the operations required to develop and produce a unique and specifically defined piece of equipment. It makes use of vendor quotes, man-loading requirements by work center and station, and engineering standards built up from time and motion studies. It is sometimes referred to as "grass roots" or "bottoms-up" estimating.

5.1.5.1.2.1 Advantages. The advantages of engineering cost estimating procedures are:

a. They can provide accurate cost projections of equipment in current production.

b. The method can be applied independently to the various detailed functional cost elements. As more detailed information becomes available for specific elements, initial parametric cost estimates should be replaced by engineering estimates (see Figure 2).

c. They provide a good reasonableness check of current plans since they force the analyst to examine tasks and level of effort required to complete similar efforts.

5.1.5.1.2.2 Disadvantages. The disadvantages of the engineering cost estimating procedures are:

a. The engineering estimate method cannot be used until detailed cost data are available (by the time this information is available, past decisions might preclude certain attractive courses of action).

b. They are usually more costly and time consuming than the other methods. A great deal of effort is required to acquire the necessary cost data and to keep these data up to date and internally consistent while the system or design is in a state of flux.

c. Reviewing and evaluating cost models which use engineering relationships is complicated by the size, complexity and level of detail involved.

d. They may not account for program uncertainties and complexity.

The Model is designed to facilitate the preparation of industrial engineering estimates. The Model allows the user to estimate manhours or manloading and task duration and materiel requirements for the items to be developed or produced . It will also calculate unit and total costs for R&D and production. These calculations can be done at any level of the WBS, depending on the availability of data. See also 5.7.

5.1.5.1.3 Analogy cost estimating relationships. Analogy cost estimating relationships, like parametric CER's, predict the costs of a new program from data on past costs of similar programs. This technique frequently involves estimation of the incremental or marginal cost associated with program or equipment changes.

5.1.5.1.3.1 Advantages. Analogy type estimates are relatively simple and inexpensive to perform and they yield accuracy for similar systems.

5.1.5.1.3.2 Disadvantages. Analogy estimates require analogous equipments and data which limits them to systems based on similar technology and manufacturing techniques. This often limits them to equipments built by the same firm.

5.1.5.1.4 Subjective cost estimating relationships. Subjective or judgmental cost estimating relationships are derived from the judgment of "experts." Expert opinion is valuable when there are insufficient or inadequate data to use parametric engineering or analogy methods. They are particularly useful when a major change in either engineering or manufacturing state-of-the-art change is involved. When time and resources allow, Delphi techniques (i.e., the iterative soliciting of opinions from a number of experts) should be used since expert opinion is subject to bias and becomes less reliable as system complexity increases and the number of "experts" decreases.

5.1.6 Data collection. After the objectives and assumptions of the LCC methodology have been defined and the cost elements and CER's have been determined, the analyst's next task is to collect data. Data collection represents perhaps 90 percent of the total work effort in life cycle costing and involves six basic steps:

a. Identify potential sources (reports, opinions and judgments of experts, results of simulation modeling, observation and tabulation of steps in a work process, outside organizations, technical information centers). Potential sources are shown in Figure 8.

b. Develop strategies to exploit the sources, e.g., interviews and task letters

c. Obtain available data

d. Extract data

DEVELOPMENT

- AP (Acquisition plan)
- APP (Advanced Procurement Plan)
- Budget Reports
- Contract Specifications
- DRD (Detailed Requirements Study)
- Personnel Requirements Study
- ILSP (Preliminary integrated Logistics Support Plan)
- ROC/JMSNS (Required Operational Capability/ Justification for Major System New Starts)
- Contractors

PRODUCTION

- AP
- APP
- Budget Reports
- Contractor Reports
- Contracts
- Design Reviews
- GFE (Government Furnished Equipment) Plan
- Development Plan
- Management Plan
- STE (System Test Equipment) List
- Supply Reports
- Test Plans
- Training Commands
- Depots
- Contractors

OPERATING & SUPPORT

- Budget reports
- ILSPs (Integrated Logistics Support Plans)
- ISP (Integrated Support Plan)
- LORA (Level of Repair Analysis)
- LSA (Logistic Support Analysis)
- QQPRI (Quantitative, Qualitative Personnel Requirements Information)
- RAM (Reliability, Availability, Maintainability) Reports
- Test Reports
- Training Plans
- Depots
- ILS Personnel
- Service Cost Factors Manuals
- Operating Forces

LIFE CYCLE COST MODEL

UPDATED LIFE CYCLE COST ESTIMATE

FIGURE 8. Life Cycle Cost Data Sources

e. Classify data in terms of uncertainty and reliability

f. Identify missing data and data which require further refinement or updating and validation; go back to the first step if necessary.

This handbook has been prepared as an adjunct to the Model to help the analyst understand the overall structure and detail of the Model in order to organize and plan for data collection. It furnishes a checklist for data collection which, when completed, becomes a comprehensive record of all data collected. This handbook is the key to working with and implementing the Model.

5.1.6.1 Data collection problems. A number of problems confound the data collection process. These problems should be considered in the data collection plan. It may be necessary to review the assumptions and objectives of the estimate to accommodate anticipated data deficiencies.

5.1.6.1.1 Wrong cost category. Incorrect estimates for a cost element can occur when good data are placed in the wrong cost category or when costs are inadvertently listed in two categories instead of one (double counting). Consistency of cost element definitions and hence data is obtained by standardizing them and supplying them in written form (in this handbook) to all data collectors and Model users. The definitions and analyst's notes are provided to minimize confusion when attempting to define required data collection, especially when dealing with multiple agencies.

5.1.6.1.2 Obtaining sufficient resources. The analyst must be prepared to convince the many participants in the acquisition process that a need exists which justifies the often not inconsiderable work required to develop relevant costs or cost factors. The data collection plan provides invaluable assistance in defining and narrowing requirements, thus reducing the chances of developing or receiving data of little or no use.

5.1.6.1.3 Voluminous data available. Once documents and reports begin to be accumulated, the analyst must attempt to extract relevant cost data from the mass of words and numbers available. Cost data categories in source documents are frequently so vaguely defined that the researcher cannot precisely determine what activities and resources the costs encompass and exclude.

5.1.6.1.4 Data source identification. Another serious documentation problem is the lack of source citation. Too often data cannot be traced back to a reliable and reviewable source, be this an individual or a document. Unattributable cost estimates must be regarded as suspect and should not be used.

5.1.6.1.5 Inflation adjustment. Sometimes costs are identified with a year, but it is not specified whether this is calendar year or fiscal year. Other times costs are attributed to a specific year when in fact they have been extracted from an earlier source and not adjusted for inflation. Costs which cannot be attributed to any year cannot be adjusted for inflation and should not be used.

Normally, all costs used in an analysis must be normalized as to time, i.e., adjusted for inflation to the base year of the analysis. The Model performs much of this task for the analyst. System level costs are the only costs which must be normalized to the base year for the estimate and this should be done during data collection. Life cycle costs may be presented in "constant dollars" or "current dollars." Constant dollars are usually determined as costs in the fiscal year for which the estimate is made, and are not further inflated. Therefore, any cost element estimate which predates the base fiscal year must be inflated to the base year for use with the Model. WBS items can be entered in any base year dollars and the Model will normalize them to the base year selected for the estimate.

Current dollars are constant dollars inflated to the year in which they are going to be spent. Current dollars are also called "then-year dollars." Future budgetary planning usually necessitates "current dollar" figuring. The Model calculates current year estimates based on inflation, schedule and spending rates.

5.1.6.2 Bibliography. One of the most important steps in data collection is to create a bibliography which clearly identifies each source used in the estimate. The importance of this step cannot be overemphasized. The data collection effort is a massive task. At a minimum, the estimate will depend upon dozens of documents, studies, personal and phone interviews. This mass of documentation will grow over time. Properly catalogued, it provides an invaluable source to document program decisions and a resource for future studies. The bibliography must be created during the data review process whenever a source is first used. Each cost estimate should cite the source document's catalogue number assigned in the bibliography and the page for future reference.

5.1.6.2.1 Contents. A sequential notation or numbering scheme should be created which allows the analyst to reference the bibliography on each worksheet. Each source document should be marked with the document identifying notation used in the bibliography. Each entry in the bibliography should include the title, name(s) of the author(s), if any, issuing agency or publisher, publication date and volume or revision number, if any. The location of documents including those held by the analyst should be part of the bibliography. Memoranda of all phone calls and interviews used as source data should be prepared which provide similar identifying information, including phone numbers. A useful procedure is to prepare a standard form for each study which can be used to record bibliographic information as it is accumulated. Different forms for documents, interviews, meetings and phone calls may be appropriate.

5.1.6.2.2 Library. The second essential task step in data collection is to create a library of source data which can be referenced as backup for the estimate, reviewed and updated and used as a source for future studies. The data collection workbook and the bibliography serve as the index to the source data library.

5.1.7 Estimate element costs. After the necessary data have been collected and evaluated, estimates of element costs can be obtained through the use of relevant CER's.

5.1.7.1 Uncertainty. The analyst should estimate the degree of uncertainty associated with each cost element. This could be expressed statistically through confidence intervals or through pessimistic, most likely, and optimistic estimates. If a quantitative measure cannot be obtained, the analyst should make a subjective judgment on the uncertainty of the cost element estimates. A number of techniques are available for estimating uncertainty. Unfortunately, many of these techniques rely on data which are not available in reliable form for most programs. Factors bearing on uncertainty are schedule constraints, the degree to which the state of engineering or management art and practice is being pushed, skill levels of the design team and the number of dependent events which must be accomplished before the system can be fielded. Delays in schedule due to one or two intractable engineering or management problems can have disproportionate impact upon the total system cost.

5.1.7.2 Global considerations. The process of estimating element costs requires the analyst to bear in mind not only the factors influencing the cost element at hand, but also those influencing the system acquisition as a whole. This is not a trivial process. It requires experience, common sense, the ability to deal effectively with ambiguity and to recognize data which are not as reliable as may first appear, and a well developed balance between skepticism and optimism. The analyst must be willing to reject previously developed estimates and either go back to the source for better data or substitute his own judgment.

5.1.8 Perform sensitivity and trade-off analyses. Sensitivity and trade-off analyses are performed by systematically changing the decision relevant inputs to the Model and noting the effects on the output cost estimates. By doing this, the analyst is able to identify those portions of the cost estimate that require further refinement, identify areas of risk, and present alternative courses of action with their resultant costs.

Sensitivity and trade-off analyses are the primary reasons for life cycle costing. The ability to quickly and easily measure the resource implications of alternatives facilitates the decision process. The whole process of developing a complete life cycle cost data base is aimed at giving the diverse members (Government, prime and support contractors) of the acquisition effort a tool with which to measure the economic impact of alternative courses of action.

5.1.8.1 Sensitivity analyses. Sensitivity analyses primarily involve changes to cost drivers which influence the operational and maintenance costs. Some examples are:

a. Changing equipment values such as failure rates, maintainability time, weight, power consumption and material consumption

b. Changing the operational scenario of a system by varying the number of equipments, operating cycles, operational transportation, power requirements, and frequency of deployments.

c. Changing the maintenance scenario of a system by varying the levels of repair, discard vs repair rates, and stockage and transportation of spares.

d. Changing the manpower requirements of a system by varying manning levels, productivity factors, pay grades, and training requirements.

5.1.8.2 Trade-off analyses. Trade-offs between costs and effectiveness primarily deal with examinations of alternative acquisition strategies. Trade-off analyses are used to evaluate proposed alternative systems or equipment configurations in terms of estimated total costs, technical risks, benefits, and operational effectiveness. These studies are designed to assist decision makers in identifying a preferred choice among possible alternatives. Most importantly, they provide analysts, planners, and decision makers useful visibility into the implications of the time-phased funding and benefits of broad management planning choices.

The Model is not designed to evaluate the impact on operational effectiveness of various trade studies. Moreover, most operational effectiveness models are not designed to yield good estimates of costs for alternatives. Operational effectiveness models typically simulate war time conditions. Life cycle costs represent the cost to be ready for war, not the cost of combat. For example, a combat simulation may yield relative changes in combat outcomes when comparing two main guns or power plants. The Model is designed to serve as a adjunct to this process, yielding the costs of each alternative and the delta cost between each.

5.1.9 Present results of cost estimates. It is important that the steps followed in the analysis and the results obtained from the analysis be adequately documented. This documentation should include:

a. A description of assumptions to include R&D and production quantities and schedules, maintenance concepts, personnel requirements, and all other assumptions which are required to define the total cost of the system to the DoD

b. Cost elements used and definitions unique to the system, subsystem, and equipment costed

c. Cost estimating relationships used, their source, their limitations, and the data base used

d. A bibliography of data sources

e. Summary of element cost estimates and total life cycle cost estimates and the supporting material from which they were derived

f. Inflation indices and how they were applied

g. Description and results of sensitivity analyses

h. LCCM input summary sheets.

5.2 System level R&D cost worksheets. System level R&D cost elements include all contract and Government in-house costs. These are the costs for those activities not directly attributable to individual hardware and software items required to bring a product's development from concept to production including program management, systems engineering, system test and evaluation, training, technical data, and facilities costs. System level cost elements documented in this section also exclude the costs to design and develop the hardware and software items themselves. Costs which can be attributed to hardware or software configuration items are computed on the basis of inputs to the WBS data base as explained in 5.7.3.

5.2.1 System R&D worksheets. Summary worksheets for entering costs are contained in Figure 9. Figures 10-71 are data collection worksheets for each of the R&D system level cost elements. These worksheets define each cost element and provide a structure for documenting the development of each cost estimate. Backup pages, in formats developed by the analyst, detailing the development of variables used to arrive at an estimate should be attached to the cost element worksheet.

5.2.2 Level of detail. The analyst may enter costs at any level in the following worksheets suitable to the availability of data and the detail required by the program decision environment. An entry at any level in the cost structure (including a zero) will cause the Model to skip to the next entry with an equal or lesser numbered level. For example, an entry for 112.12 Program Management which is a level 4 cost element, would cause the Model to skip the entries for 112.12.1 through 112.12.3 and ask for data for 112.13 Government Test which is also a level 4 entry.

5.2.3. Selecting cost elements. The cost element structure in Figure 9 is intended to be a checklist for each acquistion program. Not all cost elements apply to any one program. The selection of cost elements for each program and the level of detail appropriate for each estimate depends upon current Service policy, the program manager's decision requirements and the data and estimating techniques available to the analyst at the time of the estimate.

5.2.4 CER flags. Entering a 1 for any first, second or third level cost element will cause the Model to compute costs for level and level 5 entries which are less than one as percentages of the calculated cost for the element with the 1. Results of calculations for WBS records are included in the cost calculation. For instance, if a 1 were entered for 111 Contractor D&V costs, and .25 entered for 111.15 Data, the Model would calculate an interim value for 111, divide that value by (1-.25) to arrive at a final cost for 111 and then allocate 25% of that cost to 111.15 Data.

DEFENSE SYSTEM LIFE CYCLE COST MODEL   DATE: ______________
R&D COST INPUTS (PAGE 1 of 4)   SYSTEM: ______________

DEMONSTRATION&VALIDATION-CONTRACTOR

Cost Element	Description	Level	Value/Reference
100	RESEARCH & DEVELOPMENT	<1>	______________
110	DEMONSTRATION AND VALIDATION	<2>	______________
111	CONTRACTOR	<3>	______________
111.12	SYSTEM/PROJECT MANAGEMENT	<4>	______________
111.13	SYSTEM TEST & EVALUATION	<4>	______________
111.14	TRAINING	<4>	______________
111.15	DATA	<4>	______________
111.15.1	ENGINEERING	<5>	______________
111.15.2	MANAGEMENT	<5>	______________
111.15.3	LOGISTICS SUPPORT	<5>	______________
111.15.4	SOFTWARE SUPPORT	<5>	______________
111.16	INDUSTRIAL FACILITIES	<4>	______________
111.16.1	RDT&E	<5>	______________
111.16.2	MILCON	<5>	______________
111.17	SOFTWARE CENTER	<4>	______________
111.17.1	RDT&E	<5>	______________
111.17.2	MILCON	<5>	______________
111.18	OTHER	<4>	______________
111.18.1	RDT&E	<5>	______________
111.18.2	O&M	<5>	______________
111.18.3	OP	<5>	______________
111.18.4	PROC	<5>	______________

Entering data, except CER flags in levels 1-3, will cause the Model to skip to the next cost element with an equal or smaller level.

Type SAV to save data at any time.

FIGURE 9. R&D system level input worksheet

DEFENSE SYSTEM LIFE CYCLE COST MODEL
R&D COST INPUTS (PAGE 2 of 4)

DATE: ______________
SYSTEM: ______________

DEMONSTRATION&VALIDATION-GOVERNMENT

Cost Element	Description	Level	Value/Reference
112	GOVERNMENT	<3>	
112.12	PROGRAM MANAGEMENT	<4>	
112.12.1	PROGRAM MANAGEMENT MILITARY	<5>	
112.12.2	PROGRAM MANAGEMENT CIVILIAN	<5>	
112.12.3	PGM MGT CONTRACTOR SUPPORT	<5>	
112.13	GOVERNMENT TEST(DT/OT I)	<4>	
112.13.1	TEST SITE ACTIVATION	<5>	
112.13.2	DEVELOPMENT TEST I	<5>	
112.13.3	OPERATIONAL TEST I	<5>	
112.14	TRAINING	<4>	
112.15	FACILITIES	<4>	
112.15.1	RDT&E	<5>	
112.15.2	MILCON	<5>	
112.16	SOFTWARE CENTER	<4>	
112.16.1	RDT&E	<5>	
112.16.2	MILCON	<5>	
112.16.3	PROC	<5>	
112.17	OTHER	<4>	
112.17.1	RDT&E	<5>	
112.17.2	O&M	<5>	
112.17.3	OP	<5>	
112.17.4	PROC	<5>	

Entering data, except CER flags in levels 1-3, will cause the Model to skip to the next cost element with an equal or smaller level.

Type SAV to save data at any time.

FIGURE 9. R&D system level input worksheet - continued

DEFENSE SYSTEM LIFE CYCLE COST MODEL
R&D COST INPUTS (PAGE 3 of 4)

DATE: ____________
SYSTEM: ____________

FSD-CONTRACTOR

Cost Element	Description	Level	Value/Reference
120	FULL SCALE DEVELOPMENT	<2>	____
121	CONTRACTOR	<3>	____
121.12	SYSTEM/PROJECT MANAGEMENT	<4>	____
121.12.1	SYSTEM ENGINEERING	<5>	____
121.12.2	PROJECT MANAGEMENT	<5>	____
121.13	SYSTEM TEST & EVALUATION	<4>	____
121.13.1	MOCKUPS	<5>	____
121.13.2	TEST & EVALUATION SUPPORT	<5>	____
121.13.3	TEST FACILITIES	<5>	____
121.14	TRAINING	<4>	____
121.14.1	EQUIP	<5>	____
121.14.2	SERVICES	<5>	____
121.14.3	FACILITIES	<5>	____
121.14.3.1	RDT&E	<6>	____
121.14.3.2	MILCON	<6>	____
121.15	DATA	<4>	____
121.15.1	TECH ORDERS & MANUALS	<5>	____
121.15.2	ENGINEERING	<5>	____
121.15.3	MANAGEMENT	<5>	____
121.15.4	LOGISTICS SUPPORT	<5>	____
121.15.5	SOFTWARE SUPPORT	<5>	____
121.16	INDUSTRIAL FACILITIES	<4>	____
121.16.1	RDT&E	<5>	____
121.16.2	MILCON	<5>	____
121.16.3	PROCUREMENT	<5>	____
121.17	SOFTWARE CENTER	<4>	____
121.17.1	RDT&E	<5>	____
121.17.2	MILCON	<5>	____
121.17.3	PROCUREMENT	<5>	____
121.18	OTHER	<4>	____
121.18.1	RDT&E	<5>	____
121.18.2	O&M	<5>	____
121.18.3	OP	<5>	____
121.18.4	PROC	<5>	____

Entering data, except CER flags in levels 1-3, will cause the Model to skip to the next cost element with an equal or smaller level. Type SAV to save data at any time.

FIGURE 9. R&D system level input worksheet - continued

DEFENSE SYSTEM LIFE CYCLE COST MODEL
R&D COST INPUTS (PAGE 4 of 4)

DATE: ____________
SYSTEM: ____________

FSD-GOVERNMENT

Cost Element	Description	Level	Value/Reference
122	GOVERNMENT	<3>	____________
122.12	PROGRAM MANAGEMENT	<4>	____________
122.12.1	PROGRAM MANAGEMENT MILITARY	<5>	____________
122.12.2	PROGRAM MANAGEMENT CIVILIAN	<5>	____________
122.12.3	PGM MGT CONTRACTOR SUPPORT	<5>	____________
122.13	GVRNMNT TEST (DT/OT II)	<4>	____________
122.13.1	TEST SITE ACTIVATION	<5>	____________
122.13.2	DEVELOP TEST & EVAL (DT-II)	<5>	____________
122.13.3	OPRTNL TEST & EVAL (OT-II)	<5>	____________
122.13.3.1	RDT&E	<6>	____________
122.13.3.2	O&M	<6>	____________
122.13.3.3	PROC	<6>	____________
122.14	TRAINING	<4>	____________
122.15	FACILITIES	<4>	____________
122.15.1	RDT&E	<5>	____________
122.15.2	MILCON	<5>	____________
122.16	SOFTWARE CENTER	<4>	____________
122.16.1	RDT&E	<5>	____________
122.16.2	MILCON	<5>	____________
122.16.3	PROC	<5>	____________
122.17	OTHER	<4>	____________
122.17.1	RDT&E	<5>	____________
122.17.2	O&M	<5>	____________
122.17.3	OP	<5>	____________
122.17.4	PROC	<5>	____________

Entering data, except CER flags in levels 1-3, will cause the Model to skip to the next cost element with an equal or smaller level.

Type SAV to save data at any time.

FIGURE 9. R&D system level input worksheet - continued

100 RESEARCH AND DEVELOPMENT

This is the sum of all costs to the Government (contractor plus in-house Government costs) of products and services necessary to bring the materiel system from concept to serial production, regardless of how funded (O&M, R&D, MILCON, MILPER, OP). It includes costs for applied research, engineering, tooling, manufacturing (e.g., breadboards, prototype, flight vehicles, DT&E items and spares), purchased equipment, quality control, allowance for changes, general and administrative, and profit associated with the cost occurring during the Demonstration-Validation (Advanced Development), and Full Scale Development phases of the life cycle. Exclude Research (6.1) and Exploratory Development (6.2) funded activities.

USER NOTE: Costs should be entered at this level only if no detailed R&D costs are available. If a cost is entered for this element the Model will skip the balance of the R&D inputs and the cost will be treated as R&D funded.

Sums To: Total Life Cycle Cost

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 10. Research and development

110 DEMONSTRATION AND VALIDATION

These are all costs through Advanced Development from the time the system is designated a Program Element or a major project in a program element. It includes the costs associated with the developmental effort oriented toward demonstrating (i.e., through simulation modeling, advanced prototyping and testing of subsystems and components) the feasibility of the concept and technology, and a more formalized development effort directed toward validation through prototype development, simulation modeling of the concept and technological feasibility analysis of the candidate system(s) and its major components. This excludes Research (6.1) and Exploratory Development (6.2) funds.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for 111 and 112.

Sums To: 100 Research and Development.

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 11. Demonstration and Validation

111 DEMONSTRATION AND VALIDATION, CONTRACTOR

This is the cost of Demonstration and Validation efforts performed by a private business while under contract with the Government. It includes simulation modeling, applied research, engineering design, advanced prototyping, development testing, and program management activities related to testing concepts and demonstrating technological feasibility. This also includes any G&A, IR&D and fee not already accounted for in the WBS data base.

Sums To: 110 Demonstration and Validation

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 12. Demonstration and validation, contractor

111.12 SYSTEM/PROJECT MANAGEMENT

This is the contractor costs for systems engineering and technical control as well as business management of particular systems/projects expended during the Demonstration and Validation phase of R&D. This element encompasses planning, directing, and controlling the definition and development of a system/project including logistics support (maintenance support, facilities, personnel, training, supply support, spares planning and testing). System/project management effort that can be associated specifically with each hardware element is excluded, unless this management effort is of special contractual or engineering significance.

Sums To: 111 Demonstration and Validation, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 13. System/Project Management

111.13 SYSTEM TEST AND EVALUATION

This is the contractor cost of testing prototype or specially fabricated hardware to obtain or validate engineering data on the performance of the system during advanced development. This includes test planning, conduct, support data reduction, reports, and all hardware items which are consumed (or planned to be consumed) in the conduct of testing. It also includes all effort associated with the design, production and maintenance of models, specimens, fixtures, and instrumentation in support of the test program. Excluded are: test articles which are complete units (i.e., functionally configured as required by the mission equipment) as well as any development, component acceptance or other testing which can be specifically associated with the hardware element, unless these tests are of special contractual or engineering significance.

Sums To: 111 Demonstration and Validation, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 14. System test & evaluation

111.14 TRAINING

This is the cost incurred during advanced development to develop training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will acquire sufficient concepts, skills, and aptitudes to operate and maintain prototype systems. This element includes all effort associated with the design and development of training equipment as well as the execution of training services. This excludes prime mission equipment which should be costed under the appropriate WBS item.

Sums To: 111 Demonstration and Validation, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 15. Training

111.15 DATA

This is the cost of all deliverable data required to be listed on a DD Form 1423 "Contract Data Requirements List". Data requirements will be selected from DoD 5000.19-L, Volume II "Acquisition Management Systems and Data Requirements Control List." This element includes the cost of acquiring, writing, assembling, reproducing, packaging, and shipping the data. It also includes the cost of represaring into Government format, data items identical to those used by the contractor but in a different format. It does not include cost of efforts normally charged to G&A, overhead, other cost elements, or efforts completed under other contracts.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for its subelements.

Sums To: 111 Demonstration and Validation, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 16. Data

111.15.1 ENGINEERING DATA

This is the cost of engineering drawings, associated lists, specifications and other documentation required by the Government in accordance with Functional Categories E, H, R, S, and T of DoD 5000.19-L, Volume II. This element includes, for example, all plans, procedures, reports and documentation pertaining to the system, subsystems, component engineering, configuration management, tests, human factors, and systems analysis.

Sums To: 111.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 17. Engineering data

111.15.2 MANAGEMENT DATA

This is the cost of data items required for configuration management, cost, schedule, contractual data management, program management, etc., required by the Government in accordance with Functional Categories A, F, and P of DoD 5000.19-L, Volume II. This element includes, for example, contractor cost reports, cost performance reports, contractor funds status reports, project/program status reports, schedule, milestone, and networks.

Sums To: 111.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 18. Management data

111.15.3 LOGISTICS SUPPORT DATA

This is the cost of data items designed to document the logistics support planning and provisioning process in accordance with Functional Categories L and V of DoD 5000.19-L, Volume II. This element includes, for example, integrated logistics support plans, supply and general maintenance plans and reports, transportation handling, packaging information as well as data to support the provisioning process.

Sums To: 111.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 19. Logistics support data

111.15.4 SOFTWARE SUPPORT DATA

This is the cost of those data items required to develop a support capability for the computer software portion of the system. Included are software maintenance data program listings, progress reports, training planning data and troubleshooting procedures. Refer to the required documentation deliverable found on DD Form 1423.

Sums To: 111.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 20. Software support-data

111.16 INDUSTRIAL FACILITIES

This is the cost for the construction, conversion or expansion of industrial facilities including the acquisition of real estate for the demonstration and validation program of a particular system purchased by the contractor for the Government. This includes equipment acquisition, modernization, and maintenance.

USER NOTE: If only RDT&E funds are involved, enter costs for 111.16. If MILCON funds are involved, skip 111.16 and enter costs for RDT&E and MILCON.

Sums To: 111 Demonstration and Validation, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 21. Industrial facilities

111.17 SOFTWARE CENTER

This is the contractor costs incurred in establishing a software development center during Demonstration and Validation. The software center is a special purpose grouping of commercial, military (non GFE), and special test equipment and software. It is configured so as to operate as a software development laboratory and test center and as a flexible program preparation, validation, integration, and documentation center. The software center may evolve into the center used for follow-on software support.

USER NOTE: If only RDT&E funds are involved, enter costs for 111.17. If MILCON funds are involved, skip 111.17 and enter costs for RDT&E and MILCON.

Sums To: 111 Demonstration and Validation, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 22. Software Center

111.18 OTHER

This is a general purpose cost element to capture all other system level costs incurred by the contractor during advanced development which are not included in the aforementioned elements. Included are G&A, IR&D, fee and profit not included elsewhere. All costs should be carefully documented on this sheet.

USER NOTE: Other contractor costs may be funded with RDTE, O&M, other procurement and Procurement dollars. If a cost is entered for 111.18 the Model will assume RDTE dollars and skip the prompt for cost by appropriation.

Sums To: 111 Demonstration and Validation, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 23. Other

112 DEMONSTRATION AND VALIDATION, GOVERNMENT

This is the cost of the efforts performed by the Government and Government support contractors. It includes simulation modeling, applied research, design engineering, advanced prototyping, program management, development testing by in-house development centers and support contractors. It also includes all the requirements documentation actions performed prior to the FSD phase. Specifically excluded are Research (6.1) and Exploratory Development (6.2) funded activities.

Sums To: 110 Demonstration and Validation

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 24. Demonstration and validation, government

112.12 PROGRAM MANAGEMENT

These are the Government's costs associated with the technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the Demonstration and Validation phase of the equipment's 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. This includes costs for support contractors.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for its subelements.

Sums To: 112 Demonstration and Validation, Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 25. Program management

112.12.1 PROGRAM MANAGEMENT, MILITARY (G,D&V)

This is the cost for military personnel associated with the Government's program management effort during the Demonstration & Validation Phase. It includes pay and allowances, travel, per diem and any other costs associated with military personnel engaged in technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during Demonstration and Validation.

USER NOTE: Costs may be entered at this level as a gross amount. Military program management personnel may be entered through the Personnel Costing Module (PCM) using the PMDD level with appropriate grade and numbers. The PCM will employ the following cost formula to compute pay and allowances:

Pay and Allowances = Years of D&V (calculated)
* annual pay and allowances per pay grade
* number of personnel per pay grade

112.12.1 Program Management, Military = 112.12.1 + Pay and Allowances

Sums to: 112.12 Program Management (G,D&V)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 26. Program Management, military (G,D&V)

112.12.2 PROGRAM MANAGEMENT, CIVILIAN (G,D&V)

This is the cost for civilian personnel associated with the Government's program management effort during the Demonstration and Validation Phase. It includes pay and allowances, travel, per diem and any other costs associated with civilian personnel engaged in technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during Demonstration and Validation.

USER NOTE: Costs may be entered at this level as a gross amount. Civilian program management personnel may be entered through the Personnel Costing Module (PCM) using the PMPD level with appropriate grade and numbers. The PCM will employ the following cost formula to compute civilian pay:

Pay = Years of D&V (calculated)
 * annual pay and allowances per pay grade
 * number of personnel per pay grade

112.12.2 Program Management, Civilian = 112.12.2 + Pay

Sums to: 122.12 Program Management (G,D&V)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 27. Program Management, civilian (G,D&V)

112.12.3 PROGRAM MANAGEMENT, CONTRACTOR SUPPORT

This is the cost for nonprime mission equipment contractors who assist Government managers (military and civilian) in managing the Government's advanced development effort. It includes costs associated with technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during Demonstration and Validation. Examples of these activities are configuration management, cost/schedule management, data management, contract management, liaison, value engineering, quality assurance, and integrated logistic support management. Support contractor costs directly attributable to testing are excluded.

Sums To: 112.12 Program Management

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 28. Program management, contractor support

112.13 GOVERNMENT TEST (DT/OT I)

This is the sum of Government costs for system test and evaluation activities conducted during Demonstration and Validation (DT/OT I). Included are personnel costs (per diem); system costs (storage, government modifications and refurbishment of test items & components, handling); rental or recording and other equipment not part of the test site; and expendables. These are R&D funded. Ammunition which is not the R&D item may be purchased with procurement funds. Separately identified O&M funds may be required to support operational testing if such testing cannot be accomplished within the scope of normal unit training. This also includes any costs for support contractors involved in test planning, data collection and data analysis. All costs directly attributable to the development contractor are excluded. Costs to train (including per diem) initial test crews and maintenance personnel are also excluded (see 112.14 Training).

USER NOTE: An entry at this level will cause the Model to skip the subelements 112.13.1-112.13.3.

Sums To: 112 Demonstration and Validation, Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 29. Government test (DT/OT I)

112.13.1 TEST SITE ACTIVATION

This is the sum of the costs incurred during the preparation of a test site for Government conducted testing. It includes the cost of transporting the equipment and testing personnel to the test site, rental and installation of special range equipment, and any other direct labor or material charges associated with preparing the test site.

Sums To: 112.13 Government Test (DT/OT I)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 30. Test site activation

112.13.2 DEVELOPMENT TEST I

This is the Government cost for developmental tests to demonstrate that the engineering design is feasible and that risks have been minimized; demonstrate that the system will meet military specifications; and estimate the system's military suitability when introduced. Compatibility and interoperability with existing or planned systems and equipments shall be tested to the extent practical at this stage of development. This includes support contractor costs for planning, data collection and analysis, travel and per diem of government test personnel, storage, handling and government refurbishment of hardware, GFE maintenance, rental of special recording and test equipment and consumables. It excludes training of crew/maintenance personnel.

Sums To: 112.13 Government Test

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 31. Development test I

112.13.3 OPERATIONAL TEST (OT I)

This is the Government cost for operational tests during the Demonstration and Validation Phase to assess the man-machine interface in an operating environment as well as to determine the system's operational effectiveness and suitability (including compatibility, interoperability, reliability, maintainability, logistic and training requirements). This is also a test of Service doctrine, tactics, organization and personnel requirements (including skill levels). This includes support contractor costs for test planning, data collection and analysis, travel and per diem of Government test personnel, transportation, storage, handling and Government refurbishment of hardware, GFE maintenance, rental of special recording and test equipment not part of the test facility and consumables. Excluded are military pay and allowances, and training costs of crew/maintenance personnel.

Sums To: 112.13 Government Test

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 32. Operational test (OT I)

112.14 TRAINING

This is the Government cost to develop services, devices, accessories, aids, equipment, facilities and parts used to facilitate instruction. It includes the cost of Government and Government support contractor efforts associated with the design and development of prototype training equipment and the execution of training services. It includes costs of training initial service test crews and maintenance personnel involved in DT/OT I.

Sums To: 112 Demonstration and Validation, Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 33. Training

112.15 FACILITIES

This is the Government cost of any new building, conversion or expansion of existing facilities, and the acquisition of real estate for development and testing of the system.

USER NOTE: Facilities may be funded with RDT&E and MILCON dollars. If a cost is entered for 112.15, the Model will assume RDT&E dollars and skip the prompt for input by budget category.

Sums To: 112 Demonstration and Validation. Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 34. Facilities

112.16 SOFTWARE CENTER

This is the Government costs incurred in establishing a software development center for the Demonstration and Validation phase. The software center is a special purpose grouping of GFE data processing and test equipment and software. It is configured so as to operate as a software development laboratory and test center and as a flexible program preparation, validation, integration, and documentation center. The software center, may evolve into the center used for follow-on software support.

USER NOTE: The software center cost may be funded with RDT&E, MILCON and Procurement dollars. If a cost is entered for 112.16, the Model will assume RDT&E dollars and skip the inputs by appropriation.

Sums To: 112 Demonstration and Validation. Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 35. Software center

112.17 OTHER

This is a general cost category for any other system level costs incurred by the Government during advanced development which are not included in the preceding elements.

USER NOTE: Other Government costs may be funded with RDT&E, O&M, other procurement and procurement dollars. *If a cost is entered for* 112.17, the Model will assume RDT&E dollars and skip the prompt by appropriation.

Sums To: 112 Demonstration and Validation. Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 36. OTHER

120 FULL-SCALE DEVELOPMENT (FSD)

This is the total contractor and Government costs for FSD. FSD is that portion of the R&D phase in which a design concept, having been proven in theory is engineered, fabricated and tested to determine if technology is ready to produce the selected system, that the system satisfies service requirements and that the system is affordable. It typically includes program management, engineering, fabrication, training, testing, and associated documentation.

USER NOTE: If a cost is entered at this level, the Model will not prompt for its subelements and treat the cost as R&D only.

Sums To: 100 Research and Development

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 37. Full-scale development (FSD)

121 FULL-SCALE DEVELOPMENT, CONTRACTOR

This is the sum of all FSD costs incurred by a private business while under contract with the Government. It includes all effort associated with the development of complete WBS items (development engineering, producibility engineering, tooling and prototype manufacturing) as well as system/project management, system test and evaluation, training, data and industrial facilities. This also includes any G&A, IR&D and fee not accounted for in the WBS data base. It excludes costs for Government support contractors who should be accounted for under the appropriate Government cost category.

USER NOTE: The development costs for contractor developed WBS items are calculated from the WBS data base. If a cost is entered at this level, the Model will skip the inputs for its subelements.

Sums To: 120 Full-Scale Development

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 38. Full-scale development, contractor

121.12 SYSTEM/PROJECT MANAGEMENT

This is the contractor costs for systems engineering and technical control as well as business management of particular systems/projects expended during the Full Scale Development phase of R&D. This element encompasses planning, directing, and controlling the definition and development of a system/project including logistics support (maintenance support, facilities, personnel, training, supply support, spares planning and testing). System/project management effort that can be associated specifically with each hardware element is excluded, unless this management effort is of special contractual or engineering significance.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for 121.12.1 and 121.12.2

Sums To: 121 Full Scale Development, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 39. System/Project Management

121.12.1 SYSTEM ENGINEERING

This is the contractor cost for technical and management efforts of directing and controlling the integrated engineering efforts of a program. This element encompasses the system's engineering effort to define the system and the integrated planning and control of the technical program efforts of design engineering, logistics engineering, specialty engineering, and integrated test planning. It includes, but is not limited to, system engineering to transform an operational need or statement of deficiency into a description of system requirements and a preferred system configuration; logistics engineering to define, optimize, and integrate logistics support considerations into the mainstream effort to ensure development of a supportable and cost-effective weapon system; and technical planning and control for planning, monitoring, measuring, evaluating, and directing of the technical program. It excludes design engineering directly related to products or services of deliverable end items. Examples of system engineering include:

(1) System definition, overall system design, design integrity analysis, intrasystem and intersystem compatibility assurance; integration and balancing of reliability, maintainability, producibility, safety, and survivability; human factors, personnel, and training program requirements; security requirements; configuration identification and control; quality assurance program; value engineering; preparation of equipment and component performance specifications; and design of test and demonstration plans.

(2) Support synthesis, design impact projections, life cycle cost factors, time factors, trade-off analysis, logistics design appraisal, use studies, support function requirements identification, repair level determination, task analysis, standardization review, logistics requirements identification, logistics support verification, and preparation and updating of logistics support plans, maintenance plans, facilities planning (operational and maintenance) and transportation and handling plans.

(3) Preparation of the system's engineering management plan, specification tree, program risk analysis, system test planning; decision control process, technical performance measurement, technical reviews, subcontractor/vendor reviews, work authorization and technical documentation control.

Sums To: 121.12 System/Project Management

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 40. System/Engineering

121.12.2 PROJECT MANAGEMENT

This is the cost of business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall project objectives which are not associated with specific hardware elements and are not included in system engineering. Examples of these activities are in-house logistics management, cost/schedule/performance management, contract management, data management, vendor liaison and contract WBS.

Sums To: 121.12 System/Project Management

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 41. Project management

121.13 SYSTEM TEST AND EVALUATION

This is the cost of testing prototype or specially fabricated hardware to obtain or validate engineering data on the performance of the system. This includes test planning, conduct, support, data reduction, reports, and all hardware items which are consumed (or planned to be consumed) in the conduct of testing. It also includes all effort associated with the design, production and maintenance of models, specimens, fixtures, and instrumentation in support of the test program. Excluded are: test articles which are complete units (i.e., functionally configured as required by the mission equipment) as well as any development, component acceptance or other testing which can be specifically associated with the hardware element, unless these tests are of special contractual or engineering significance.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for its subelements.

Sums To: 121 FSD, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 42. System test & evaluation

121.13.1 MOCKUPS

This is the cost for the design engineering and production of system or subsystem mockups which have special contractual or engineering significance, or which are not required solely for the conduct of Development Test II/Operational Test II. This excludes mockups made for marketing purposes which are paid for with G&A funds.

Sums To: 121.13 System Test and Evaluation

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 43. Mockups

121.13.2 TEST AND EVALUATION SUPPORT

This is the cost of all contractor support necessary to operate and maintain systems and subsystems during the test and evaluation phase that are not consumed during a particular element of testing. This element includes spares, repair of failed components, repair parts, and contractor technical support, operator and maintenance personnel, consumables, special fixtures, special instrumentation, etc., which are utilized or consumed in DT/OT II.

Sums To: 121.13 System Test and Evaluation

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 44. Test & evaluation support

121.13.3 TEST FACILITIES

This is the cost of special test facilities required for performance of the various developmental tests necessary to prove the design and reliability of the system or subsystem. This element includes, for example, white rooms, test chambers, etc. The brick-and-mortar-type facilities allocable to industrial facilities are excluded.

Sums To: 121.13 System Test & Evaluation

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 45. Test facilities

121.14 TRAINING

This is the cost to develop training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will acquire sufficient concepts, skills, and aptitudes to operate and maintain the system with maximum efficiency. This element includes all effort associated with the design and development of training equipment as well as associated training services. It excludes training equipment costed in the WBS data base.

USER NOTE: If a cost is input at this level, the Model will skip the prompts for its subelements.

Sums To: 121 FSD, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 46. Training

121.14.1 TRAINING EQUIPMENT

This is the cost to develop distinctive end items of training equipment required to meet specific training objectives. This element includes, for example, operational trainers (i.e., simulators), maintenance trainers (i.e., maintenance training units), and other items such as cutaways, mock-ups, and models. This excludes prime mission equipment which should be costed under the appropriate WBS items.

Sums To: 121.14 Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 47. Training equipment

121.14.2 TRAINING SERVICES

This is the cost to develop services, devices, accessories, and aids necessary to accomplish the objectives of training. This element includes, for example, training plans, training aids, training course materials, and contractor-conducted training (including both in-plant and service training) for testing.

Sums To: 121.14 Training

Comments/Calculations

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 48. Training services

121.14.3 TRAINING FACILITIES

This is the cost of special construction necessary to accomplish the objectives of training (primarily, the brick-and-mortar-type facility constructed solely for the training mission). The equipment used for the purpose of acquainting the trainee with the system or establishing trainee proficiency is excluded. This would not be a normal element during the R&D phase.

USER NOTE: Facilities costs may be funded with RDT&E and/or MILCON dollars. If a cost is entered for 121.14.3 the Model will assume RDT&E dollars and skip the prompt for costs by appropriation.

Sums To: 121.14 Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 49. Training facilities

121.15 DATA

This is the cost of all deliverable data required to be listed on a DD Form 1423 "Contract Data Requirements List". Data requirements will be selected from DoD 5000.19-L, Volume II "Acquisition Management Systems and Data Requirements Control List." This element includes the cost of acquiring, writing, assembling, reproducing, packaging, and shipping the data. It also includes the cost of repreparing into Government format, data items identical to those used by the contractor but in a different format. It does not include cost of efforts normally charged to G&A, overhead, other cost elements, or efforts completed under other contracts.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for its subelements.

Sums To: 121 FSD Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 50. Data

121.15.1 TECHNICAL ORDERS AND MANUALS

This is the cost to develop or acquire rights to formal technical orders/manuals, commercial, advance, real property installed equipment manuals, and miscellaneous manuals for the installation, operation, maintenance, overhaul, training and reference of hardware, hardware systems, and computer programs; and contractor instructional materials, inspection documentation, and historical type records which may accompany individual items of equipment. This element includes the data item descriptions set forth in Functional Category M of DoD 5000.19-L, Volume II.

Sums To: 121.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 51. Technical orders and manuals

121.15.2 ENGINEERING DATA

This is the cost of engineering drawings, associated lists, specifications and other documentation required by the Government in accordance with Functional Categories E, H, R, S, and T of DoD 5000.19-L, Volume II. This element includes, for example, drawings, specifications, procedures, reports and documentation pertaining to the system, subsystems, component engineering, testing human factors, and systems analysis.

Sums To: 121.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 52. Engineering data

121.15.3 MANAGEMENT DATA

This is the cost of the data items required for the cost, schedule, contractual and project/programs data management required by the Government in accordance with Functional Categories A, F, and P of DoD 5000.19-L, Volume II. This element includes, for example, contractor cost reports, cost performance reports, contractor funds status reports, project/program status reports,schedules, milestones, and networks.

Sums To: 121.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 53. Management data

121.15.4 LOGISTICS SUPPORT DATA

This is the cost of data items designed to document the logistics support planning and provisioning process in accordance with Functional Categories L and V of DoD 5000.19-L, Volume II. This element includes, for example, integrated logistics support plans, supply and general maintenance plans and reports, transportation, handling, packaging information, interservice materiel support, as well as data to support the provisioning process.

Sums To: 121.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 54. Logistics support data

121.15.5 SOFTWARE SUPPORT DATA

This is the cost of those data items required to develop a support capability for the computer software portion of the system. Included are software maintenance data program listings, progress reports, training planning data and troubleshooting procedures. Refer to the required documentation deliverables found on DD Form 1423.

Sums To: 121.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 55. Software support data

121.16 INDUSTRIAL FACILITIES

This is the cost for the construction, conversion or expansion of industrial facilities including the acquisition of real estate for the FSD program of a particular system purchased by the contractor for the Government. This includes equipment acquisition, modernization, and maintenance.

USER NOTE: If only RDT&E funds are involved, enter costs for 121.16. If MILCON funds are involved, skip 121.16 and enter costs for RDT&E, MILCON or Procurement, as appropriate.

Sums to 121 FSD, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 56. Industrial facilities

121.17 SOFTWARE CENTER

This is the contractor costs incurred in establishing a software development center. The software center is a special purpose grouping of commercial, military (non GFE), and special test equipment and software. It is configured so as to operate as a software development laboratory and test center and as a flexible program preparation, validation, integration, and documentation center. The FSD software center, if any, may evolve into the center used for follow-on software support.

Sums To: 121 FSD, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 57. Software center

121.18 OTHER

This is a general purpose cost element to capture all other costs by the contractor during full-scale development which are not included in the aforementioned elements. Included are G and A, fee and profit if not included elsewhere. All costs which are entered here should be carefully documented as to use on this sheet.

USER NOTE: Other contractor FSD costs may be funded with RDTE, O&M, other procurement and/or procurement dollars. If a cost is entered for 121.18, the Model will assume RDTE dollars and skip the prompt for cost by appropriation.

Sums To: 121 FSD, Contractor

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 58. Other

122 FULL SCALE DEVELOPMENT, GOVERNMENT

This is the sum of all nonrecurring in-house Government costs incurred during FSD. It includes the calculated nonrecurring GFE costs (R&D GFE QTY * Unit production cost) from the WBS item data base as well as test site activation, Government test (DT/OT II), program management, training, and facilities costs.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for its subelements. For a more inclusive definition of this element, see the definitions of its subelements.

Sums To: 120 FSD

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 59. Full scale development, government

122.12 PROGRAM MANAGEMENT

These are the Government's costs associated with the technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the FSD phase of the equipment's 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. This includes costs for support contractors.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for its subelements.

Sums To: 122 FSD, Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 60. Program management

122.12.1 PROGRAM MANAGEMENT, MILITARY (G.FSD)

This is the cost for military personnel associated with the Government's program management effort during Full Scale Development. It includes pay and allowances, travel, per diem and any other costs associated with military personnel engaged in technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the FSD phase.

USER NOTE: Costs may be entered at this level as a gross amount. Military program management personnel may be entered through the Personnel Costing Module (PCM) using the PMFD level with appropriate grade and numbers. The PCM will employ the following cost formula to compute pay and allowances:

Pay and Allowances = Years of FSD (calculated)
* annual pay and allowances per pay grade
* number of personnel per pay grade

122.12.1 Program Management, Military = 122.12.1 + Pay and Allowances

Sums to: 122.12 Program Management (G,FSD)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 61. Program management, military (G,SFD)

122.12.2 PROGRAM MANAGEMENT, CIVILIAN (G, FSD)

This is the cost for civilian personnel associated with the Government's program management effort during Full Scale Development. It includes pay and allowances, travel, per diem and any other costs associated with civilian personnel engaged in technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the FSD phase.

USER NOTE: Costs may be entered at this level as a gross amount. Civilian program management personnel may be entered through the Personnel Costing Module (PCM) using the PMPD level with appropriate grade and numbers. The PCM will employ the following cost formula to compute civilian pay:

Pay = Years of FSD (calculated)
  * annual pay and allowances per pay grade
  * number of personnel per pay grade

122.12.2 Program Management, Civilian = 122.12.2 + Pay

Sums to: 122.12 Program Management (G,FSD)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 62. Program management, civilian (G, FSD)

122.12.3 PROGRAM MANAGEMENT, CONTRACTOR SUPPORT

This is the cost for nonprime mission equipment contractors who assist Government managers (military or civilian) in managing the Government's FSD effort. It includes costs associated with technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during FSD. Examples of these activities are configuration management, cost/schedule management, data management, contract management, liaison, value engineering, quality assurance, and integrated logistic support management. Support contractor costs directly attributable to testing are excluded.

Sums To: 122.12 Program Management

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 63. Program management, contractor support

122.13 GOVERNMENT TEST (DT/OT II)

This is the sum of Government costs for system test and evaluation activities conducted during Full Scale Development (DT/OT II). It includes: personnel costs (per diem); system costs (storage, government modifications and refurbishment of test items & components, handling); rental of recording and other equipment not part of the test site; and expendables. These are R&D funded. Ammunition which is not the R&D item may be purchased with procurement funds. Separately identified O&M funds may be required to support operational testing if such testing cannot be accomplished within the scope of normal unit training. This also includes any costs for support contractors involved in test planning, data collection and data analysis. All costs directly attributable to the development contractor are excluded. Costs to train (including per diem) initial test crews and maintenance personnel are also excluded (see 122.14 Training).

USER NOTE: An entry at this level will cause the Model to skip the subelements 122.13.1-122.13.3.

Sums To: 122 FSD, Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 64. Government test (DT/OT II)

122.13.1 TEST SITE ACTIVATION

This is the sum of the costs incurred during the preparation of a test site for Government conducted testing. It includes the cost of transporting the equipment and testing personnel to the test site, rental and installation of special range equipment, and any direct labor or material charges associated with preparing the test site.

Sums To: 122.13 Government Test (DT/OT II)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 65. Test site activation

122.13.2 DEVELOPMENT TEST II

This is the Government cost for developmental tests to demonstrate that engineering is reasonably complete, that all significant design problems which affect compatibility, interoperability, reliability, maintainability and logistical considerations have been identified and that solutions have been developed. This includes support contractor costs for planning, data collection and analysis, travel and per diem of Government test personnel, storage, handling and Government refurbishment of hardware, GFE maintenance, rental of special recording and test equipment and consumables. It excludes training of crew/maintenance personnel.

Sums To: 122.13 Government Test

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 66. Development test-II

122.13.3 OPERATIONAL TEST & EVALUATION (OT II)

This is the sum of all Government costs for Operational Testing during Full Scale Development to estimate the prospective system's operational effectiveness and operational suitability (including compatibility, interoperability, reliability, maintainability and logistic and training requirements). In addition, OT&E provides information on Service doctrine, tactics, organization, and personnel requirements including skills. It may also provide data to support or verify operating instructions, publications and handbooks. This includes costs of support contractors to develop test support packages (threat concept of employment) test plans, data collection and analysis, travel and per diem of Government test personnel, transportation, storage, handling and Government refurbishment of hardware, GFE maintenance, rental of recording or test equipment not part of the test site, and consumables. Excluded are military pay and allowances and training costs for crews/maintenance personnel.

USER NOTE: If a cost is entered for 122.13.3, the Model will assume RDTE dollars and skip the input by appropriation.

Sums To: 122.13 Government Test (DT/OT II)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 67. Operational test & evaluation (OT II)

122.14 TRAINING

This is the Government cost to develop services, devices, accessories, aids, equipment, facilities and parts used to facilitate instruction. It includes the cost of Government and Government support contractor efforts associated with the design and development of prototype training equipment and the execution of training services. It includes costs of training initial service test crews and maintenance personnel involved in DT/OT II.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for 122.14.1 and 122.14.2

Sums To: 122 FSD. Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 68. Training

122.15 FACILITIES

This is the Government cost of any new building, conversion or expansion of existing facilities, and the acquisition of real estate for development and testing of the system.

USER NOTE: Facilities may be funded with RDTE and MILCON dollars. If a cost is entered for 122.15, the Model will assume RDTE dollars and skip the prompt for input by budget category.

Sums To: 122 FSD. Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 69. Facilities

122.16 SOFTWARE CENTER

This is the Government costs incurred in establishing a software development center during FSD. The software center is a special purpose grouping of data processing and test equipment and software. It is configured so as to operate as a software development laboratory and test center and as a flexible program preparation, validation, integration, and documentation center. The FDS software center, if any, may evolve into the center used for follow-on software support.

Sums To: 122 FSD, Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 70. Software center

122.17 OTHER (G, N-R)

This is a general costs category for any other cost incurred by the Government during full-scale development which is not included in the preceding elements.

USER NOTE: Other Government costs may be funded with RDTE, O&M, other procurement and procurement dollars. If a cost is entered for 122.17, the Model will assume RDTE dollars and skip the prompt by appropriation.

Sums To: 122 FSD. Government

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 71. Other (G, N-R)

5.3 Production (investment)system level worksheets. System level production cost elements include all contract and Government in-house costs. These are the costs for those activities not directly attributable to individual hardware and software items required to transform the R&D product into an operational system. Included are program management, systems engineering, system test and evaluation, training, technical data, and facilities costs. System level cost elements documented in this section also exclude the costs to produec the hardware and software items themselves. Costs which can be attributed to hardware or software configuration items are computed on the basis of inputs to the WBS data base as explained in 5.7.4 and 5.7.5.

5.3.1 System production worksheets. Summary worksheets for entering costs are contained in Figure 72. Figures 73-128 are data collection worksheets for each of the production system level cost elements. These worksheets define each cost element and provide a structure for documenting the development of each cost estimate. Backup pages, in formats developed by the analyst, detailing the development of variables used to arrive at an estimate should be attached to the cost element worksheet.

5.3.2 Level of detail. The analyst may enter costs at any level in the following worksheets suitable to the availability of data and the detail required by the program decision environment. An entry at any level in the cost structure (including a zero) will cause the Model to skip to the next entry with an equal or lesser numbered level. For example, an entry for 212.12 Program Management which is a level 4 cost element, would cause the Model to skip the entries for 212.12.1 through 212.12.3 and ask for data for 212.13 Government Test which is also a level 4 entry.

5.3.3. Selecting cost elements. The cost element structure in Figure 72 is intended to be a checklist for each acquistion program. Not all cost elements apply to any one program. The selection of cost elements for each program and the level of detail appropriate for each estimate depends upon current Service policy, the program manager's decision requirements and the data and estimating techniques available to the analyst at the time of the estimate.

5.3.4 CER flags. Entering a 1 for any first, second or third level cost element will cause the Model to compute costs for level and level 5 entries which are less than one as percentages of the calculated cost for the element with the 1. Results of calculations for WBS records are included in the cost calculation. For instance, if a 1 were entered for 211 Contractor nonrecurring production costs, and .25 entered for 211.15 Data, the Model would calculate an interim value for 211, divide that value by (1-.25) to arrive at a final cost for 211 and then allocate 25% of that cost to 211.15 Data.

DEFENSE SYSTEM LIFE CYCLE COST MODEL
PRODUCTION INPUTS (PAGE 1 of 4)

DATE: ______________
SYSTEM: ______________

CONTRACTOR-NONRECURRING

Cost Element	Description	Level	Value/Reference
200	PRODUCTION	<1>	______
210	PRODUCTION (NON-RECURRING)	<2>	______
211	CONTRACTOR	<3>	______
211.12	SYSTEM/PROJECT MANAGEMENT	<4>	______
211.12.1	SYSTEM ENGINEERING	<5>	______
211.12.2	PROJECT MANAGEMENT	<5>	______
211.13	TRAINING	<4>	______
211.13.1	EQUIPMENT	<5>	______
211.13.2	SERVICES	<5>	______
211.13.3	FACILITIES	<5>	______
211.13.3.1	PROC	<6>	______
211.13.3.2	MILCON	<6>	______
211.14	PRODUCTION STARTUP	<4>	______
211.14.1	TOOLING	<5>	______
211.14.2	PRODUCTION ENGINEERING	<5>	______
211.14.3	FACILITIES	<5>	______
211.14.3.1	PROC	<6>	______
211.14.3.2	MILCON	<6>	______
211.15	DATA	<4>	______
211.15.1	TECH ORDERS & MANUALS	<5>	______
211.15.2	ENGINEERING	<5>	______
211.15.3	MANAGEMENT	<5>	______
211.15.4	SUPPORT	<5>	______
211.15.5	SOFTWARE SUPPORT	<5>	______
211.16	INITIAL SPARES & REPAIR PARTS	<4>	______
211.17	SYSTEM TEST & EVAL SUPT	<4>	______
211.18	SOFTWARE CENTER	<4>	______
211.19	CONTRACTOR TECH SUPPORT	<4>	______
211.20	OTHER	<4>	______
211.20.1	PROC	<5>	______
211.20.2	RDT&E	<5>	______
211.20.3	O&M	<5>	______

Entering data, except for CER flags in levels 1-3, will cause the model to skip to the next cost element with an equal or smaller level.

Type SAV to save data entered at any time.

FIGURE 72. Production system level input worksheet

DEFENSE SYSTEM LIFE CYCLE COST MODEL
PRODUCTION INPUTS (PAGE 2 of 4)

DATE: ____________________
SYSTEM: ____________________

GOVERNMENT NON-RECURRING

Cost Element	Description	Level	Value/Reference
212.	GOVERNMENT	<2>	____________________
212.12	INITIAL TRAINING	<4>	____________________
212.12.1	EQUIPMENT	<5>	____________________
212.12.2	SERVICES	<5>	____________________
212.12.3	FACILITIES	<5>	____________________
212.12.3.1	MILCON	<6>	____________________
212.12.3.2	O&M	<6>	____________________
212.12.4	STUDENT COSTS	<5>	____________________
212.13	SYSTEM TEST & EVALUATION	<4>	____________________
212.13.1	PROD ACCPT TEST&EVAL(PATE)	<5>	____________________
212.13.1.1	PROC	<6>	____________________
212.13.1.2	OP	<6>	____________________
212.13.1.3	MP	<6>	____________________
212.13.2	OPRTNL TEST & EVAL(OT&E)	<5>	____________________
212.13.2.1	PROC	<6>	____________________
212.13.2.2	OP	<6>	____________________
212.13.2.3	MP	<6>	____________________
212.14	TEST SITE ACTIVATION	<4>	____________________
212.15	TECH ORDERS AND MANUALS	<4>	____________________
212.16	SOFTWARE CENTER	<4>	____________________
212.17	INVENTORY MANAGEMENT	<4>	____________________
212.18	INDUSTRIAL FACILITIES	<4>	____________________
212.18.1	CONST/CONVERT/EXPAND	<5>	____________________
212.18.1.1	PROC	<6>	____________________
212.18.1.2	MILCON	<6>	____________________
212.18.2	EQUIP ACQUISITION & MODERNIZATION	<5>	____________________
212.19	OTHER	<4>	____________________
212.19.1	PROC	<5>	____________________
212.19.2	O&M	<5>	____________________
212.19.3	OP	<5>	____________________

Entering data, except for CER flags in levels 1-3, will cause the model to skip to the next cost element with an equal or smaller level.

Type SAV to save data entered at any time.

FIGURE 72. Production system level input worksheet-continued

DEFENSE SYSTEM LIFE CYCLE COST MODEL DATE: ____________
PRODUCTION COST INPUTS (PAGE 3 of 4) SYSTEM: ____________

CONTRACTOR-RECURRING

Cost Element	Description	Level	Value/Reference
220	PRODUCTION(RECURRING)	<2>	____________
221.	CONTRACTOR	<3>	____________
221.12	PROGRAM MANAGEMENT	<4>	____________
221.12.1	SYSTEM ENGINEERING	<5>	____________
221.12.2	PROJECT MANAGEMENT	<5>	____________
221.13	INITIAL TRAINING	<4>	____________
221.14	DATA DEPOSITORY(PROD)	<4>	____________
221.15	MAINTENANCE INDUSTRIAL FCLTYS	<4>	____________
221.16	ENGINEERING CHANGES	<4>	____________
221.17	DATA	<4>	____________
221.18	INITIAL SPARES/REPAIR PARTS	<4>	____________
221.19	SYSTEM TEST & EVAL SUPPORT	<4>	____________
221.20	TRANSPORTATION	<4>	____________
221.21	OTHER	<4>	____________
221.21.1	PROC	<5>	____________
221.21.2	O&M	<5>	____________
221.21.3	OP	<5>	____________

Entering data, except for CER flags in levels 1-3, will cause the model to skip to the next cost element with an equal or smaller level.

Type SAV to save data entered at any time.

FIGURE 72. Production system level input worksheet-continued

DEFENSE SYSTEM LIFE CYCLE COST MODEL
PRODUCTION COST INPUTS (PAGE 4 of 4)

DATE: ____________________
SYSTEM: ____________________

GOVERNMENT-RECURRING

Cost Element	Description	Level	Value/Reference
222.	GOVERNMENT(RECURRING)	<3>	
222.12	PROGRAM MANAGEMENT	<4>	
222.12.1	PROGRAM MANAGEMENT MILITARY	<5>	
222.12.2	PROGRAM MANAGEMENT CIVILIAN	<5>	
222.12.3	CONTRACTOR SUPPORT	<5>	
222.13	TRANSPORTATION	<4>	
222.14	OPERATIONAL SITE ACTIVATION	<4>	
222.14.1	PROC	<5>	
222.14.2	MILCON	<5>	
222.14.3	MILPER	<5>	
222.14.4	O&M	<5>	
222.15	QUALITY CONTROL & INSPECTION	<4>	
222.15.1	PROC	<5>	
222.15.2	O&M	<5>	
222.15.3	MILPER	<5>	
222.16	SUPPORT ENGINEERING	<4>	
222.17	INITIAL TRAINING	<4>	
222.17.1	NEW EQUIP TRAIN TEAMS	<5>	
222.17.1.1	MILPER	<6>	
222.17.1.2	O&M	<6>	
222.17.2	INITIAL OPER TRAINING	<5>	
222.18	SYSTEM TEST&EVAL(DT/OTIII)	<4>	
222.18.1	PROC	<5>	
222.18.2	O&M	<5>	
222.18.3	MILPER	<5>	
222.19	INITIAL SPARES & REPAIR PARTS	<4>	
222.20	OTHER	<4>	
222.20.1	PROC	<5>	
222.20.2	O&M	<5>	
222.20.3	OP	<5>	

Entering data, except for CER flags in levels 1-3, will cause the model to skip to the next cost element with an equal or smaller level.

Type SAV to save data entered at any time.

FIGURE 72. Production system level input worksheet-continued

200 PRODUCTION

This is the sum of all costs to the Government, contractor plus in-house Government costs, resulting from the production and introduction of a materiel system into an operational inventory. Included are all nonrecurring and recurring engineering and engineering support to production, initial-rate-sustaining tooling, manufacturing, purchased equipment, quality control, allowance for changes. warranties. first destination transportation (when applicable), general and administrative, and profit associated with the cost occurring during the procurement phase of the life cycle.

USER NOTE: Costs should be entered at this level only if no detailed costs are available for the production phase. If a value is entered here, the Model will skip the balance of production inputs.

Sums To: Total Life Cycle Cost

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 73. Production

210 PRODUCTION (NONRECURRING)

These are the nonrecurring program costs required beyond the development phase to introduce into operational use a new capability; to procure initial, additional or replacement equipment for operational forces; or to provide for major modifications of an existing capability. Non-recurring costs refer to production costs which are one-time costs incurred during the production phase. But these costs can recur if there is a change in the design, contractor, or manufacturing process.

USER NOTE: If a cost is input for this element, the Model will skip all input to 220 Production recurring.
Sums To: 200 Production

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 74. Production (non-recurring)

211 CONTRACTOR (Nonrecurring)

These are the nonrecurring production costs incurred by a private business while under contract with the Government. Included are the necessary engineering and capitalization (plant facilities, tools, test equipment) costs to achieve initially the total production capability for the materiel system. It includes all nonrecurring contractor costs associated with manufacturing the hardware. This excludes support contractors who assist the Government in system acquisition management and planning. The Government support contractors should be costed under the appropriate Government cost element.

USER NOTE: If a cost is input at this level, the Model will skip inputs to 212.1 Government (N-R).

Sums To: 210 Production (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 75. Contractor (nonrecurring)

211.12 SYSTEM/PROJECT MANAGEMENT (C, N-R)

System/project management refers to systems engineering and technical control as well as business management of particular systems/ projects. This element encompasses nonrecurring costs associated with planning, directing, and controlling production of a system/project, including the functions of logistics and logistics support, maintenance support, facilities, personnel and training, testing, and activation of a system. System/project management efforts which can be associated specifically with hardware elements is excluded, unless this effort is of special contractual or engineering significance, e.g., associate contractor.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for 211.12.1 and 211.12.2.

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 76. System/project management (C, N-R)

211.12.1 SYSTEM ENGINEERING (C, N-R)

This is the cost of the technical and management efforts of directing and controlling totally integrated engineering efforts of a program. This element encompasses integrated planning and control of the technical program efforts of production engineering, logistics engineering, specialty engineering, and integrated test planning. This element includes, but is not limited to, the logistics support consideration into the mainstream engineering effort to ensure the production of a supportable and cost effective weapon system; and the technical planning and control effort for planning, monitoring, measuring, evaluating, directing, and replanning the management of the technical program. It excludes production engineering directly related to products or services of the deliverable end item. Examples of system engineering include:

(1) Integration and balancing of reliability, maintainability, producibility, safety, and survivability; human factors, personnel, and training program requirements; security requirements; configuration identification and control; quality assurance program; value engineering; preparing of equipment and component performance specifications; and design of test and demonstration plans.

(2) Support synthesis, life cycle cost factors, time factors, trade-off analysis, logistics appraisal, use studies, support function requirements identification, repair level determination, task analysis, standardization review, logistics requirements identification, logistics support verification, and the preparation and updating of the logistics support plan, the maintenance plan, facilities planning (operational and maintenance), the transportation and handling plan.

(3) Preparation of the systems engineering management plan, specification tree, program risk analysis, system test planning, decision control process, technical performance measurement, technical reviews, subcontractor/vendor reviews, work authorization, technical documentation control.

Sums To: 211.12 System/Project Management

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 77. System Engineering (C, N-R)

211.12.2 PROJECT MANAGEMENT (C, N-R)

This is the cost of business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall project objectives which are not associated with specific hardware elements and are not included in system engineering. Examples of these activities are logistics management, cost/schedule/performance management, contract management, data management, vendor liaison, contract WBS, etc.

Sums To: 211.12 System/Project Management

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 78. Project management (C, N-R)

211.13 TRAINING (Non-Recurring)

This is the cost of training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will acquire sufficient concepts, skills, and aptitudes to operate and maintain the system with maximum efficiency. It includes the costs of training initial service instructors and initial crew and maintenance personnel, but excludes the cost of replacement training which are captured in the O&S phase.

USER NOTE: If a cost is input at this level, the Model will skip inputs for 211.13.1, 211.13.2 and 211.13.3

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 79. Training (nonrecurring)

211.13.1 EQUIPMENT (C, N-R)

This is the cost of distinctive end items of contractor furnished training equipment which are required to meet specific training objectives. it includes operational trainers (i.e., simulators), maintenance trainers (i.e., MTU's), and other items such as cutaways, mockups, and models specifically designed to facilitate instruction.

Sums To: 211.13 Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 80. Equipment (C, N-R)

211.13.2 SERVICES TRAINING (C, N-R)

This is the cost of contractor furnished services, devices, accessories, and aids necessary to accomplish the objectives of training. This element includes, for example, training plans, training aids, training course materials, new equipment training and contractor-conducted training (including both in-plant and service training), performed during the production phase of the system's life cycle.

Sums To: 211.13 Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 81. Services (training) (C,N-R)

211.13.3 FACILITIES (C, N-R)

This is the cost of special construction necessary to accomplish the objectives of training (primarily, the brick and mortar type facility constructed solely for the training mission). The equipment used for the purpose of acquainting the trainee with the system or establishing trainee proficiency is excluded. This cost element is restricted to those costs incurred during the production phase of the life cycle of the system.

USER NOTE: Training facilities may be funded with Procurement and MILCON dollars. If a value is entered for 211.13.3, all dollars will be assumed as MILCON and the Model will skip the prompt for entries for each POM category.

Sums To: 211.13 Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 82. Facilities (C, N-R)

211.14 PRODUCTION START-UP (C, N-R)

This is the nonrecurring financing required to achieve a total production capability for the materiel system. It includes the necessary production engineering and capitalization for plant facilities, tools, production line set-up and test equipment. Examples are initial hard tooling and production line set-up to support low rate and full scale production of the system, cost of fabrication, assembly, and installation of tools (including modification and rework of R&D tools for production purposes) dies, templates, patterns, form block manufacture, jigs, fixtures, master forms, inspection equipment, work platforms and test equipment to support the manufacture of the specified system and initial and duplicate set of tools necessary to reach full rate production.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for 211.14.1, 211.14.2, and 211.14.3.

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 83. Production start-up (C, N-R)

211.14.1 TOOLING (C, N-R)

These are the nonrecurring contractor costs pertaining to initial hard tooling and production line set-up including the cost of fabricating, assembling, and installing tools, dies, templates, patterns, form block manufacture, jigs, fixtures, master forms, inspection equipment, handling equipment, load bars, work platforms, and test equipment (such as checkers and analysts) to support the manufacture of the system. The element also includes costs to modify and rework R&D tools for production purposes and costs to maintain tool records, to establish make-or-buy and manufacturing plans on non-recurring tools and equipment, to schedule and control orders for tools, and to program and prepare tapes for numerically controlled machine equipment.

Sums To: 211.14 Production Start-Up

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 84. Tooling (C, N-R)

211.14.2 PRODUCTION ENGINEERING (C, N-R)

This is the nonrecurring contractor production engineering effort required to achieve the total production capability. It refers to the technical and management efforts of directing and controlling the establishment of initial production facilities including the tooling and production line set-up.

Sums To: 211.14 Production Start-up

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 85. Production engineering (C, N-R)

211.14.3 FACILITIES (C, N-R)

This is the cost of construction, conversion or expansion of facilities for production, inventory, and maintenance required to accomplish a specified production program. These facilities may be required for the total system or for specific components of the system.

USER NOTE: Facilities for production may be funded with Procurement and MILCON dollars. If a value is entered for 211.14.3, all dollars will be assumed as MILCON and the Model will skip the prompt for costs by budget category.

Sums To: 211.14 Production Start-Up

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 86. Facilities (C, N-R)

211.15 DATA (Nonrecurring)

This is the cost of all deliverable data required to be listed on a DD Form 1423 "Contract Data Requirements List". Data requirements will be selected from DoD 5000.19-L, Volume II "Acquisition Management Systems and Data Requirements Control List." This element includes the cost of acquiring, writing, assembling, reproducing, packaging, and shipping the data. It also includes the cost of repreparing into Government format, data items identical to those used by the contractor but in a different format. It does not include cost of efforts normally charged to G&A, overhead, other cost elements, or efforts completed under other contracts.

USER NOTE: If a cost is entered at this level, the Model will skip inputs for the subelements of 211.15.

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 87. Data (nonrecurring)

211.15.1 TECHNICAL ORDERS AND MANUALS (C, N-R)

This is the cost of contractor furnished technical orders/manuals, commercial and miscellaneous manuals for the installation, operation, maintenance, overhaul, training and reference of hardware, hardware systems and computer programs; and contractor instructional materials, inspection documentation, and historical-type records which may accompany individual items of equipment. This element includes the data item descriptions set forth in functional category M of DOD 5000.19-L. Volume II.

Sums To: 211.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 88. Technical orders & manuals (C, N-R)

211.15.2 ENGINEERING DATA (C, N-R)

This is the cost of engineering drawings, associated lists, specifications and other documentation required by the Government in accordance with Functional Categories E, H, R, S, and T of DoD 5000.19-L, Volume II. This element includes, for example, all plans, procedures, reports and documentation pertaining to the system, subsystems, component engineering, configuration management, testing, human factors, and systems analysis.

Sums To: 211.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 89. Engineering data (C,N-R)

211.15.3 MANAGEMENT DATA (C, N-R)

This is the cost of data items required for cost, schedule, contractual and project/program data management required by the Government in accordance with Functional Categories A, F, and P of DoD 5000.19-L, Volume II. This element includes, for example, contractor cost reports, cost performance reports, contractor funds status reports, project/program status reports,schedule, milestone, and networks.

Sums To: 211.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 90. Management data (C, N-R)

211.15.4 SUPPORT DATA (C, N-R)

This is the cost of data items designed to document the logistics support planning and provisioning process in accordance with Functional Categories L and V of DoD 5000.19-L, Volume II. This element includes, for example, integrated logistics support plan, level of repair analysis, supply and general maintenance plans and reports, transportation handling, packaging information, etc., as well as data to support the provisioning process.

Sums To: 211.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 91. Support data (C, N-R)

211.15.5 SOFTWARE SUPPORT DATA (C, N-R)

This is the cost of those data items required to develop a support capability for the computer software portion of the system. Included are software maintenance data program listings, progress reports, training planning data and troubleshooting procedures. Refer to the required documentation deliverable found on DD Form 1423.

Sums To: 211.15 Data

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 92. Software support data (C, N-R)

211.16 INITIAL SPARES AND REPAIR PARTS (C. N-R)

This is the cost of initial supply of repair parts to fill the planned pipeline. It includes components, assemblies, modules, circuit cards, and individual parts which will be procured as an initial stock for maintenance replacement purposes in major end items prior to provisioning, and should be distinguished from replenishment spares included in O&S costs which are purchased to replace expended stock. This element excludes system test and evaluation spares (Cost Elements 211.17 and 221.19) and spares provided specifically for use during system installation assembly and checkout on site (Cost Element 222.14). Initial spares and repair parts are normally bought to stock these items in the pipeline during the period from initial issue of production equipment until the supply system is provisioned with spares and repair parts for routine replenishment operation.

Allocating initial spares costs as nonrecurring costs will cause the Model to buy all initial spares in the first 1/3 - 1/2 of the production cycle, based on the nonrecurring production spendout rate. If the analyst desires to allocate these costs over the whole production run, enter the costs under 221.18 (see 221.18, Initial Spares and Repair Parts, Recurring).

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 93. Initial spares & repair parts (C, N-R)

211.17 SYSTEM TEST AND EVALUATION SUPPORT (C, N-R)

This is the contractor cost of system-related development and operational test activities (DT/OT III) including the cost of specially fabricated hardware to obtain or validate engineering data on the performance of the system. It also includes the cost of detailed planning, conduct, support, data reduction, and reports from such testing, as well as the cost of test items consumed in the conduct of such operations and the cost of effort associated with the design and production of models, specimens, fixtures, and instrumentation in support of the test program. Articles for testing which are complete units (i.e., functionally configured) should not be costed here if the test units are costed separately in the R & D phase.

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 94. System test & evaluation support (C, N-R)

211.18 SOFTWARE CENTER (C, N-R)

This is the contractor nonrecurring production costs incurred in establishing a software center for follow-on software support. The software center is a special purpose grouping of commercial, military, and special test equipment and software. It is configured so as to operate as a software development laboratory and test center and as a flexible program preparation, validation, integration, and documentation center.

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 95. Software center (C, N-R)

211.19 CONTRACTOR TECHNICAL SUPPORT (Nonrecurring)

This is the cost of all materials and services provided by the contractor related to achieving initial operational capability. This element includes, for example, repair of reparables, standby services, final turnover.

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 96. Contractor technical support (nonrecurring)

211.20 OTHER PRODUCTION (C, N-R)

This includes any contractor incurred nonrecurring production costs not contained in the elements previously defined.

USER NOTE: Other contractor nonrecurring costs may be entered as Procurement, RDT&E and/or O&M dollars. If a value is entered for 211.20, the Model will skip the prompt for input by budget category and the costs will be assigned to procurement.

Sums To: 211 Contractor (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 97. Other production (C, N-R)

212 GOVERNMENT (NONRECURRING)

This is the sum of all nonrecurring in-house Government costs associated with the procurement phase of a materiel system. It includes the nonrecurring costs to the Government for: GFE supplied to the contractor, initial training, system test and evaluation test site activation, technical orders and manuals, software center, inventory management and industrial facilities. Efforts by Government support contractors should be costed in this element or the appropriate subelement.

USER NOTE: If a cost is input at this level, the Model will skip inputs for its subelements. For a more inclusive definition of this element, see the definitions for its subelements.

Sums To: 210 Production (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 98. Government (nonrecurring)

212.12 INITIAL TRAINING (G, N-R)

This is the cost of Government furnished training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will acquire sufficient concepts, skills, and aptitudes to operate and maintain the system with maximum efficiency. This element includes all effort associated with the production of training equipment as well as the execution of training services.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for the subelements of 212.12.

Sums To: 212 Government (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 99. Initial training (G, N-R)

212.12.1 EQUIPMENT (TRAINING) (G, N-R)

This is the cost of Government furnished end items of training equipment required to meet specific training objectives. This element includes, for example, operational trainers (i.e., simulators), maintenance trainers (i.e., maintenance training units), and other items such as cutaways, mockups, and models.

USER NOTE: PME acquired for schools is costed under the production buy quantity (U016); it is not to be costed in this element.

Sums To: 212.12 Initial Training (G, N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 100. Equipment (training) (G,N-R)

212.12.2 SERVICES (TRAINING) (G, N-R)

This is the cost of Government provided services, devices, accessories, and aids necessary to accomplish the objectives of training. This element includes, for example, training plans, training aids, training course materials, new equipment training teams, contractor-conducted training (including both in-plant and service training).

Sums To: 212.12 Initial Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 101. Services (training) (G, N-R)

212.12.3 FACILITIES (TRAINING) (G, N-R)

The facilities element refers to that special construction necessary to accomplish the objectives of training (primarily, the brick-and-mortar-type facility constructed solely for the training mission). The equipment used for the purpose of acquainting the trainee with the system or establishing trainee proficiency is excluded.

USER NOTE: The costs associated with training facilities may be funded with procurement and MILCON dollars. If costs are entered for 212.12.3, the Model will assume all dollars are MILCON and skip the inputs for each budget category.

Sums To: 212.12 Initial Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 102. Facilities (training) (G, N-R)

212.12.4 STUDENT COSTS (G, N-R)

This is the cost of all travel and TDY chargeable to the program for personnel attending initial training courses. It includes trainees and personnel assigned to new equipment training teams. Normally, student pay and allowances are not charged to the development effort. If pay and allowances are to be charged to the program, these should be included here.

Sums To: 212.12 Initial Training (G, N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 103. Student cost (G, N-R)

212.13 SYSTEM TEST AND EVALUATION (G, N-R)

This is the cost of Government furnished prototype, production, or specially fabricated hardware to obtain or validate engineering data on the performance of the materiel system. This element includes the detailed planning, conduct, support, data reduction and reports from such testing, and all Government furnished hardware items which are consumed or planned to be consumed in the conduct of such testing. It also includes all Government effort associated with the design and production of models, specimens, fixtures, and instrumentation in support of the test program. Test articles which are complete units (i.e., functionally configured as required by the mission equipment) are excluded as are development and component acceptance and testing which can be specifically associated with the hardware element, unless these tests are of special contractual or engineering significance.

USER NOTE: If a value is entered here, the Model will skip the inputs for the subelements of 212.13.

Sums To: 212 Government (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 104. System test & evaluation (G, N-R)

212.13.1 PRODUCTION ACCEPTANCE TEST AND EVAL (G, N-R)

This is the cost of all Government effort associated with the conduct of production acceptance testing to demonstrate that items procured fulfill the requirements and specifications of the procuring agency.

USER NOTE: PATE may be funded with procurement, other procurement, and military personnel dollars. If a cost is entered for 212.13.1, all dollars will be assumed as procurement and the Model will skip the inputs for each budget category.

Sums To: 212.13 System Test and Evaluation

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 105. Production acceptance & test eval (G, N-R)

212.13.2 OPERATIONAL TEST AND EVALUATION (OTE) (G, N-R)

This is the cost associated with test and evaluation conducted by agencies other than the developing command to assess the prospective system's military utility, operational effectiveness, operational suitability, logistics supportability (including compatibility, interoperability, reliability, maintainability, and logistic requirements), cost of ownership, and need for any modifications. This element includes such tests as integrated systems tests, appropriate flight tests, sea trials, mobility demonstrations, and other tests as required to prove the operational capability of the deliverable system. It also includes contract support (e.g., technical assistance, maintenance, labor, material, etc.), consumed during this phase of testing.

USER NOTE: OTE may be funded with procurement, other procurement, and military personnel dollars. If a cost is entered for 212.13.2 all dollars will be assumed procurement and the Model will skip the prompt for costs by budget category.

Sums To: 212.13 System Test and Evaluation

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 106. Operational test & evaluation (OTE) (G, N-R)

212.14 TEST SITE ACTIVATION (G, N-R)

This is the cost to activate Government special test facilities required for performance of the system or subsystem. This element includes, for example, white rooms and test chambers. The brick-and- mortar-type facilities allocable to industrial facilities are excluded.

Sums To: 212 Government (N-R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 107. Test site activation (G, N-R)

212.15 TECHNICAL ORDERS AND MANUALS (G, R)

These are the costs associated with Government produced and published technical manuals/orders and other documents shipped with the equipment.

Sums To: 212 Government (Nonrecurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 108. Technical orders and manuals (G, N-R)

212.16 SOFTWARE CENTER (G, N-R)

This is the Government's costs incurred in establishing a software center for follow-on software support. The software center is a special purpose grouping of commercial, military, and special test equipment and software. It is configured to operate as a software laboratory development and test center and as a flexible center for program preparation, validation, integration, and documentation.

Sums To: 212 Government, N-R

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 109. Software center (G, N-R)

212.17 INVENTORY MANAGEMENT (G, N-R)

This is the nonrecurring management cost of entering an item in inventory. This includes identification, description, *submission to* screening, and editing by the data documents center; inclusion in maintenance and supply catalogs; establishment by supply management of inventory and replacement rates; provisioning; requisitioning; and procurement directives. Annual recurring costs for maintaining an item in inventory are costed in Cost Element 343.

USER NOTE: A gross inventory management cost may be entered at *this level* or a zero may be entered and the Model will use the following cost formula to compute the cost:

212.17 Inventory Management = Inventory Introduction Cost (A3)
* [Number of new FSN/NSN under under $5k (049)
+ Number of new FSN/NSN $5-50k (050)
+ Number of new FSN/NSN $50-500k (051)
+ Number of new FSN/NSN $ over 500k (052)]

Sums To: 212 Government, N-R

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 110. Inventory management (G, N-R)

212.18 INDUSTRIAL FACILITIES

This is the cost for Government funded construction, conversion, or expansion of facilities for production, inventory, and contractor depot maintenance required by one or more suppliers for the specific system. This element includes, for example, equipment acquisition or modernization, where applicable, and maintenance of the aforementioned facilities or equipment.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for 212.18.1 and 212.18.2.

Sums to: 212 Government, N-R

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 111. Industrial facilities (G, N-R)

212.18.1 CONSTRUCTION/CONVERSION/EXPANSION

This is the Government's direct cost for the construction/conversion/expansion element of real estate and preparation of system peculiar facilities for production, inventory, depot maintenance, and other related activities.

USER NOTE: Construction/conversion/expansion activities may be funded with procurement or MILCON dollars. If a cost is entered for 212.18.1, the Model will assume procurement dollars and skip the prompt for input by budget category.

Sums To: 212.18 Industrial Facilities

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 112. Construction/conversion/expansion (G, N-R)

212.18.2 EQUIPMENT ACQUISITION OR MODERNIZATION

This is the cost for any Government procured production equipment, and the modernization or transfer of equipment to the contractor for the production line (pertains primarily to Government owned and leased equipment under facilities contract).

Sums To: 212.18 Industrial Facilities

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 113. Equipment acquisition or modernization

212.19 OTHER NONRECURRING PRODUCTION COSTS

These are any other Government-incurred nonrecurring production costs not contained in the preceding cost elements.

USER NOTE: Other nonrecurring Government costs may be entered as procurement, O&M and other procurement dollars. If a cost is entered for 212.19, the Model will assume procurement dollars and skip prompting for the other budget categories. To enter the other budget categories, enter a <cr> for 212.19.

Sums To: 212 Government, Nonrecurring

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 114. Other nonrecurring production cost (G, N-R)

220 PRODUCTION (Recurring)

These are the 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 operationally usable systems to the using command or organization.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for its subelements.

Sums to: 200 Production

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 115. Production (recurring)

221 CONTRACTOR (Recurring)

These are the recurring production costs incurred by a private business while under contract with the Federal Government. It includes all recurring effort associated with the production of complete units (prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of their end use) as well as system/project management, initial training, data depository, maintenance of industrial facilities, engineering changes, initial spares and repair parts, system test and evaluation support, and transportation.

USER NOTE: If costs are entered at this level, the Model will skip the input requirements for its sub-elements.

Sums To: 220 Production (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 116. Contractor (recurring)

221.12 SYSTEM/PROJECT MANAGEMENT (C, R)

These are the contractor recurring costs associated with systems engineering and technical control as well as business management of particular systems/projects. It encompasses planning, directing, and controlling the production of a system/project, including the functions of logistics and logistics support, maintenance support, facilities, personnel and training, testing, and activation of a system. System/project management effort which can be associated specifically with hardware elements is excluded, unless this effort is of special contractual or engineering significance, e.g., associate contractor.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for 221.12.1 and 221.12.2

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 117. System/project management (C, R)

221.12.1 SYSTEM ENGINEERING (C, R)

The system engineering element refers to the recurring costs associated with the technical and management efforts of directing and controlling the totally integrated engineering efforts of a system's program. It encompasses integrated planning and control of technical program efforts of production engineering, logistics engineering, specialty engineering, and integrated test planning. This element includes, but is not limited to, the logistics engineering effort to optimize and integrate the logistics support considerations into the mainstream engineering effort to ensure the production of a supportable and cost-effective weapon system; and the technical planning and control effort for planning, monitoring, measuring, evaluating, directing, and replanning the management of the technical program. It excludes production engineering directly related to the products or services of a deliverable end item. Examples of system engineering efforts include:

(1) Integration and balancing of reliability, maintainability, producibility, safety, and survivability; human factors, personnel, and training program requirements; security requirements; configuration identification and control; quality assurance program; value engineering; preparation of equipment and component performance specifications; and design of test and demonstration plans.

(2) Support synthesis, life cycle cost factors, time factors, trade-off analysis, logistics appraisal, use studies, support function requirements identification, repair level determination, task analysis, standardization review, logistics requirements identification, logistics support verification, and the preparation and updating of the logistics support plan, the maintenance plan, facilities planning (operational and maintenance), the transportation and handling plan.

(3) Preparation of the systems engineering management plan, specification tree, program risk analysis, system test planning, decision control process, technical performance measurement, technical reviews, subcontractor/vendor reviews, work authorization, technical documentation control, etc.

Sums To: 221.12 System/Project Management (C,R)

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 118. System engineering (C, R)

221.12.2 PROJECT MANAGEMENT (C, R)

This is the recurring cost for business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall project objectives which are not associated with specific hardware elements and are not included in system engineering. Examples of these activities are logistics management, data management, vendor liaison, and contract WBS.

Sums To: 221.12 System/Project Management (C,R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 119. Project management (C, R)

221.13 INITIAL TRAINING (C, R)

These are the contractor recurring costs for training services, devices, accessories, aids, equipment, facilities, and parts used to facilitate instruction, through which personnel will acquire sufficient skills and aptitudes to operate and maintain the system(s) with maximum efficiency. It includes the costs of training initial service instructors and initial crew and maintenance personnel but excludes replacement training which is covered during the O&S phase of the system.

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 120. Initial training (C, R)

221.14 DATA DEPOSITORY (C, R)

This is the cost for a facility designated to act as custodian in establishing and maintaining a master engineering specification and drawing depository service for Government-approved documents which are the property of the U.S. Government. As custodian for the Government, the contractor is authorized by approved change orders to maintain these master documents at the latest approved revision level. When documentation is called for on a given item of data retained in the depository, the charges (if charged directly) will be to the appropriate data element. This element represents a distinct entity of its own and includes all efforts of drafting, clerical, filing, etc., required to provide the service outlined above. All similar efforts for the contractor's engineering/production activities are excluded.

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 121. Data depository (C, R)

221.15 MAINTENANCE (INDUSTRIAL FACILITIES) (C, R)

This is the recurring cost associated with the maintenance, preservation, and repair of industrial facilities and equipment.

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 122. Maintenance (Industrial Facilities) (C, R)

221.16 ENGINEERING CHANGES (C, R)

These are the costs associated with official alterations made to a system while it is still in the manufacturing process (before acceptance by the military service). Modification work orders executed after acceptance are costed for the operating and support phase of the system life cycle.

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 123. Engineering changes (C, R)

221.17 DATA (C, R)

This is the contractor recurring cost during the production phase of gathering, storing, reproducing, and disseminating technical and managerial data, and of preparing, updating, and reproducing publications such as technical orders, handbooks, and field manuals. It includes the cost of all deliverable data listed on the DD Form 1423. This element includes the cost of acquiring, writing, assembling, reproducing, packaging, and shipping the data. It also includes the cost of repreparing into Government format, data items identical to those used by the contractor but in a different format. It does not include costs of efforts normally charged to G&A, overhead, other cost elements, or efforts completed under other contracts.

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 124. Data (C, R)

221.18 INITIAL SPARES AND REPAIR PARTS (C, R)

This is the cost of initial supply of repair parts to fill the planned pipeline. It includes components, assemblies, modules, circuit cards, and individual parts which will be procured as an initial stock for maintenance replacement purposes in major end items prior to provisioning, and should be distinguished from replenishment spares included in O&S costs which are purchased to replace expended stock. This element excludes system test and evaluation spares (Cost Elements 211.17 and 221.19) and spares provided specifically for use during system installation assembly and checkout on site (Cost Element 222.14). Initial spares and repair parts are normally bought to stock these items in the pipeline during the period from initial issue of production equipment until the supply system is provisioned with spares and repair parts for routine replenishment operation.

USER NOTE: If the initial provisions cost factor (A2) is > 0, the Model will employ the following cost formula for calculating recurring initial spares and repair parts for each contractor furnished item in the WBS data base and sum the results to 221.18.

221.18 per unit = Initial Provisioning Cost Factor (A2) * Buy Quantity (U12)
* DTUPC (calculated)

If costs are calculated as recurring, the Model will spread these costs over the whole production run based on the annual buy quantity. If the analyst wants to purchase all spares in the first 1/3 to 1/2 of the production run, enter a 0 for A2 and enter the analyst derived cost under 211.16 (see 211.16, Initial Spares and Repair Parts, N-R).

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 125. Initial Spares and Repair Parts (C, R)

221.19 SYSTEM TEST AND EVALUATION SUPPORT (C, R)

This is the contractor cost of system-related development and operational test activities (DT/OT III) including the cost of specially fabricated hardware to obtain or validate engineering data on the performance of the system. It also includes the cost of detailed planning, conduct, support, data reduction, and reports from such testing, as well as the cost of test items consumed in the conduct of such operations and the cost of effort associated with the design and production of models, specimens, fixtures, and instrumentation in support of the test program. Articles for testing which are complete units (i.e., functionally configured) should not be costed here if the test units are costed separately in the R & D phase.

USER NOTE: This cost would normally be entered under 211.17, System Test & Evaluation Support (C, N-R). This element is provided for those program managers who desire to treat the cost as spread over the whole production cycle.

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 126. System test and evaluation support (C, R)

221.20 TRANSPORTATION (C, R)

These are the contractor recurring costs incurred during the transport of a system/item to first destinations. First destination transportation costs include any contractor costs associated with moving the system and associated equipment from the manufacturing plant, assembly point or test plant to a Government depot or other point of Government acceptance in the continental U.S. This covers costs associated with temporary assignment of contractor crews (transportation costs and travel allowances, etc.) and the cost of supplies, minor repairs and fuel during delivery. Excluded are transportation costs paid by a vendor which are included in the equipment cost as prescribed in procurement contracts.

Sums To: 221 Contractor (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 127. Transportation (C, R)

221.21 OTHER (SPECIFY) (C, R)

These are any contractor-incurred recurring production costs not contained in the preceding elements.

USER NOTE: Other contractor recurring costs may be funded with procurement, O&M or other procurement dollars. If a cost is entered for 221.21 all dollars will be assumed as procurement and the Model will skip the prompt for each budget category.

Sums To: 221 Contractor (Recurring)
Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 128. Other (specific) (C, R)

222 GOVERNMENT PRODUCTION (Recurring)

These are the recurring investment costs incurred by organizations of the Federal Government. It includes the recurring Government costs for: GFE, program management, transportation, operational site activation, quality control and inspection, support engineering, initial training, system test and evaluation, and initial spares and repair parts. Included herein are costs for support contractors who provide program management support to Government procurement offices.

USER NOTE: If a cost is input at this level, the Model will skip the inputs for its subelements. For a more inclusive definition of this element, see the definitions for its subelements.

Sums To: 220 Production (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 129. Government production (recurring)

222.12 PROGRAM MANAGEMENT (G,R)

These are the costs incurred during the production phase. It includes the business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall project objectives which are not associated with specific hardware elements and are not included in system engineering. Examples of these activities are logistics management, cost/schedule/ performance management, contract management, data management, vendor liaison, and contract WBS.

Sums To: 222 Government (R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 130. Program Management (G,R)

222.12.1 PROGRAM MANAGEMENT, MILITARY (G,R)

This is the cost for military personnel associated with the Government's program management effort during production. It includes pay and allowances, travel, per diem and any other costs associated with military personnel engaged in technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the production phase.

USER NOTE: Costs may be entered at this level as a gross amount. Military program management personnel may be entered through the Personnel Costing Module (PCM) using the PMPD level with appropriate grade and numbers. The PCM will employ the following cost formula to compute pay and allowances:

Pay and Allowances = Years of Production(calculated)
* annual pay and allowances per pay grade
* number of personnel per pay grade

222.12.1 Program Management, Military = 222.12.1 + Pay and Allowances

Sums to: 222.12 Program Management (G,R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 131. Program Management, Military (G,R)

222.12.2 PROGRAM MANAGEMENT, CIVILIAN (G,R)

This is the cost for civilian personnel associated with the Government's program management effort during production. It includes pay and allowances, travel, per diem and any other costs associated with civilian personnel engaged in technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the production phase.

USER NOTE: Costs may be entered at this level as a gross amount. Civilian program management personnel may be entered through the Personnel Costing Module (PCM) using the PMPD level with appropriate grade and numbers. The PCM will employ the following cost formula to compute civilian pay:

Pay = Years of Production(calculated)
 * annual pay and allowances per pay grade
 * number of personnel per pay grade

222.12.2 Program Management, Civilian = 222.12.2 + Pay

Sums to: 222.12 Program Management (G,R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 132. Program Management, Civilian (G,R)

222.12.3 PROGRAM MANAGEMENT CONTRACTOR SUPPORT (G,R)

This is the cost of Government support contractors who assist Government program managers (military or civilian) in business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall project objectives. These are efforts which are not associated with specific hardware elements and are not included in system engineering. Examples of these activities are logistics management, cost/schedule/ performance management, contract management, data management, vendor liaison, and contract WBS.

Sums To: 222 Program Management (G,R)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 133. Program management contractor support (G,R)

222.13 TRANSPORTATION (G, R)

These are the recurring costs associated with the transportation, storage, and handling of the end items from the point of Government acceptance to the user. It is often referred to as second destination shipping.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 134. Transportation (G,R)

222.14 OPERATIONAL/SITE ACTIVATION (G, R)

This is the cost of 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 levels, except for turnkey operations wherein real estate and construction are involved as a package procurement. This element includes conversion of site, ship or vehicle; system assembly; checkout; and installation into site facility or ship to achieve operational status. It also includes contractor support in relation to operational/site activation.

USER NOTE: These activities may be funded with Procurement, MILCON, O&M and MILPER funds. An entry for 222.14 will cause all costs to be allocated to procurement. If the analyst desires to enter costs for other appropriations, enter a carriage return for 222.14 and the Model will prompt for the other appropriations.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 135. Operational/site activation (G,R)

222.15 QUALITY CONTROL AND INSPECTION (G, R)

These are all Government recurring production costs associated with the quality control and inspection activities at the contractor's plant or at first destination.

USER NOTE: These elements may be funded with procurement, O&M or military personnel dollars. If a cost is entered for 222.15, the dollars will be assumed as procurement and the Model will skip the inputs for each budget category.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 136. Quality control and inspection (G,R)

222.16 SUPPORT ENGINEERING (G, R)

This is the Government recurring production cost associated with the engineering performed after quantity production starts. This will include such items as maintainability/reliability engineering, maintenance engineering, value engineering, and production engineering. It also includes the preparation, at depot level, for assuming the engineering function during the operating and support phase of the equipment's life cycle.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 137. Support Engineering (G,R)

222.17 INITIAL TRAINING (G, R)

This is the cost of recurring training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will acquire sufficient concepts, skills, and aptitudes to operate and maintain the system with maximum efficiency.

USER NOTE: If a cost is entered at this level, the Model will skip the inputs for its subelements.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 138. Initial Training (G,R)

222.17.1 NEW EQUIPMENT TRAINING TEAMS (G, R)

This is the cost of new equipment training teams established to provide training on the operation and maintenance of new equipment. It includes costs associated with the training equipment required as well as the cost of the training services (pay and allowances, TDY, travel).

USER NOTE: Costs may be entered for military personnel and O&M appropriations. If an entry is made for 222.17.1, the Model will assume O&M and skip Military Personnel. To make both Military Personnel and O&M entries, enter a carriage return for 222.17.1.

Sums To: 222.17.1 Initial Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 139. New equipment training teams (G,R)

222.17.2 INITIAL OPERATIONAL TRAINING (G, R)

This is the cost of training initial crew and maintenance personnel. It includes costs for travel, per diem and Government furnished material consumed in the training effort. This is O&M funded costs only. It excludes pay and allowances for initial training and the costs for replacement training which are captured in estimates which cover the O&S phase of the equipment life cycle. If costs for initial service instructors/new equipment training teams are not included under 212.12 and its subelements, they should be added here.

Sums To: 222.17 Initial Training

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 140. Initial operational training (G,R)

222.18 SYSTEM TEST AND EVALUATION (G, R)

This is the cost of system-related development and operational test activities (DT/OT III) including the cost of specially fabricated hardware to obtain or validate engineering data on the performance of the system. This element includes the detailed planning, conduct, support, data reduction and reports from such testing, and all test items which are consumed in the conduct of such testing. It also includes all effort associated with the design and production of models, specimens, fixtures, and instrumentation in support of the test program. Test articles which are complete units (i.e., functionally configured as required by the mission equipment) should not be costed here if the test units are costed separately in the R & D phase.

USER NOTE: If a cost is entered for 222.18, the Model will assume procurement dollars and skip the input by appropriation.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 141. System test and evaluation (G,R)

222.19 INITIAL SPARES AND REPAIR PARTS (G, R)

This is the cost of the initial supply of repair parts and special tools to fill the planned pipeline. It includes components, assemblies, modules, circuit cards, and individual parts which will be procured as an initial stock for maintenance replacement purposes in major end items prior to provisioning, and should be distinguished from replenishment spares included in O&S costs which are purchased to replace expended stock. This element excludes system test and evaluation spares (Cost Elements 211.17 and 221.19) and spares provided specifically for use during system installation assembly and checkout on site (Cost Element 222.14). Initial spares and repair parts are normally bought to stock these items in the pipeline during the period from initial issue of production equipment until the supply system is provisioned with spares and repair parts for routine replenishment operation.

USER NOTE: If a zero is entered here, the Model will use the following cost formula for calculating recurring initial spares and repair parts for each GFE unit in the data base and sum these costs to 222.19.

222.19 = The sum of Initial Provisioning for all GFE items where:
Initial Provisioning per GFE unit = Initial Provisioning Cost Factor
* Buy quantity * UPC

To prevent the Model from calculating a cost for this element enter .01 for 222.19.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 142. Initial spares and repair parts (G,R)

222.20 OTHER (SPECIFY) (G, R)

These are any Government recurring production costs not included in the preceding elements.

USER NOTE: Other Government recurring costs may be funded with procurement, O&M and other procurement dollars. If a cost is entered for 222.20, the costs will be assigned to procurement and the Model will skip inputs by appropriation.

Sums To: 222 Government (Recurring)

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 143. Other (specify) (G,R)

5.4 Operating and support inputs. Operating and support includes all costs resulting from the operation, maintenance and support (including personnel support) of the system after it is accepted into the Service's inventory.

5.4.1 O&S input worksheets. Summary worksheets for entering costs are contained in Figure 144. Figures 145-195 are data collection worksheets for each of the O&S input costs. These worksheets define each cost element and provide a structure for documenting the development of each cost estimate. Backup pages, in formats developed by the analyst, detailing the development of variables used to arrive at an estimate should be attached to the cost element worksheet.

5.4.2 Level of detail. The analyst may enter costs at any level in the following worksheets suitable to the availability of data and the detail required by the program decision environment. An entry at any level in the cost structure will cause the Model to skip to the next entry with an equal or lesser numbered level.

Life Cycle Cost Model
for
Defense Materiel Systems

O&S COST INPUTS (PAGE 1 of 2)

SYSTEM: ____________
DATE: ____________

Description	Level	Cost Element	Value/Reference
SYSTEM OPER FACILITIES COST($/YR)	<1>	O1	____________
NUMBER OF OPER UNITS-CONUS	<2>	O2	____________
NUMBER OF OPER UNITS-EUROPE	<2>	O3	____________
NUMBER OF OPER UNITS-WESTPAC	<2>	O4	____________
NUMBER OF OPER UNITS W/FACILITIES	<2>	O5	____________
SIZE OF AVG OPER FACILITY (FT^2)	<2>	O6	____________
OPER FACILITY MAINT COST ($/$FT^2$/YR)	<2>	O7	____________
SYSTEM OPER TRANSPORTATION($/YR)	<1>	O8	____________
UNIT TRAINING TRANS MILES/YEAR TRUCK	<2>	O9	____________
UNIT TRAINING TRANS MILES/YEAR RAIL	<2>	O10	____________
UNIT TRAINING TRANS MILES/YEAR SEA	<2>	O11	____________
UNIT TRAINING TRANS MILES/YEAR AIR	<2>	O12	____________
OPER UNIT LIFT WEIGHT(TONS)	<2>	O13	____________
OPER UNIT LIFT VOLUME(FT^3)	<2>	O14	____________
OPERATING EQUIP LEASEHOLDS($/YR)	<1>	O15	____________
LEASEHOLDS/OPERATING SITE($/YR/SITE)	<2>	O16	____________
OTHER OPERATING COSTS($/YR)	<1>	O17	____________
PROC	<2>	O18	____________
O&M	<2>	O19	____________
OPROC	<2>	O20	____________
MILPER	<2>	O21	____________
SYSTEM ORGANIZATION MAINT FAC COST($/YR)	<1>	O22	____________
NUMBER OF ORG MAINT SITES	<2>	O23	____________
SIZE OF AVG ORG MAINT SITE(FT^2)	<2>	O24	____________
ORG MAINT FLOOR AREA COST($/$FT^2$/YR)	<2>	O25	____________
SYSTEM INT MAINT FACILITIES COST($/YR)	<1>	O26	____________
NUMBER OF INT MAINT SITES	<2>	O27	____________
SIZE OF AVG INT MAINT SITE(FT^2)	<2>	O28	____________
INT MAINT FLOOR AREA COST($/$FT^2$/YR)	<2>	O29	____________
GOVERNMENT MAINT OF OPR S/W CENTER($/YR)	<1>	O30	____________
CONTRACTOR MAINT OF OPR S/W($/YR)	<1>	O31	____________
NUMBER YRS CONTRACTOR MAINT OF OPR S/W	<1>	O32	____________
NUMBER YRS GOVERNMENT MAINT OF OPR S/W	<1>	O33	____________

Entering data for any level <1> cost factor will cause the model to skip to the next level <1> cost factor.

Type SAV at any time to save data being entered.

FIGURE 144. O&S cost inputs

Life Cycle Cost Model
for
Defense Materiel Systems

SYSTEM: ________________
DATE: ________________

O&S COST INPUTS (PAGE 2 of 2)

Cost Factor Description	Level	Cost Element	Value/Reference
GOVERNMENT MAINT OF M&D S/W CENTER($/YR)	<1>	034	
CONTRACTOR MAINT OF M&D S/W($/YR)	<1>	035	
NUMBER YRS CONTRACTOR MAINT OF M&D S/W	<1>	036	
NUMBER YRS GOVERNMENT MAINT OF M&D S/W	<1>	037	
CONTRACTOR SUPPORT SERVICES($/YR)	<1>	038	
NUMBER YEARS CONTRACTOR SUPPORT	<1>	039	
SYSTEM SUPPLY FACILITIES($/YR)	<1>	040	
MAINT ORG SUPPLY FAC($/FT^2/YR)	<2>	041	
ORG SUPPLY REQUIREMENT(FT^2/SITE)	<2>	042	
MAINT INT SUPPLY FAC ($/FT^2/YR)	<2>	043	
INT SUPPLY REQUIREMENT(FT^2/SITE)	<2>	044	
MAINT FIELD DEP SUPPLY FAC($/FT^2/YR)	<2>	045	
FIELD DEPOT SUPPLY RQMT(FT^2/SITE)	<2>	046	
NUMBER OF FIELD DEPOT SUPPLY SITES	<2>	047	
SYSTEM BONDED STORAGE COST($/YR)	<1>	048	
NUMBER OF BONDED STORAGE SITES	<2>	049	
COST PER BONDED STORAGE SITE($/YR)	<2>	050	
TECH DATA REVISIONS($/YR)	<1>	051	
TECH DATA REVISION COSTS($/PAGE)	<2>	052	
TECH DATA PAGES REQ REVISION(PAGES/YR)	<2>	053	
NUMBER NEW FSN/NSN UNDER $5K	<1>	054	
NUMBER NEW FSN/NSN $5-50K	<1>	055	
NUMBER NEW FSN/NSN $50-500K	<1>	056	
NUMBER NEW FSN/NSN OVER $500K	<1>	057	
OTHER LOGISTIC SUPPORT COSTS($/YR)	<1>	058	
PROC	<2>	059	
O&M	<2>	060	
OPROC	<2>	061	
MILPER	<2>	062	

Entering data for any level <1> cost factor will cause the model to skip to the next level <1> cost factor.

Type SAV at any time to save data being entered.

FIGURE 144. O&S cost inputs (continued)

01 OPERATIONAL FACILITIES ($/Yr)

This is the annual cost of maintaining fixed facilities used to house the prime mission equipment, including the maintenance of real property where applicable. It covers direct labor, material, overhead and other direct charges such as heat, light, and air conditioning. This element excludes deployable shelters which should be costed as part of the WBS data base.

Cost Elements Affected: 314

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 145. Operational facilities ($/Yr)

O2 NUMBER OF OPERATIONAL COMMANDS (CONUS)

This is the number of operational units in CONUS scheduled to receive the materiel system. This factor is used to determine the weighted average distance from the user locations to CONUS depots for maintenance transportation and to calculate operational transportation.

Cost Elements Affected: 316, 323.3, 324.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 146. Number of operational commands (CONUS)

O3 NUMBER OF OPERATIONAL COMMANDS (Europe)

This is the number of operational units in Europe scheduled to receive the materiel system. This factor is used to determine the weighted average distance from the user locations to CONUS depots for maintenance transportation and to calculate operational transportation.

Cost Elements Affected: 316, 323.3, 324.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 147. Number of operational commands (Europe)

04 NUMBER OF OPERATIONAL COMMANDS (WESTPAC)

This is the number of operational units in western Pacific scheduled to receive the materiel system. This factor is used to determine the weighted average distance from the user locations to CONUS depots for maintenance transportation and to calculate operational transportation.

Cost Elements Affected: 316, 323.3, 324.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 148. Number of operational commands (WESTPAC)

05 NUMBER OF OPERATIONAL COMMANDS WITH FACILITIES

This is the number of operational sites with operational facilities which require maintenance and upkeep. This number is applied to the size of the facilities to be maintained and the annual cost/ft^2 (06) to derive annual maintenance costs.

Cost Elements Affected: 314

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 149. Number of operational commands with facilities

06 SIZE OF AVERAGE OPERATIONAL SITE (Ft^2)

This factor represents the average size, in square feet of fixed operational sites. It is applied to the annual per square foot cost for facilities maintenance and the number of operational commands with fixed facilities to derive annual maintenance costs for operational facilities. This does not apply to deployable shelters.

Cost Elements Affected: 314

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 150. Size of average operational site (FT^2)

O7 FACILITIES MAINTENANCE COST ($/Ft^2/Yr)

This factor provides the annual cost per square foot of space to maintain fixed operational facilities for the system. It includes the upkeep of real property, where applicable, and covers direct labor, material, overhead and other direct charges such as heat, light, and air conditioning. This element does not apply to deployable shelters.

Cost Elements Affected: 310, 314

Comments/Calculations;

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 151. Facilities maintenance cost ($/FT^2/Yr)

O8 OPERATIONAL TRANSPORTATION ($/Yr)

This element is the annual cost of transporting prime mission equipment from one operational site to another for such activities as alerts, training, maneuvers, and exercises. Excluded are the transport of equipment for maintenance purposes and the initial shipment of the equipment from the supplier to the user.

Cost Elements Affected: 316

Comments/Calculations

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 152. Operational transportation ($/Yr)

09 TRAINING TRANSPORTATION-COMMERCIAL TRUCK (Mi/Yr)

This factor represents the average number of miles per year that the PME is transported by commercial truck to accomplish the training/operational mission, including the mileage covered by prime movers used in equipment operation and training exercises. Since this value will vary by type organization, an average value should be employed, and should be weighted, if appropriate, to account for differences in activities of active forces, reserve units, support units or agencies, and schools if these commands are not separately entered in the data base. This factor requires input for 02-04 to produce a value.

Cost Elements Affected: 316

Comments/Calculations;

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 153. Training transportation-commercial truck (Mi/Yr)

010 TRAINING TRANSPORTATION-RAIL (Mi/Yr)

This factor represents the average mileage per year that the PME is transported by rail to accomplish the training/operational mission. Since this value will vary by type organization, an average value should be employed and should be weighted if warranted to account for differences in the activities of active forces, reserve units, support units or agencies, and schools if these commands are not separately entered in the data base.

Cost Elements Affected: 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 154. Training transportation-rail (Mi/Yr)

011 TRAINING TRANSPORTATION-SEALIFT (Mi/Yr)

This factor represents the average mileage per year that the PME is transported by sealift to accomplish the training/operational mission. Since this value will vary by type organization, an average value should be employed and should be weighted if warranted to account for differences in the activities of active forces, reserve units, support units or agencies, and schools if these commands are not separately entered in the data base.

Cost Elements Affected: 316

Comments/Calculations;

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 155. Training transportation-sealift (Mi/Yr)

O12 TRAINING TRANSPORTATION-AIRLIFT (Mi/Yr)

This factor represents the average mileage per year that the PME is transported by airlift to accomplish the training/operational mission. Since this value will vary by type organization, an average value should be employed and should be weighted if warranted to account for differences in the activities of active forces, reserve units, support units or agencies, and schools if these commands are not separately entered in the data base.

Cost Elements Affected: 310, 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 156. Training transportation-airlift (Mi/Yr)

013 OPERATIONAL UNIT LIFT WEIGHT (Tons)

This is the weight in short tons of one operational command's prime mission materiel which must be transported for training/operational purposes. It is used in conjunction with annual mileage and rates per ton-mile to determine operational transportation costs. This should be the total weight of all material transported by an operational command when the PME is deployed.

Cost Elements Affected: 310, 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 157. Operational unit lift weight (tons)

014 OPERATIONAL UNIT VOLUME (Ft^3)

This is the volume in cubic feet of one operational command's prime mission materiel which must be transported for training/operational purposes. This value is converted to tons using the standard military transportation command rate of 40 ft^3/ton. The model uses the larger of 013 or the calculated weight based on this factor.

Cost Elements Affected: 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 158. Operational unit volume (Ft^3)

015 OPERATING EQUIPMENT LEASEHOLDS ($/Yr)

This is the service wide annual cost to lease special or peculiar equipment, devices, communication circuits, and material required for support of the materiel equipment. The user may optionally enter a value here or in 016 to calculate this value.

Cost Elements Affected: 315

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 159. Operating equipment leaseholds ($/Yr)

016 OPERATING EQUIPMENT LEASEHOLDS/OPERATING SITE ($/Yr)

This is the annual cost to lease special or peculiar equipment, devices, communications circuits and material required at each operational site defined in 05 (# of operational sites). This value is used to calculate a value for cost element 315 only if no value is entered in 015.

Cost Elements Affected: 315

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 160. Operating equipment leaseholds/operating site ($/Yr)

017 OTHER OPERATING COSTS ($/Yr)

This is annual operating costs which are not specifically included in other operations cost elements. The user may enter a cost for 017 if only O&M dollars are involved. If an entry is made for 017, the model will skip 018, 019, 020, and 021. If other type dollars are involved enter a <CR> for 017 and enter the costs by budget category as follows:

018 Procurement
019 O&M
020 Other Procurement
021 Military Personnel

Cost Elements Affected: 317

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 161. Other operating costs ($/yr)

022 ORGANIZATIONAL MAINTENANCE FACILITIES COST ($/Yr)

This is the annual cost for service wide upkeep of organizational maintenance facilities, including the cost of real property where applicable. Included are direct labor, material, overhead, and other direct charges. This excludes deployable maintenance vans. If a value is entered here, the Model will skip 023, 024, and 025.

Cost Elements Affected: 321.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 162. Organizational maintenance facilities cost ($/Yr)

023 NUMBER OF ORGANIZATIONAL MAINTENANCE SITES (#)

This factor represents the number of sites employed at the organizational level for maintenance of the equipment/system. It is applied to the size of the sites (ft^2) and the annual maintenance cost per square foot to yield the total annual maintenance cost. This excludes deployable maintenance vans.

Cost Element Affected: 321, 321.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 163. Number of organizational maintenance sites (#)

024 SIZE OF ORGANIZATIONAL MAINTENANCE SITE (Ft^2)

This is the average number of square feet of space required for an adequate organizational maintenance facility.

Cost Elements Affected: 321.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 164. Size of organizational maintenance site (Ft^2)

025 ORGANIZATIONAL MAINTENANCE FLOOR AREA COST ($/Ft^2/Yr)

This is the annual cost per square foot to maintain the floor area required for organizational maintenance of the equipment/system. It includes direct labor, material, overhead, and other direct charges as applicable. This does not apply to deployable maintenance vans. It excludes direct labor performed by unit maintenance personnel entered in the Model's T/O data base.

Cost Elements Affected: 321.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 165. Organizational maintenance floor area cost ($/Ft^2/Yr)

026 INTERMEDIATE MAINTENANCE FACILITIES COST ($/Yr)

This is the annual service wide cost for upkeep of intermediate level maintenance facilities including real property. It includes direct labor, overhead, material and other direct charges. Excluded are deployable maintenance vans which should be costed in the WBS data base. If a value is entered here, the Model will skip 027, 028, and 029.

Cost Elements Affected: 322.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 166. Intermediate maintenance facilities cost ($/Yr)

027 NUMBER OF INTERMEDIATE MAINTENANCE SITES (#)

This is the number of sites employed at the intermediate level for maintenance of the equipment/system. It is applied to the size of the sites in square feet and the annual maintenance cost per square foot to yield the total annual maintenance cost. This excludes deployable maintenance vans.

Cost Elements Affected: 322, 322.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 167. Number of intermediate maintenance sites (#)

O28 SIZE OF INTERMEDIATE MAINTENANCE SITE (Ft^2)

This is the average number of square feet of space required for each intermediate maintenance facility for the materiel system. This includes DSU and GSU type units where appropriate. This excludes deployable maintenance vans.

Cost Elements Affected: 322.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

Figure 168. Size of intermediate site (Ft^2)

029 INTERMEDIATE MAINTENANCE FLOOR AREA COST ($/Ft^2/Yr)

This is the annual cost per square foot to maintain the floor area required for each intermediate maintenance facility. It includes direct labor, overhead, material, and other direct charges as applicable. This excludes deployable maintenance vans.

Cost Elements Affected: 322.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 169. Intermediate maintenance floor area cost $/Ft^2/Yr)

030 MAINTENANCE OF OPERATIONAL SOFTWARE CENTER ($/Yr)

This is the annual cost for upkeep of Government facilities for the maintenance of operational software including the maintenance of real property where applicable. Costs include direct labor, material, overhead, maintenance, consumables for non-prime mission equipment telecommunications, and other direct charges. A value must be entered for 033 for this cost to be calculated.

Cost Elements Affected: 325, 325.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 170. Maintenance of operational software center ($/Yr)

031 CONTRACT MAINTENANCE OF OPERATIONAL SOFTWARE ($/Yr)

This is fully burdened annual cost of contractor support for maintenance of operational software. It includes the cost of direct labor, material, overhead and other direct charges as well as G&A and fee. A value must be entered for 032 for this cost to be calculated.

Cost Elements Affected: 325.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 171. Contract maintenance of operational software ($/Yr)

032 NUMBER YEARS OF CONTRACT MAINTENANCE OF OPERATIONAL SOFTWARE (Yrs)

This is the expected number of years of contractor support necessary for maintenance of operational software. This excludes efforts related to maintenance and diagnostic software developed for diagnosis of hardware failures.

Cost Elements Affected: 325.3

Note: This may be a decimal value, e.g., 7.5 years. First years costs are based on the number of operational months after IOC.

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 172. Number years of contract maintenance of operational software

033 NUMBER YEARS OF GOVERNMENT MAINTENANCE OF OPERATIONAL S/W (Yrs)

This is the expected number of years during which the Government is responsible for the maintenance of operational software.

Cost Elements Affected: 325.1, 325.2

Note: Government efforts begin after contractor efforts (032) if any are completed. If there are no contractor efforts, the Model costs 1st year efforts only for the number of months equipments are operational. If a zero is entered here, no Government S/W costs will be calculated for 325.1 or 325.2.

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 173. Number years of Government maintenance of operational software

034 MAINTENANCE OF MAINT & DIAG SOFTWARE CENTER ($/Yr)

This is the annual cost for the upkeep of Government facilities for the maintenance of maintenance & diagnostic software including the maintenance of real property where applicable. Costs include direct labor, material, overhead, maintenance, consumables for non-prime mission equipment, telecommunications, and other direct charges.

Cost Elements Affected: 326, 326.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 174. Maintenance of maint & diag software center ($/Yr)

035 CONTRACT MAINTENANCE OF MAINT & DIAG SOFTWARE ($/Yr)

This is the fully burdened annual cost of contractor support for maintenance of maintenance and diagnostic software. It includes the cost of direct labor, overhead and other direct charges as well as G&A and fee.

Cost Elements Affected: 326.3

Note: A value must be entered on 036 for this cost to be calculated.

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 175. Contract maintenance of maint & diag software ($/Yr)

036 NUMBER YEARS CONTRACT MAINTENANCE OF MAINT & DIAG SOFTWARE (Yrs)

This is the expected number of years of contractor support necessary for maintenance of maintenance and diagnostic software. This excludes efforts related to operational software developed for the prime mission equipment. This may be partial years (7.5). First year costs are based on months after IOC.

Cost Elements Affected: 326.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 176. Number years contract maintenance of maint & diag software (Yrs)

037 NUMBER YEARS GOVERNMENT MAINTENANCE OF MAINT & DIAG S/W (Yrs)

This is the expected number of years during which the Government is responsible for the maintenance of maintenance and diagnostic software.

Cost Elements Affected: 326.1, 326.2

Note: Government maintenance starts after contractor maintenance (036) is complete.

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 177. Number years government maintenance of maint & diag software (Yrs)

038 CONTRACTOR SERVICES ($/Yr)

This is the fully burdened annual cost of contractor support in the areas of engineering and technical services and in the maintenance of systems/equipment. Contractor engineering and technical services cover advice, instruction and training in the installation, operation and maintenance of the equipment/system. Contractor maintenance support may be one-time or on a continuing basis, without distinction as to the level of maintenance involved, and includes the costs of direct labor, travel, material, overhead and other direct charges. This cost will be incurred for the length of time specified in 039.

Cost Elements Affected: 327

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 178. Contractor services ($/Yr)

O39 NUMBER OF YEARS OF CONTRACTOR SUPPORT (YRS)

This is the period of time in years or fractions of years from the moment the system achieves operational capability that support contractors will be assigned to system support. Fractional years are costed at the end of the support period. The first year of operations is only charged for the number of months during which the equipments are operational.

Cost Elements Affected: 327

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 179. Number of years of contractor support (Yrs)

040 SUPPLY FACILITIES ($/Yr)

This is the annual cost of the maintenance of service wide supply facilities for the equipment/system including the maintenance of real property where applicable. These facilities may be located at organizational, intermediate and field depot levels. Included are direct labor, material, overhead, and other direct charges as may be applicable. Excluded are general storage costs which are covered under Cost Element 343.2, Inventory Distribution/Holding. If an entry is made for this factor, the Model will skip 041-050.

Cost Elements Affected: 342

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 180. Supply facilities ($/Yr)

041 MAINTENANCE OF ORGANIZATIONAL SUPPLY FACILITIES ($/FT^2/Yr)

This is the average service wide annual cost per square foot to maintain organizational supply facilities for the equipment/system. It includes direct labor, overhead, material and other direct charges including real property where applicable. General storage costs are included in Cost Element 343.2, Inventory Distribution/Holding.

Cost Elements Affected: 342.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 181. Maintenance of organizational supply facilities ($/Ft^2/Yr)

042 FLOOR SPACE REQUIREMENTS FOR ORGANIZATIONAL SUPPLY (FT^2/SITE)

This is the floor space in square feet required at each organizational site with supply facilities to support the equipment/system. Excluded is space required for general storage not related to the system except when the system being costed will cause the creation of new units with associated general storage requirements. The Model uses this value with 041 and 023 to calculate 342.1.

Cost Elements Affected: 342.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 182. Org supply requirements for organization supply (Ft^2/site)

043 MAINTENANCE OF INTERMEDIATE SUPPLY FACILITIES ($/FT²/YR)

This element is the service wide average annual cost per square foot to maintain intermediate supply facilities required by the equipment/system including real property where applicable. It includes direct labor, overhead, material and other direct charges. General storage costs are included in Cost Element 343.2, Inventory Distribution/Holding.

Cost Elements Affected: 342.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 183. Maintenance of intermediate supply facilities ($/Ft²/Yr)

044 FLOOR SPACE REQUIRED FOR INTERMEDIATE SUPPLY (FT^2/SITE)

This is the floor space in square feet required for each intermediate supply facility, excluding space required for purposes of general storage. The Model will use this value to calculate 342.2 with 027 and 043.

Cost Elements Affected: 342.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 184. Floor space required for intermediate supply (Ft^2/site)

045 MAINTENANCE OF FIELD DEPOT SUPPLY FACILITIES ($\$/FT^2/YR$)

This is the service wide average annual cost per square foot to maintain supply facilities at the field depot level which are required for support of the equipment/system. It includes direct labor, overhead, material and other direct charges such as real property where applicable. Excluded are general storage costs included under 343.2 Inventory Distribution/Holding.

Cost Elements Affected: 342.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 185. maintenance of field depot supply facilities ($\$/Ft^2/Yr$)

046 FLOOR SPACE REQ FOR FIELD DEPOT SUPPLY FACILITY (FT^2/Site)

This is the floor space required, in square feet, to accommodate each field depot for support of the equipment/system. This factor will be used with 047 (number of field depots) to calculate 324.3, Maintenance of Field Depots.

Cost Elements Affected: 342.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 186. Floor space req for field depot supply facility (Ft^2/site)

047 NUMBER OF FIELD DEPOT SUPPLY SITES (#)

This is the number of field depot supply sites required to support the equipment/system.

Cost Elements Affected: 342.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 187. Number of field depot supply sites (#)

048 BONDED STORAGE COST ($/Yr)

This is the annual service wide cost to provide bonded storage facilities for the materiel system. This includes all direct costs associated with operation and maintenance of a bonded storage site allocated to the system. An entry for 048 will cause the Model to skip 049 and 050.

Cost Elements Affected: 342.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 188. Bonded storage cost ($/Yr)

049 NUMBER OF BONDED STORAGE SITES

This is the number of bonded storage sites required to store high value or special security items used by the materiel systems. This value is used to calculate 342.4 only if no entry is made for 048.

Cost Elements Affected: 342.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 189. Number of bonded storage sites

050 COST PER BONDED STORAGE SITE ($/Yr)

This is the fully burdened cost to operate and maintain that portion of each bonded storage site required to support the material system. This factor is used to calculate the bonded storage cost only if no entry is made for 048.

Cost Elements Affected: 342.4

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 190. Cost per bonded storage site ($/Yr)

051 TECHNICAL DATA REVISIONS ($/Yr)

This is the average annual cost to update the technical data required for operation, maintenance, and supply support of the system, its components, and its support equipment. This includes both Government and contractor costs. If a value is entered for 051, the Model will skip 052 and 053.

Cost Elements Affected: 350

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 191. Technical data revisions ($/Yr)

052 TECHNICAL DATA REVISIONS ($/Page)

This factor represents the annual cost to revise a page of technical data required for operations, maintenance, and supply support of the system, its components, and its support equipment. It includes both Government and contractor costs. This factor is used to calculate 350, Technical Data Revisions, only if no value is entered for 051.

Cost Elements Affected: 350

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 192. Technical data revisions ($/page)

053 TECHNICAL DATA PAGES REQUIRING REVISION (Pages)

This is the average number of pages of technical data which require revision each year. This factor is used to calculate 350 (Technical Data Revisions) only if no value is entered for 051.

Cost Elements Affected: 350

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 193. Technical data pages requiring revision (pages)

054-057 NUMBER OF NEW FSN/NSN ITEMS (#)

When a new item enters the supply system, it is assigned a National Stock Number (NSN). Associated with each NSN are introduction-to-inventory costs and annual management costs. These costs are estimated based on the dollar value of the item. Thus, this factor classifies new FSN/NSN items by number of items which fall into the following four categories of dollar value:

Under $5,000
$5,000 - $49,999
$50,000 - $500,000
Over $500,000

Cost Elements Affected: 343.1

Comments/Calculations:

Input #	Categories	Expected Value	High	Low	Reference	Date
054	Under $ 5,000					
055	$ 5,000 - $ 49,999					
056	$ 50,000 - $500,000					
057	Over $500,000					

FIGURE 194. Number of new FSN/NSN items (#)

058 OTHER LOGISTIC SUPPORT COSTS ($/Yr)

This element includes the annual cost of any logistic support requirements for the equipment/system not specifically included in other logistic support cost elements, i.e., Cost Element 320 through Cost Element 350. The user may enter a single cost for 058 if only O&M costs are involved. This will cause the Model to skip 059-062. If costs are in multiple POM categories, enter a carriage return for 058 and enter the costs as follows:

059	Procurement
060	O&M
061	Other Procurement
062	Military Personnel

Cost Elements Affected: 360

Comments/Calculations:

FIGURE 195. Other logistic support costs ($/Yr)

5.5 Operating and support output. The O&S cost element structure is shown in Table II. These costs are calculated using costs and cost factors from each of the Model's files. This section defines each of the O&S outputs and shows how they are computed using variables from the Model's files. For the sake of clarity, the equations presented in this section do not account for time or inflation. Both time and inflation are accounted for by spreading functions derived from the deployment schedule (see 5.12) and composite inflation rates (see 5.13) for each year of operation.

Table II. Operating and support cost element structure.

300 OPERATIONS AND SUPPORT	320 MAINTENANCE
310 OPERATIONS	321 ORGANIZATIONAL MAINTENANCE
311 OPERATOR PERSONNEL	321.1 PERSONNEL
311.1 CREW	321.1.1 MILITARY MAINT PERS
311.1.1 MILITARY CREW	BASE PAY AND ALLOWANCES
BASE PAY AND ALLOWANCES	REPLACEMENT TRAINING
REPLACEMENT TRAINING	HEALTH CARE
HEALTH CARE	PERM CHANGE OF STATION
PERM CHANGE OF STATION	RETIREMENT
RETIREMENT	TRANS,PRIS,PATIENTS
TRANS,PRIS,PATIENTS	BASE OPERATING SUPT
BASE OPERATING SUPT	321.1.2 CIVILIAN MAINT PERS P&A
311.1.2 CIVILIAN CREW P&A	321.2 MAINT MATERIAL
311.2 INDIRECT PERSONNEL	321.2.1 DISCARDED SPARES
311.2.1 MILITARY INDIRECT	321.2.2 REPAIR MATERIAL
BASE PAY AND ALLOWANCES	321.3 TRANSPORTATION
REPLACEMENT TRAINING	321.4 ORG MAINT FACILITIES
HEALTH CARE	322 INTERMEDIATE MAINTENANCE
PERM CHANGE OF STATION	322.1 INTER MAINT PERSONNEL
RETIREMENT	322.1.1 MILITARY MAINT PERS
TRANS,PRIS,PATIENTS	BASE PAY AND ALLOWANCES
BASE OPERATING SUPT	REPLACEMENT TRAINING
311.2.2 CIVILIAN IND P&A	HEALTH CARE
312 MATERIAL CONSUMPTION	PERM CHANGE OF STATION
312.1 OIL,LUBRICANTS(LESS FUEL)	RETIREMENT
312.2 AMMUNITION,MISSILES	TRANS,PRIS,PATIENTS
312.3 OTHER MATERIAL	BASE OPERATING SUPT
312.4 MATERIAL TRANSPORTATION	322.1.2 CIVILIAN MAINT PERS P&A
313 ENERGY CONSUMPTION	322.2 MAINT MATERIAL
313.1 FUEL	322.2.1 DISCARDED SPARES
313.2 ELECTRIC POWER	322.2.2 REPAIR MATERIAL
313.3 BATTERIES	322.3 TRANSPORTATION
313.4 TRANSPORTATION	322.4 INTER MAINT FACILITIES
314 OPERATIONAL FACILITIES	323 DEPOT REPAIR
315 EQUIPMENT LEASEHOLDS	323.1 LABOR
316 OPERATIONAL TRANSPORTATION	323.2 MATERIAL
317 OTHER OPERATIONS COSTS	323.3 TRANSPORTATION

Table II. Operating and support cost element structure. - Continued

324 DEPOT OVERHAUL	326.2 SOFTWARE CENTER
324.1 LABOR	326.3 CONTRACT S/W MAINTENANCE
324.2 MATERIAL	327 CONTRACT SUPPORT SERVICES
324.3 TRANSPORTATION	330 MODIFICATIONS
325 SYSTEM SOFTWARE SUPPORT	340 SUPPLY SUPPORT
325.1 SOFTWARE MAINT PERSONNEL	341 SUPPLY PERSONNEL
325.1.1 MILITARY S/W PERS	341.1 ORGANIZATIONAL SUPPLY
BASE PAY AND ALLOWANCES	341.2 INTERMEDIATE SUPPLY
REPLACEMENT TRAINING	341.3 FIELD DEPOT
HEALTH CARE	342 SUPPLY FACILITIES
PERM CHANGE OF STATION	342.1 ORGANIZATIONAL SUPPLY
RETIREMENT	342.2 INTER SUPPLY
TRANS,PRIS,PATIENTS	342.3 FIELD DEPOT
BASE OPERATING SUPT	342.4 BONDED STORAGE
325.1.2 CIVILIAN S/W PERS P&A	343 INVENTORY ADMINISTRATION
325.2 SOFTWARE CENTER	343.1 INVENTORY MANAGEMENT
325.3 CONTRACT S/W MAINTENANCE	343.2 INVENTORY DIST/HOLDING
326 MAINT&DIAG SOFTWARE SUPPORT	350 TECH DATA REVISIONS
326.1 MAINT&DIAG S/W PERSONNEL	360 OTHER LOGISTIC SUPT COSTS
326.1.1 MILITARY S/W PERS	
BASE PAY AND ALLOWANCES	
REPLACEMENT TRAINING	
HEALTH CARE	
PERM CHANGE OF STATION	
RETIREMENT	
TRANS,PRIS,PATIENTS	
BASE OPERATING SUPT	
326.1.2 CIVILIAN S/W PERS P&A	

5.5.1 Operating and support cost (O&S) (300). This is the sum of all annual costs resulting from the operation, maintenance and support (including personnel support) of the materiel system after it is accepted into the Service's inventory. O&S cost build-up begins when the first production equipment enters the active or reserve force structure either as operating unit equipment or combat crew training equipment and ends when the last equipment is retired. It includes all deployed unit operations, below depot maintenance, installation support, depot maintenance, supply management, operational and maintenance transportation, personnel support and training and sustaining investment (e.g., replenishment spares, modification kits and material, etc.) costs associated with the operating and support phase of the life cycle.

Sums To: Total Life Cycle Cost

5.5.2 Operations (310). This is the sum of the annual costs to operate the prime mission equipment. It includes the annual cost of operators, material consumption, energy consumption, operational facilities, equipment leaseholds, operational transportation, and any other system specific operations cost to use the system. This excludes use of the equipment by formal Program 8 schools if such use is included in the cost of recurring

MOS training. It also excludes use by depot level activities if such costs are contained in the depot material rates.

Sums To: 300 Operations and Support

5.5.3 Operator personnel (311). This is the sum of the annual manpower costs, direct and indirect, incurred in operating the equipment. Included are the cost of military and civilian operational crews and the cost of military and civilian indirect personnel. Personnel costs are calculated based on the specified Table of Organization.

Sums To: 310 Operations

5.5.4 Crew (311.1). This is the sum of the annual costs of military and civilian personnel whose primary function is to operate the system being costed. It includes both direct and indirect personnel, military and civilian. These costs are calculated separately for each WBS class and for each equipment GROUP.

Sums To: 311 Operator Personnel

5.5.5 Military crew (311.1.1). This is the sum of the annual costs of:

a. Dedicated (T/O level OPRD) military personnel whose primary function is to operate the system being costed and

b. Shared (T/O level OPRS) military personnel whose operator duties are secondary to other assigned functions. Shared personnel are charged to the system based on demand. See 5.8.2.1.2.

Crew costs consist of pay and allowances, replacement training, health care,permanent change of station, retirement allowance (this is not added to the POM and Army report), base operating support, and an overhead charge for crew members who are in the status of transients, patients and prisoners.

Dedicated personnel are fully charged to the system based on manning levels (A8) and the number in the T/O.

Shared personnel are charged based on demand generated by WBS equipment records. For shared personnel, the Model calculates a weighted average hourly cost for each WBS class and equipment GROUP. The weighted average is based on the number (5.8.2.3) assigned to each line in the T/O and the number of hours each works/year(A21).

Excluded are the costs of security personnel and personnel who operate other equipment in the force unit such as trucks and switchboards. (These personnel may be charged to the system using the indirect (INDD) level.) See also 5.8.

311.1.1 Mil Crew Cost = Annual Cost of Dedicated Operators(OPRD)
+ Annual Cost of Shared Operators(OPRS)

Where:
Annual Cost of
Dedicated Oprs = Manning level(A8)
* Sum of the following costs derived from the Model's data base for all OPRD personnel:

Pay and Allowances
+ Replacement Training
+ Health Care
+ Permanent Change of Station
+ Base Operating Support
+ Transients, Patients, Prisoners
+ Retirement Allowance (Non add for POM and Army)

Annual Cost of
Shared Oprs = Weighted Avg cost/hour of the above charges for OPRS personnel for each WBS class and equipment GROUP
* Operating equipment quantity (E1)
* Operating hours (hours/year) (E2)
* Number of shared operators/equipment (E3)
/ available operator manhours per year (A21)

Sums To: 311.1 Crew

5.5.6 Civilian crew (311.1.2). This is the sum of the annual costs of:

a. Dedicated (T/O level OPRD) civilian personnel whose primary function is to operate the system being costed and

b. Shared (T/O level OPRS) civilian personnel whose operator duties are secondary to other assigned functions. Shared personnel are charged to the system based on demand. See 5.8.2.1.2.

Crew costs for civilian personnel include pay and allowances, benefits, workmen's compensation, retirement and training.

Dedicated personnel are fully charged to the system based on the number in the T/O. Manning level (A8) does not apply to civilians.

Shared personnel are charged based on demand generated by WBS equipment records. For shared personnel, the Model calculates a weighted average hourly cost for each WBS class and equipment GROUP. The weighted average is based on the number (5.8.2.3) assigned to each line in the T/O and the number of hours each works/year (A21). The Model uses the same productivity factors for military and civilian personnel.

Excluded are the costs of security personnel and personnel who operate other equipment in the force unit such as trucks and switchboards. (These personnel may be charged to the system using the indirect (INDD) level.) See also 5.8.

311.1.2 Civ Crew Cost = Annual Cost of Dedicated Opr Pers
+ Annual Cost of Shared Opr Pers

Where:
Annual Cost of Dedicated Oprs = Total Cost of Operators per GS Level for each WBS class and equipment GROUP combination

Annual Cost of
Shared operators = Weighted Avg cost/hour of the above charges for OPRS personnel for each WBS class and equipment GROUP
* Operating hours (hr/yr) (E2)
* Number of shared operators/equipment (E3)
/ available operator manhours per year (A21)

Sums To: 311.1 Crew

5.5.7 Indirect personnel (311.2). This element includes the annual costs of military and civilian personnel assigned to units below field depot level whose billets exist because of the system being costed. Examples of personnel who may fit this definition are special security personnel, company commanders, switchboard operators and truck drivers not directly involved in the operation or maintenance of the system.

The allocation of personnel to crew or indirect status is a policy decision. The primary use of the indirect category is to fully recognize the cost of personnel in a unit who are not subject to savings by the Program Manager or the contractor but who are assigned to the unit because of the system being costed. If these personnel also support other systems, their number in the T/O should be adjusted to account only for the percentage of their time dedicated to the system being costed. See 5.8.2.

Sums To: 311 Operator Personnel

5.5.8 Military (311.2.1). This is the sum of the annual costs of military indirect personnel. Included are pay and allowances, replacement training, health care,permanent change of station, base operating support, retirement allowance (this is not added for the POM and Army reports), and an overhead charge for personnel who are in the status of transients, prisoners and patients.

Indirect military personnel are costed as dedicated (INDD) personnel. The number of personnel may be entered in decimal form to represent less than 100 percent of the cost.

311.2.1 Indirect Mil Pers = manning level (A8)
* Sum of the following costs for every INDD line in the T/O:
Pay and Allowances
\+ Replacement Training
\+ Health Care
\+ Permanent Change of Station
\+ Retirement allowance
\+ Transients, Prisoners, Patients
\+ Base Operating Support

Sums To: 311.2 Indirect Personnel

5.5.9 Civilian (311.2.2). This is the sum of the annual costs of civilian indirect personnel. Included are pay and allowances, benefits, workmen's compensation, retirement and training.

Indirect civilian personnel costs are based on T/O assignments to the INDD level. The number of personnel may be entered in decimal form to represent less than 100 percent of the cost.

311.2.2 Indirect Civ Pers = Annual Manyears of Effort Per GS Level
* annual Manyear Cost per GS Level.

Sums To: 311.2 Indirect Personnel

5.5.10 Operational material consumption (312). This element covers the annual costs of nonmaintenance materials consumed in operating the system and the cost of transporting these materials between supply points. Material costs are divided into three major categories:

(1) Petroleum, oils and lubricants (POL) excluding POL which provides energy required to operate the system included in Cost Element 313.

(2) Ammunition and missiles consumed in crew (unit) training but excluding training missiles acquired during the production phase, and ammunition for small arms qualification which is included in Cost Element 317, Other Operations Costs; and

(3) Other operational materials such as assault communications wire, paper, fire suppression materials and specialized paper products.

Sums To: 310 Operations

5.5.11 Oil, lubricants (less fuel) (312.1). This is the sum of the annual costs of hydraulic oil and lubricants consumed in operating prime mission equipment(s) at all levels including active reserve units and other supporting agencies where the equipment is assigned. This excludes fuel consumed to power the equipment and its subsystems.

312.1 Oil, Lubricants = Operating Equipment Quantity(E1)
* Type 1 Material Consumption Rate (units/yr)(E10)
* Type 1 Material Cost($/unit)(E12)

Sums To: 312 Operational Material Consumption

5.5.12 Ammunition and missiles (312.2). This element includes the annual cost of ammunition and missiles associated with training the unit or crew to which the system/equipment is assigned.

Excluded are the cost of training ammunition and missiles acquired during the production (investment) phase and costed therein, costs for formal schools if included in the cost of recurring training, and the cost of ammunition for annual small arms qualification included in Cost Element 317, Other Operations Costs.

312.2 Ammunition, Missiles = Operating Equipment Quantity(E1)
* Type 2 Material Consumption Rate(units/yr)(E10)
* Type 2 Material Cost($/unit)(E12)

Sums To: 312 Operational Material Consumption

5.5.13 Other operational material (312.3). This is the sum of the annual costs of nonmaintenance material (less POL and ammunition) consumed in operating prime mission equipment(s) at all levels including active reserve units and other supporting agencies where the equipment is assigned. Examples include teletype paper, magnetic tapes, and assault communications wire.

312.3 Other Material = Operating Equipment Quantity(E1)
* Type 3 Material Consumption Rate(units/yr)(E10)
* Type 3 Material Cost($/unit)(E12)

Sums To: 312 Operational Material Consumption

5.5.14 Material transportation (312.4). This is the sum of the annual costs to transport operational (nonmaintenance) material consumed in operating prime mission equipment(s) at all levels including active reserve units and other supporting agencies where the equipment is assigned.

312.4 Material Transportation = Operating Equipment Quantity(E1)
* Material Consumption (units/yr)(E10)
* Material Weight(E13)
* Transportation Cost(calculated)

Where:

Transportation Cost
for Material Type 1 = Distance between Org and Int level (miles)(A9)
* Local transportation cost ($/lb/mile)(A14)

Transportation Cost for
Material Types 2 and 3 = (Distance between Org and Int level (miles)(A9)
* local transportation cost ($/lb/mile)(A14))
+ (Avg Dist from intermediate to depot (miles)
* Depot transportation cost($/lb/mi)(A15))

Where the average distance
from inter to depot = (A11*O2 + A12*O3 + A13*O4)/(O2+O3+O4)

Sums To: 312 Operational Material Consumption

5.5.15 Energy consumption (313). This is the sum of the annual costs of energy required to operate WBS items. This includes:

a. The cost of fuel (POL) to operate the equipment,

b. The cost of commercial and field electricity consumed in operating the equipment,

c. The cost of batteries consumed by the equipment, and

d. The cost of transportation associated with the supply of energy.

Sums To: 310 Operations

5.5.16 Fuel (313.1). This is the sum of the annual cost of fuel consumed to operate prime mission equipment(s) at all levels including active and reserve units, and other supporting agencies where the equipment is assigned. Both the cost and the power use factor must be greater than 0 for this formula to work. This excludes costs for formal school training. See 5.7.6.17 for definitions of each variable.

313.1 Fuel = Operating Equipment Quantity(E1)
* Number of Annual Operating Cycles(E2)
* Power Consumption (units/cycle)(E14)
* (Comm Power Cost(E17) * Comm Power Use Factor(E20)
+ Field Power Cost(E16) * Field Power Use Factor(E19))

Sums To: 313 Energy Consumption

5.5.17 Electric power (313.2). This is the sum of the annual costs of field generated and commercially supplied electricity consumed in operating and testing prime mission equipment(s) at all levels including active and reserve units and other supporting agencies where the equipment is assigned.

313.2 Electric Power = Operating Equipment Quantity(E1)
* Number of Annual Operating Cycles(E2)
* Power Consumption (units/cycle)(E14)
* (Comm Power Cost(E17) * Comm Power Use Factor(E20)
+ Field Power Cost(E16) * Field Power Use Factor(E19))

Sums To: 313 Energy Consumption

5.5.18 Batteries (313.3). This is the sum of the annual costs of batteries consumed to operate prime mission equipment(s) at all levels including active and reserve units and other supporting agencies.

If the WBS item consumes two types of power (e.g., electronic systems with rechargeable batteries), a separate WBS record must be entered to account for the battery. See also 5.7.6.

313.3 Batteries = Operating Equipment Quantity(E1)
* Number of Annual Operating Cycles(E2)
* Battery Consumption (units/cycle)(E14)
* (Comm Battery Cost(E17) * Comm Battery Use Factor(E20)
+ Field Battery Cost(E16) * Field Battery Use Factor(E19))

Sums To: 313 Energy Consumption

5.5.19 Transportation (313.4). This is the sum of the annual cost of transporting fuel to using commands and batteries from the depot to the intermediate supply facility and then to the ordering command.

Excluded is the cost of transportation of POL to bases as this expense is included in the price of POL. The assumption is made that the cost of fuel includes the cost to deliver the fuel to the base but not to the operating units on the base. There is no transportation charge for electricity.

313.4 Energy Transportation = Operating Equipment Quantity(E1)
* Annual Operating Cycles(E2)
* Power Consumption (units/cycle)(14)
* Power Weight(lbs/unit)(E18)
* Transportation Cost($/lb)(calculated)

Where transportation cost =

Trans to using commands = Local Trans Cost ($/lb/mi)(A14)
* Distance Org - Int(mi)(A9)

+ (for batteries only)

Trans Depot to int = Long Distance Trans Cost ($/lb/mi)(A15)
* Avg. Distance Int to Depot(mi)(calculated)

Where the average distance
from inter to depot = (A11*02 + A12*03 + A13*04)/(02+03+04)

Sums To: 313 Energy Consumption

5.5.20 Operational facilities (314). This is the sum of the annual costs (direct labor, material, overhead and other direct charges) to operate real property facilities used to house prime mission equipment. This excludes deployable shelters.

Operational Facilities costs may be entered as a gross amount for cost element 314 (O(1)) or as cost factors (see operations and support inputs for 314). The following cost formula is employed when cost factors are entered for Operational Facilities:

314 Operational Facilities = Operational facility cost($/yr) (O1)
or if O1 = 0
= Number of commands with Oper Facilities (O5)
* Size of Operational Site(ft^2)(O6)
* Maintenance Cost($/$ft^2$/yr)(O7)

Sums To: 310 Operations

5.5.21 Equipment leaseholds (315). This is the annual cost of leasing special and peculiar support equipment, devices, communication circuits, or material during the operating phase of the equipment/system life cycle.

Cost for annual equipment leaseholds may be entered as a gross amount for the entire system, or they may be entered on a per operational site basis.

315 Equipment Leaseholds = Equipment leasehold cost ($/yr) (O15)
or if O15 = 0
= Cost of Equip Leaseholds($/yr/site)(O16)
* Number of Sites with Oper Facilities(O5)

Sums To: 310 Operations

5.5.22 Operational unit transportation (316). This is the sum of the annual costs of transporting prime mission equipment from one operational site to another for operational and training purposes.

316 Operational Transportation = System oper trans cost($/yr)(08)
or if 08 = 0
= Oper unit lift weight (calculated)

*(Training Trans. miles/yr - Truck(09)
* Truck Rates(A16)
+
Training Trans. miles/yr - Rail(010
* Rail Rates(A17)
+
Training Trans. miles/yr - Sea(011)
* Sealift Rates(A18)
+
Training Trans. miles/yr - Air(012)
* Airlift Rates(A19))

Where Oper unit lift weight = the larger of
operational unit lift weight(tons)(013) or
operational unit lift volume(ft^3)(014)/40

Sums To: 310 Operations

5.5.23 Other operating costs (317). This is the sum of any annual direct operating costs not included in other O&S cost elements. Examples are:

(1) Ammunition for annual small arms qualification.

(2) Transportation of operational materials from supply locations/depots to the user if not included in the cost of special material or in Cost Element 312.4.

This cost may be entered by appropriation. See Figure 161.

Sums To: 310 Operations

5.5.24 Maintenance (320). This is the sum of the annual costs to maintain the equipment/system based on the maintenance concept(s). Maintenance includes all actions taken to retain an end item in a serviceable condition or restore it to serviceability. It includes inspection, testing, servicing, classification as to serviceability, repairs, 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 scheduling preventive maintenance. Maintenance of associated common and peculiar support equipment is also included.

Sums To: 300 Operations and Support

5.5.25 Organizational maintenance (321). This is the sum of the annual costs of maintenance at the organizational level. Organizational maintenance is the responsibility of and performed by the using unit. It includes work performed by the user or operator (1st echelon) and that performed by specially trained organizational maintenance personnel (2nd echelon maintenance).

Sums To: 320 Maintenance

5.5.26 Personnel (321.1). This is the sum of the annual costs, direct and indirect, of maintenance personnel at the organizational level. It includes both corrective and preventive maintenance. Organizational maintenance is the responsibility of, and performed by, the using organization on its assigned equipment. It normally consists of inspecting, servicing, lubricating, and adjusting the equipment and the replacement of parts, minor assemblies and subassemblies.

Sums To: 321 Organizational Maintenance

5.5.27 Military personnel (321.1.1). This is the sum of the annual manpower costs, direct and indirect, of military personnel who maintain the equipment at the organizational level. It includes both shared (OLMS) and dedicated (OLMD) maintenance personnel.

The cost includes pay and allowances, replacement training, health care, permanent change of station, retirement allowance (not added to the POM or Army reports), an overhead charge for transients, prisoners and patients, and base operating support. Total personnel costs are charged for dedicated personnel regardless of the amount of work performed, whereas these costs are apportioned for part-time personnel based on the hours worked.

The organizational workload is time-phased based on the deployment schedule for operational equipment. Thus, annual maintenance costs will vary depending on the quantity of equipment operational during each year and will not level out until all planned deployments are completed. These costs are based on the Table of Organization.

```
321.1.1 Military Personnel = Sum of the following costs for every OLMD
                             line in the T/O by equipment GROUP and WBS
                             class within the GROUP:
                          Manning level (A22)
                        * (Pay and Allowances
                          + Health Care
                          + Replacement Training
                          + Permanent Change of Station
                          + Retirement Allowance(nonadd for POM & Army)
                          + Transients, Prisoners, Patients
                          + Base Operating Support)

                         + (if the workload exceeds dedicated manhours)
                           ((Estimated Maintenance workload(manhours)
                              - Available OLMD manhours)
                             * weighted avg. cost of OLMS personnel($/hr))
```

Available OLMD manhours = sum of the numbers assigned to each OLMD line in
the T/O by WBS class and equipment GROUP
* manning level field maintenance (A22)
* manhours/manyear-field maintenance (A20)

Maintenance Workload = The sum of the following for each equipment
GROUP and WBS class within the GROUP:

PM Preventive maintenance hours/yr(E31)

+

Failures(calculated)
Repair * Organizational maintenance rate (%)(M18)
*(MTTR(mhrs)(E24)+Organizational repair overhead (mhrs)(M32))
* (1 + probability good unit removal (%)(M39))

+

Lot Buy Quantity (#)(U12 or U4)
Modifications * Mean time to modify-field (MHRS) (M3)
* Modify rate-field (%) (M6)
* Organizational maintenance rate(%)(M18)
* Organizational repair rate (%) (M25)

Where Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2)/MTBF(E22)
Sums To: 321 Organizational Maintenance

5.5.28 Civilian personnel (321.1.2). This is the sum of the annual civilian manpower costs associated with organizational maintenance of equipment. It includes pay and allowances, benefits, workmen's compensation, retirement and training. These costs are based on the Table of Organization for civilian personnel assigned to level OLMD and OLMS. Manning level (A22) does not apply to civilian personnel.

321.1.2 Civ Personnel = Sum of the annual cost for civilian OLMD in T/O
+ (if the workload exceeds available manhours)
((Estimated maintenance workload(hours)
- Available OLMD manhours)
* weighted avg. cost of OLMS civ personnel)

Available OLMD manhours and maintenance workload are as defined in 5.5.27

Sums To: 321 Organizational Maintenance

5.5.29 Organizational maintenance material (321.2). This is the sum of the annual costs of spares discarded at the organizational level and the cost of repair materials (piece parts, etc.) consumed at that level.

Sums To: 321 Organizational Maintenance

5.5.30 Discarded spares (321.2.1). This is the sum of the annual costs of reparable spares which replace those discarded at the organizational level of maintenance.

321.2.1 Discarded Spares = Number of completed organizational repairs
* Organizational discard rate(M11)
* Reparable LRU cost(E7)

Where number of completed organizational repairs = Failures
* Org maintenance rate(M18) * Org repair rate(M25)

Where Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2)/MTBF(E22)

Sums To: 321.2 Maintenance Material

5.5.31 Repair material (321.2.2). This is the sum of the annual cost of repair parts, assemblies, consumables, and other materials expended during maintenance operations at the organizational level. Purchase of initial spares and repair parts is covered under the production phase estimate. Note that the discarded LRU cost, if used, is charged for every completed organizational repair action (maint rate*repair rate).

321.2.2 Repair Material = Number of completed organizational repairs
* (Discard LRU cost((E6)
+(Reparable LRU cost (E7)
* Repair material cost factor(E8)
* (1-Organizational discard rate(M11)))

Where number of completed organizational repairs = Failures
* Org maintenance rate(M18) * Org repair rate(M25)

Where Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2)/MTBF(E22)

Sums To: 321.2 Maintenance Material

5.5.32 Organizational maintenance transportation (321.3). This is the sum of the costs to transport spares and repair materials between supply points for use at the organizational level of maintenance. If organic vehicles are used for these deliveries and the use of organic vehicles is to be excluded from the analysis, set the short distance transportation cost (A14) or the distance from organization to intermediate (A9) = 0.

321.3 Transportation = Number of completed organizational repairs
(as defined in 5.5.30)
Replace repair parts and material * Transportation cost($/lb)(calculated)
* (LRU weight(E5) * Org discard rate (M11)
+ (Repair material weight(E9)* (1-Org discard rate))

+

Trans of failed equip 2 * Equip weight(E4)
* short dist trans cost(A14)
* distance from org to int(A9)

Where transportation cost =
(org to int) A14*A9
(depot to int to org) + A15*((A11*O2 + A12*O3 + A13*O4)/(O2+O3+O4))

Sums To: 321 Organizational Maintenance

5.5.33 Organizational maintenance facilities (321.4). This is the sum of the annual costs for upkeep of organizational maintenance facilities. It includes the maintenance of real property, where applicable. Direct labor, material, overhead and other direct charges are included. Maintenance of deployable maintenance vans is excluded.

321.4 Org Maint Facilities = Org maint facilities cost ($/yr) (O22)
or if O22 = 0
Org Maint Facilities = Number of org maint sites (O23)
* Size of org maint site (ft^2) (24)
* Org maint floor area cost ($/$ft^2$/Yr) (O25)

Sums To: 321 Organizational Maintenance

5.5.34 Intermediate maintenance (322). This is the sum of the annual costs of maintenance at the intermediate level. Intermediate maintenance (third and fourth echelons) is performed by designated activities/units in direct support of using organizations. It consists of calibration and repair/replacement of damaged or unserviceable parts, components, and assemblies; emergency manufacture of unavailable parts; and technical assistance to operational units. This cost element includes personnel, material, transportation and maintenance facilities. There are five categories of intermediate maintenance allowed by the Model, each with its own repair strategy and personnel:

a. Intermediate
b. Direct Support Unit
c. Direct Support Unit Contact Team
d. General Support Unit
e. General Support Unit Contact Team

Sums To: 320 Maintenance

5.5.35 Intermediate maintenance personnel (322.1). This is the sum of the annual costs of military and civilian personnel who perform maintenance at intermediate level maintenance activities. This normally consists of calibration and repair or replacement of damaged or unserviceable parts, components, or assemblies; the manufacture of critical nonavailable parts; and provision of technical assistance to using organizations. Intermediate maintenance is normally accomplished in fixed or mobile shops, tenders, shore-based repair facilities or by mobile teams. The Model partitions these costs by the five levels of repair within the intermediate maintenance activities, by equipment GROUP and by WBS class within each equipment GROUP.

Sums To: 322 Intermediate Maintenance

5.5.36 Military maintenance personnel (322.1.1). This is the sum of the annual manpower costs, direct and indirect, of dedicated (Category D) and shared (Category S) military maintenance personnel at each of the intermediate maintenance activities.

It includes the cost of pay and allowances, replacement training, health care, permanent change of station, retirement allowance(not added to the POM or Army reports), an overhead charge for transients, prisoners and patients, and base operating support.

The maintenance workload is time-phased based on the deployment schedule for operational equipment. Thus, annual maintenance costs will vary depending on the quantity of equipment operational during each year and will not level out until all planned deployments are completed.

```
322.1.1 Military Maintenance
          Personnel              = Manning level(A22)
                                 * Sum of the following costs for every
                                   T/O line with an intermediate level code
                                   (ILMD, DSUD, DCTD, GSUD, GCTD)
                                  (Pay and allowances
                                 + Health care
                                 + Replacement training
Dedicated Personnel              + Permanent change of station
                                 + Retirement allowance
                                 + Transients, prisoners, patients
                                 + Base operating support )

      + (if workload for any intermediate level of repair exceeds
            available manhours)

                              ((maint workload(hours) at each inter level
Shared Personnel                - Available maintenance manhours at
                                  each intermediate level)
                              * Weighted average labor cost by level($/hr))

Where:
Maintenance Workload = The sum of the following for each level
                       of intermediate maintenance (ILM, DSU,
                       DCT, GSU, GCT) in each equipment GROUP and
                       WBS class within the GROUP:

                       Failures
                     * Maintenance rate (%)(M19-M23)
Repair               * (MTTR(E25-E29) + Repair overhead (mhrs)(M33-M37))
                     * (1 + probability good unit removal (%)(M40-M44))
              +
                       Lot Buy Quantity (#)(U12 or U4)
                     * Mean time to modify-field (MHRS) (M3)
Modifications        * Modify rate-field (%) (M6)
                     * Maintenance rate(%)(M19-M23)
                     * Repair rate (%) (M26-M30)

Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2) /MTBF(E22)
```

Available manhours = sum of the numbers of ILMD, DSUD, DCTD, GSUD, GCTD for each inter acty in the T/O by WBS class and equipment GROUP
* manning level field maintenance (A22)
* manhours/manyear-field maintenance (A20)

Sums To: 322.1 Intermediate Maintenance Personnel

5.5.37 Civilian maintenance personnel (322.1.2). This is the sum of the annual manpower costs, direct and indirect, of dedicated (category D) and part-time (category S) Government civilian personnel engaged in intermediate level maintenance. It includes pay and allowances, benefits, workmen's compensation, retirement, and training. There is no manning level for civilian personnel.

322.1.2 Civilian Maintenance Personnel = Sum of the annual cost for every line of Dedicated civilian ILMD, DSUD, DCTD, GSUD, GCTD in the T/O
+
Shared ((Estimated maintenance workload
- Maintenance capabilities of ILMD, DSUD, DCTD, GSUD, GCTD personnel)
* Weighted average cost of ILMS, DSUS, DCTS, GSUS, GCTS civilian personnel)

Where:
Maintenance workload and capability are as defined in 5.5.36

Sums To: 322.1 Intermediate Maintenance Personnel

5.5.38 Maintenance material (322.2). This is the sum of the annual costs of spares which replace spares discarded at the intermediate level and the cost of repair materials (piece parts, etc.) consumed at that level.

Sums To: 322 Intermediate Maintenance

5.5.39 Discarded spares (322.2.1). This is the sum of the annual costs of reparable LRU's purchased to replace reparable LRU's discarded at intermediate maintenance sites.

322.2.1 Discard Spares = Sum by level of maintenance of the number of failures repaired at each site
*((Cost of reparable LRU's(E7) * discard rate(E7))

Where:
number of failures repaired at each intermediate site = Failures
* Maintenance rate at each site(M19-M23)
* Repair rate at each site(M26-M30)

Where Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2) /MTBF(E22)

Sums To: 322.2 Maintenance Material

5.5.40 Repair material (322.2.2). This is the sum of the annual costs of repair parts, assemblies, consumables and other materials expended at intermediate maintenance sites.

```
322.2.2 Repair material = Sum by level of maintenance of the
                          number of failures repaired at each site
                         *(discard LRU cost(E6)
                           + (Cost of reparable LRU(E7)
                           * (1 - discard rate by site(M12-M16))
                           * Repair material cost factor(E8))

Where:
number of failures repaired
at each intermediate site = Failures
                           * Maintenance rate at each site(M19-M23)
                           * Repair rate at each site(M26-M30)

Where Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2) /MTBF(E22)
```

Sums To: 322.2 Maintenance Material

Sums To: 322.2 Maintenance Material

5.5.41 Transportation (322.3). This is the sum of the annual costs to transport spares and repair materials between supply points for use at intermediate maintenance sites. Excluded are deliveries by organic vehicles.

```
322.3 Transportation = Failures
                     * Maintenance rate at each site(M19-M23)
                       * Repair rate at each site(M26-M30)
                     * (Trans from int to depot (calculated)
Repair parts        *((LRU weight(E5)*Discard rate(by level)(M12-M16))
and material         + ((1-Discard rate)*Repair Material Weight(E8)))

Trans of failed       2 * Equip weight(E4)
equip from org          * short dist trans cost(A14)
to int maint site       * distance from org to int(A9)

Where:
     Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2) /MTBF(E22)
     Trans Int to Depot = Long Distance Trans Cost ($/lb/mi)(A15)
                        * Avg. Distance Int to Depot(mi)(calculated)
     average distance
     int to depot = (A11*O2 + A12*O3 + A13*O4)/(O2+O3+O4)
```

Sums To: 322 Intermediate Maintenance

5.5.42 Intermediate maintenance facilities (322.4). This is the sum of the annual costs of intermediate level maintenance facilities upkeep including real property where applicable. Direct labor, overhead, materiel and other direct charges are included. The costs to maintain deployable maintenance vans are excluded.

322.4 Inter Maintenance Facilities = Intermediate maintenance facilities cost ($/yr) (026)
or if 026 = 0
Inter Maintenance Facilities = Number of intermediate maintenance sites (027)
* Size of intermediate maintenance site (ft^2) (028)
* Intermediate maintenance floor area cost ($/$ft^2$/yr) (029)

Sums To: 322 Intermediate Maintenance

5.5.43 Depot repair (323). This is the sum of the annual costs of LRU/module repair at the depot level. It includes the cost of depot maintenance personnel, discard of reparable LRU's beyond capability of maintenance, repair material and round trip transportation to the depot.

Sums To: 320 Maintenance

5.5.44 Depot labor (323.1). This is the sum of the costs, on an annual basis, for depot maintenance personnel to repair and modify WBS items at the depot.

323.1 Labor =

Repair
Failures
* depot maintenance rate (%)(M24)
* (MTTR(E30) + depot repair overhead (hours)(M38))
* depot hourly labor rates(M9)

+

Modifications
Lot Buy Quantity (#)(U12 or U4)
* Mean time to modify-depot (mhrs) (M2)
* Modify rate-depot (%) (M5)
* depot hourly labor rates (M9)

Where Failures = Oper Equip Qty(E1) * Annual Oper Cycles(E2) /MTBF(E22)

Sums To: 323 Depot Repair

5.5.45 Depot material (323.2). This is the sum of the annual costs of repair materials (piece parts, etc.) consumed in the repair of WBS items at the depot level of maintenance plus the value of WBS items shipped for repair but discarded as not economically repairable.

323.2 Material = Oper Equip Qty(E1) * Annual Oper Cycles(E2) /MTBF(E22)
Parts
* Depot maintenance rate(M24)*Depot Repair Rate(%) (M31)
* ((Depot MTTR(E30)+Depot overhead(mhrs)(M38))
* Depot material rate($/hr)(M10)

+

Discard Reparable LRU's
(1-Depot repair rate(%)(M31))*Reparable LRU cost($)(E7))

Sums To: 323 Depot Repair

5.5.46 Transportation (323.3). This is the sum of the annual costs of transporting spares, repair parts, failed/repaired items and other repair material in support of depot repair operations. The assumption is made that all items are shipped by an intermediate supply or maintenance activity to the depot for repair and are replaced by the depot on a one for one basis.

323.3 Trans = Oper Equip Qty(E1) * Annual Oper Cycles(E2) /MTBF(E22)
* Depot maintenance rate(M24) * LRU weight(E5)
* 2*Transportation from depot to intermediate

Where: Trans Int to Depot = Long Distance Trans Cost (\$/lb/mi)(A15)
* Avg. Distance Int to Depot(mi)(calculated)
Average distance
int to depot = (A11*O2 + A12*O3 + A13*O4)/(O2+O3+O4)

Sums To: 323 Depot Repair

5.5.47 Depot overhaul (324). Overhaul is the process of disassembling so that all operating components and the basic end item can be inspected; followed by repair, replacement, or servicing, as necessary; followed by reassembly and bench check/flight test. Upon completion of the overhaul operation, the item will be capable of performing for its intended service life. Overhauls are calculated based on the number of equipments deployed in any given year plus the number of years between overhauls. Costs are allocated only if the remaining service life of the system is at least 50% of the interval between overhauls (M7). Overhaul is normally accomplished in fixed shops, shipyards and other shore-based facilities, or by depot field teams. This is the sum of the annual costs of all scheduled depot overhauls and includes labor, material, and transportation.

Sums To: 320 Maintenance

5.5.48 Labor (324.1). This is the sum of depot labor costs associated with depot level overhaul for items in the WBS file.

324.1 Labor = Overhaul Quantity (calculated)
* Depot Labor Rate (\$/manhour) (M9)
* Manhours to Overhaul(M8)
Overhaul quantity = Number of WBS items reaching the overhaul year based on the WBS item's overhaul schedule (M7) and the delivery rate.

Sums To: 324 Depot Overhaul

5.5.49 Material (324.2). This is the sum of the annual costs of materials consumed in the overhaul of end items at the depot. These costs are based on the hourly depot material charge for repair.

324.2 Material Charges = Overhaul Quantity(calculated)
* Depot Material Rate (\$/manhour) (M10)
* Manhours to overhaul (M8)
Overhaul quantity = Number of WBS items reaching the overhaul year based on the WBS item's overhaul schedule (M7) and the delivery schedule

Sums To: 324 Depot Overhaul

5.5.50 Transportation (324.3). This is the sum of the annual costs of transporting WBS items to the depot maintenance facility for overhaul. The assumption is made that all items are shipped by intermediate maintenance or supply activities and that shipped items are replaced on a one for one basis.

324.3 Transportation = 2 * Trans from depot to intermediate level
* Equipment weight(E4)
* Overhaul quantity(calculated)

Where:
Overhaul quantity = Number of WBS items reaching the overhaul year based on the WBS item's overhaul schedule (M7) and the delivery schedule

Trans Int to Depot = Long Distance Trans Cost ($/lb/mi)(A15)
* Avg. Distance Int to Depot(mi)(calculated)

Average distance
Int to depot = (A11*O2 + A12*O3 + A13*O4)/(O2+O3+O4)

Sums To: 324 Depot Overhaul

5.5.51 System software support (325). This is the sum of the annual contractor and Government costs for the computer software support required in the upkeep, modification, or reprograming of operational computer programs.

Sums To: 320 Maintenance

5.5.52 Software maintenance personnel (325.1). This is the sum of the annual direct and indirect software personnel costs (military and civilian) incurred in providing software support.

Sums To: 325 System Software Support

5.5.53 Military Software personnel (325.1.1). This is the sum of the annual manpower costs, direct and indirect, incurred in providing operational software support.

It includes pay and allowances, replacement training, health care, PCS, retirement allowance (not added to POM and Army reports), base operating support and the cost of transients, prisoners and patients.

If these personnel work on other systems, they may be entered using fractional values in the T/O for the number of personnel assigned to this system based on the ratio of effort devoted to this system compared to all other systems being supported.

The Model begins charging for Government maintenance of operational software in the same month as IOC offset by the number of years of contractor maintenance(O32), if any. There will cause an overlap if the duration of contractor maintenance is a decimal value, e.g. 5.4 years. The overlap is the remainder after the integer number of years, .4 years in this example. The duration of Government maintenance (O33) may also be a decimal value.

325.1.1 Military Software Personnel = Manning Level(A29) *
Sum of the following costs for every line of SWPD in the T/O
Pay and allowances
+ Health care
+ Replacement training
+ Permanent change of station
+ Retirement allowance(nonadd for POM and Army)
+ Base operating support

Sums To: 325.1 Software Maintenance Personnel

5.5.54 <u>Civilian software personnel (325.1.2).</u> This is the sum of the annual manpower costs of Government civilian personnel who provide software support. It includes pay and allowances, benefits, workmen's compensation, retirement and training. Manning level (A29) does not apply to civilians.

If these personnel work on other systems, they may be entered using fractional values in the T/O for the number of personnel assigned to this system based on the ratio of effort devoted to this system compared to all other systems being supported.

The Model begins charging for Government maintenance of operational software in the same month as IOC offset by the number of years of contractor maintenance(032), if any. There will cause an overlap if the duration of contractor maintenance is a decimal value, e.g. 5.4 years. The overlap is the remainder after the integer number of years, .4 years in this example. The duration of Government maintenance (033) may also be a decimal value.

325.1.2 Civilian Software Personnel = Manning Level (A29) *
Sum of the annual cost for every line of civilian SWPD in the T/O

Sums To: 325.1 Software Maintenance Personnel

5.5.55 <u>Operational software center (325.2).</u> This is the sum of the annual costs of upkeep of the software center (Cost Element 212.16). It includes maintenance of real property where applicable. All direct labor, material, overhead, maintenance, consumables for nonprime mission equipment and telecommunications, and other direct charges are included.

The Model begins charging for Government maintenance of operational software in the same month as IOC offset by the number of years of contractor maintenance(032), if any. There will cause an overlap if the duration of contractor maintenance is a decimal value, e.g. 5.4 years. The overlap is the remainder after the integer number of years, .4 years in this example. The duration of Government maintenance (033) may also be a decimal value.

Sums To: 325 System Software Support

5.5.56 Contract software maintenance (325.3). This is the sum of the annual costs for contract vice Government software maintenance.

325.3 Contract Software Maintenance = Number of years contract software maintenance(031)
* Annual cost for contract software maintenance(032)

Sums To: 325 System Software Support

5.5.57 Maintenance and diagnostic software support (326). This is the sum of the annual contractor and Government costs for the maintenance of program test sets required by common and peculiar support equipment for maintenance of WBS items.

Sums To: 320 Maintenance

5.5.58 Maintenance and diagnostic software personnel (326.1). This is the sum of the annual direct and indirect personnel costs (military and civilian) incurred in the maintenance of program test sets.

Sums To: 326 Maintenance and Diagnostic Software Support

5.5.59 Military software personnel (326.1.1). This is the sum of the annual manpower costs, direct and indirect, incurred in providing support for maintenance and diagnostic software. It includes pay and allowances, replacement training, health care, PCS, retirement allowance(this is not added to the POM and Army reports), base operating support and the cost of transients, prisoners and patients.

If these personnel work on other systems, they may be entered using fractional values in the T/O for the number of personnel assigned to this system based on the ratio of effort devoted to this system compared to all other systems being supported.

The Model begins charging for Government maintenance of maintenance and diagnostic software in the same month as IOC offset by the number of years of contractor maintenance(036), if any. There will cause an overlap if the duration of contractor maintenance is a decimal value, e.g. 5.4 years. The overlap is the remainder after the integer number of years, .4 years in this example. The duration of Government maintenance (037) may also be a decimal value.

326.1.1 Military Software Personnel = Manning level (A29) *
Sum of the following costs for every line of SWMD in the T/O:
Pay and allowances
+ Health care
+ Replacement training
+ Permanent change of station
+ Retirement allowance
+ Base operating support

Sums To: 326.1 Maintenance and Diagnostic Software Personnel

5.5.60 Civilian software personnel (326.1.2). This is the sum of the annual manpower costs of Government civilian personnel who maintain or develop program test sets for common or peculiar support equipment. It includes pay and allowances, benefits, workmen's compensation, retirement, and training. There is no manning level (A29) for civilian personnel.

If these personnel work on other systems, they may be entered using fractional values in the T/O for the number of personnel assigned to this system based on the ratio of effort devoted to this system compared to all other systems being supported.

The Model begins charging for Government maintenance of maintenance and diagnostic software in the same month as IOC offset by the number of years of contractor maintenance(O36), if any. There will cause an overlap if the duration of contractor maintenance is a decimal value, e.g. 5.4 years. The overlap is the remainder after the integer number of years, .4 years in this example. The duration of Government maintenance (O37) may also be a decimal value.

326.1.2 Civilian Software Personnel = Sum of the annual cost for every line of civilian SWMD in the T/O

Sums To: 326.1 Maintenance and Diagnostic Software Personnel

5.5.61 Maintenance and diagnostic software center (326.2). This is the sum of the annual costs of upkeep of the software center (cost element 212.1.6). It includes maintenance of real property, where applicable. All direct labor, material, overhead, maintenance, consumables for nonprime mission equipment, telecommunications and other direct charges are included.

The Model begins charging for Government maintenance of maintenance and diagnostic software in the same month as IOC offset by the number of years of contractor maintenance(O36), if any. There will cause an overlap if the duration of contractor maintenance is a decimal value, e.g. 5.4 years. The overlap is the remainder after the integer number of years, .4 years in this example. The duration of Government maintenance (O37) may also be a decimal value.

Sums To: 326 Maintenance and Diagnostic Software Support

5.5.62 Contract software maintenance (326.3). This is the sum of the annual costs for contract vice Government software maintenance.

326.3 Contract Software Maintenance = Number of years contract software maintenance (A36)
* Annual cost for contract software maintenance (A35)

Sums To: 326 Maintenance and Diagnostic Software Support

5.5.63 Contract support services (327). This is the sum of annual 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 for DoD personnel in the installation, operation, and maintenance of equipment.

Contract maintenance includes the cost incurred for maintenance 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. Contract support starts at IOC and continues for the number of years set in O39. The duration may be a decimal value, i.e. 5.4 years.

327 Contract support services = Contract support services($/yr)(O38)
* number of years contract support(O39)

Sums To: 320 Maintenance

5.5.64 Modifications (330). This is the sum of the average annual costs of modifications of WBS items to make them safer for continued operation, enable them to perform mission essential tasks (not new capability) and to improve reliability or reduce maintenance costs. Included are the costs of fully developed and tested modification kits and spares.

Labor is included if the labor and material modification factor (M1) is greater than 0. Only material is included in this cost element if M1 = 0 and either the field or depot modification rates (M5 or M6) are greater than 0. If the field or depot modification rates are set, modification labor is charged to the field and depot maintenance activities based on mean times to modify (M2 and M3) and the normal distribution of failures for repair (the product of the maintenance and repair rates for each echelon of maintenance.) See 5.7.7.2 - 5.7.7.7

330 Modifications =

If annual modification cost factor (labor + material)(M1) > 0
Annual modifications = Buy quantity(U12 or U4)
* Unit cost (calculated)
* Annual modification cost factor (M1)
Else if Modification material cost factor-field (%)(M4) > 0
Annual modifications = Buy quantity(U12 or U4)
* Unit cost (calculated)
* Field modification material cost factor (%) (M4)
* (Mod rate, field (%)(M6) + Mod rate, depot (%)(M5))
Else annual modifications = 0

Sums To: 300 Operating and Support

5.5.65 Supply support (340). This is the sum of the annual costs of supply operations in support of maintenance of the equipment/system. It includes 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. Five levels of supply are permitted: organizational, intermediate, field depot and bonded storage.

Sums To: 300 Operating and Support

5.5.66 Supply personnel (341). This is the sum of the annual manpower costs, direct and indirect, which are incurred in the performance of the supply function if not included under 342 Supply Facilities. The personnel involved are associated with the functions of packaging, preservation, receipt, transfer, issue and disposal of spares, repair parts, bulk materials, consumables and POL. Included are not only the cost of personnel pay and allowances, but also PCS, replacement training, health care, base operating support, retirement allowance (this is not added to the POM and Army reports), and allowance for transients, prisoners and patients.

Sums To: 340 Supply Support

5.5.67 Organizational supply personnel (341.1). This is the sum of the annual costs of that portion of the organizational supply personnel who are associated with the organizational level of maintenance.

341.1 Organizational Supply = Cost of pay and allowances of (321.1) organizational maintenance personnel
* Supply personnel cost factor (%) (A27)

Sums To: 341 Supply Personnel

5.5.68 Intermediate supply personnel (341.2). This is the sum of the annual costs of that portion of intermediate supply personnel who are associated with all intermediate levels of maintenance through the GSU.

341.2 Intermediate Supply = Cost of Pay & Allowances of all intermediate maintenance personnel (322.1)
* Supply personnel cost factor(%) (A27)

Sums To: 341 Supply Personnel

5.5.69 Field depot personnel (341.3). This is the sum of the annual costs of the supply personnel who are associated with field depot maintenance.

Sums To: 341 Supply Personnel

341.3 Field Depot Personnel is reserved for future use.

5.5.70 Supply facilities (342). This is the sum of the annual upkeep costs of supply facilities which support the maintenance function. It includes the maintenance of real property, where applicable. All direct labor not reported in 341 Supply Personnel, material, overhead and other direct charges are included. General storage costs are included in Cost Element 343.2 (Inventory Distribution/Holding).

342 Supply Facilities = Supply Facilities ($/yr) (040) (Direct Input)
or if 040 = 0
Supply Facilities = Organizational supply facilities ($/yr)
+ Intermediate supply facilities ($/yr)
+ Field depot supply facilities ($/yr)
+ Bonded storage ($/yr)

Sums To: 340 Supply Support

5.5.71 Organizational supply facilities (342.1). This is the sum of the annual costs for upkeep of supply facilities at the organizational level which support organizational maintenance. It includes maintenance of real property, where applicable, and consists of charges for direct labor not in 341.1, material, overhead, and other direct expenses.

342.1 Organizational supply = Organizational supply requirement (Ft^2/site) (042)
* Organizational supply facilities cost($/ft^2/yr) (041)
* Number of org maintenance sites (023)

Sums To: 342 Supply Facilities

5.5.72 Intermediate supply facilities (342.2). This is the sum of the annual costs of maintaining supply facilities at the intermediate level in support of the maintenance of the equipment/system. It includes the upkeep of real property, where applicable, and summarizes costs of direct labor not included in 341.2 Intermediate supply personnel, overhead, material and other direct charges.

342.2 Intermediate Supply = Inter supply requirement (ft^2/site)(044)
* Intermediate supply facilities cost($/ft^2/yr) (043)
* Number of inter maintenance sites (027)

Sums to:: 342 Supply Facilities

5.5.73 Field depot facilities (342.3). This is the sum of the annual costs for upkeep of depot supply facilities which support maintenance of the equipment/system at the depot level. It includes the upkeep of real property, where applicable, and incorporates charges for direct labor, material, overhead, and other direct expenses.

342.3 Field Depot = Field depot supply requirement (ft^2/site) (046)
* Field depot supply facilities cost($/ft^2/yr) (045)
* Number of field depot sites (047)

Sums To: 342 Supply Facilities

5.5.74 Bonded-storage facilities (342.4). This is the sum of the annual, service wide, costs to provide bonded storage facilities for the materiel system. It includes the upkeep of real property, where applicable, and incorporates charges for direct labor, material, overhead, and other direct expenses.

342.4 Bonded Storage = Bonded storage (048)(Direct Input)
or if 048 = 0
Bonded Storage = Number of bonded storage sites (049)
* Cost per bonded storage site ($/yr) (050)

Sums To: 342 Supply Facilities

5.5.75 Inventory administration (343). Inventory administration includes the sum of the annual costs of stocking inventory in the supply system as well as the functions of cataloging and provisioning. Specifically, the costs are a function of inventory management and inventory holding.

Sums To: 340 Supply Support

5.5.76 Inventory management (343.1). This is the sum of the annual management costs for maintaining an item in inventory. This is a nonadd for the Army report.

343.1 Inventory Management =
Number of new FSN/NSN < $5,000 (054)
* Inventory management < $5,000 ($/yr) (A4)
\+ Number of new FSN/NSN > $5,000 < $50,000 (055)
* Inventory management > $5,000 < $50,000 ($/yr) (A5)
\+ Number of new FSN/NSN > $50,000 < $500,000 (056)
* Inventory management > $50,000 < $500,000 ($/yr) (A6)
\+ Number of new FSN/NSN > $500,000 (057)
* Inventory management > $500,000 ($/yr) (A7)

Sums To: 343 Inventory Administration

5.5.77 Inventory distribution/holding (343.2). This is the sum of the annual costs of inventory distribution/holding. It includes the cost of physically holding WBS items purchased but not operated (e.g., PWRS, maintenance float) as well as the value of initial spares not out of stock due to maintenance demand.

The storage cost factor should include general storage costs to the extent they are not included in 341 or 342. The shrinkage cost factor accounts for deterioration in storage, obsolescence, and losses in storage of initial spares and repair parts only. Shrinkage does not apply to end items.

343.2 Inventory Distribution/Holding =

Nonoperating End item storage	Storage cost factor (A24) * (Lot buy quantity(U12 or U4) - operating equipment quantity (E1))
	+
Storage and losses of spares and repair parts	(Initial spares(calculated) -out of stock(calculated)) *(Storage cost factor (A24) + Shrinkage cost factor (A25))

Where out of stock = the value of all repair material and discarded spares consumed each year by each repair echelon below depot (321.2 + 322.2)
* Supply pipeline time in days (A30-A36)at each repair echelon/365

Sums To: 343 Inventory Administration

5.5.78 Technical data revision (350). This is the sum of the annual costs of updating the technical data and documents needed to perform maintenance on the system, its components, and support equipment. It includes both contractor and Government costs.

350 Technical Data Revisions = Technical data revisions ($/yr) (051)
or if 051 = 0
Technical Data Revisions = Tech data pages requiring revision (052)
* Tech data revision costs ($/page) (053)

Sums To: 300 Operating and Support

5.5.79 Other logistics support costs (360). This is the sum of the annual costs of any logistics support requirements for the equipment/system not specifically included in other logistics support cost elements, i.e., Cost Element 320 through Cost Element 350.

360 Other Logistics Support Costs = Other logistics support costs(058)
or if O8* = 0
= sum of costs by appropriation(059-062)

Sums To: 300 Operating and Support

5.6 Assumptions. The assumptions used to obtain cost estimates have a significant affect on the life cycle cost estimate. Explicit and valid assumptions are critical to the usefulness and acceptance of an analysis. Assumptions should be critically examined at the beginning and reviewed throughout the course of analysis for consistency, acceptability, and applicability. Justification and documentation are a necessary part of making assumptions explicit.

5.6.1 Assumptions worksheets. Summary worksheets for entering assumptions are contained in Figure 196. Figures 197-232 are data collection worksheets for each of the assumptions. These worksheets define each assumption and provide a structure for documenting the development of each assumption. Backup pages, in formats developed by the analyst, detailing the development of variables used to arrive at an estimate should be attached to the cost element worksheet.

Life Cycle Cost Model
for
Defense Materiel Systems

SYSTEM: ____________________
DATE: ____________________

ASSUMPTION INPUTS

Description	Cost Element	Value/Reference
BASE FISCAL YEAR OF ASSUMPTIONS		____________________
YEARS OF OPERATION	A1	____________________
INITIAL PROVISIONING COST FACTOR	A2	____________________
INVENTORY INTRODUCTION ($/NSN)	A3	____________________
INVENTORY MANAGEMENT $1-4,999 ($/NSN/YEAR)	A4	> ____________________ <
INVENTORY MANAGEMENT $5,000-49,999 ($/NSN/YR)	A5	____________________
INVENTORY MANAGEMENT $50,000-500,000 ($/NSN/YR)	A6	____________________
INVENTORY MANAGEMENT $500,000 + ($/MSN/YEAR)	A7	____________________
MANNING LEVEL (OPERATOR,INDIRECT) (% of T/O)	A8	> ____________________ <
DISTANCE FROM ORG TO INT MAINT SITES (MILES)	A9	____________________
DISTANCE FROM DSU TO GSU MAINT SITES (MILES)	A10	____________________
DISTANCE FROM CONUS INT SITE TO DEPOT (MILES)	A11	____________________
DISTANCE FROM EUROPE INT SITE TO DEPOT (MILES)	A12	> ____________________ <
DISTANCE FROM WESTPAC INT SITE TO DEPOT(MILES)	A13	____________________
TRANSPORTATION COST ORG TO INT ($/LB-MI)	A14	____________________
TRANSPORTATION COST INT TO DEPOT($/LB-MI)	A15	____________________
OPER UNIT TRANSPORTATION TRUCK ($/TON-MI)	A16	> ____________________ <
OPER UNIT TRANSPORTATION RAIL ($/TON-MI)	A17	____________________
OPER UNIT TRANSPORTATION SEA ($/TON-MI)	A18	____________________
OPER UNIT TRANSPORTATION AIR ($/TON-MI)	A19	____________________
AVAILABLE MANHOURS/MANYEAR-FIELD MAINT(HOURS)	A20	> ____________________ <
AVAILABLE MANHOURS/MANYEAR-OPERATOR(HOURS)	A21	____________________
MANNING LEVEL FIELD MAINTENANCE (% of T/O)	A22	____________________
ADMIN&LOGISTIC DELAY TIME (HOURS/FAILURE)	A23	____________________
STORAGE COST FACTOR (% of inventory held)	A24	> ____________________ <
INVENTORY SHRINKAGE COST FACTOR (% inventory)	A25	____________________
MANUFACTURER MANHOURS/MANMONTH	A26	____________________
SUPPLY PERSONNEL COST FACTOR (% maint labor)	A27	____________________
DOD DISCOUNT RATE (%/YEAR)	A28	> ____________________ <
MANNING LEVEL SOFTWARE PERSONNEL(% of T/O)	A29	____________________
SUPPLY PIPELINE TIME ORG (DAYS)	A30	____________________
SUPPLY PIPELINE TIME INT (DAYS)	A31	____________________
SUPPLY PIPELINE TIME DSU (DAYS)	A32	> ____________________ <
SUPPLY PIPELINE TIME GSU (DAYS)	A33	____________________
SUPPLY PIPELINE TIME CONUS TO DEPOT(DAYS)	A34	____________________
SUPPLY PIPELINE TIME EUROPE TO DEPOT(DAYS)	A35	____________________
SUPPLY PIPELINE TIME WESTPAC TO DEPOT(DAYS)	A36	> ____________________ <

Enter rates as decimal values e.g., 25% as .25

Type SAV at any time to save data being entered.

FIGURE 196. Assumption inputs

A1 YEARS OF OPERATION (Years)

This is the number of years the system is expected to operate before being replaced. In general, the life of equipment/systems is the period of time during which the system remains cost-effective and continues to provide positive benefit to the military. See also 5.1. The specific factors limiting the duration of deployment with main force units are:

- o Mission life: the period during which the operational need remains valid.
- o Physical life: the period prior to physical wearout.
- o Technological life: the period prior to obsolescence or disappearance of the industrial support base.

Generally, the operational life of an alternative should be taken as the least of the above three periods.

Cost Elements Affected: All O&S Cost Elements

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 197. Years of operation (years)

A2 INITIAL PROVISIONING COST FACTOR (%)

This factor, when multiplied by the calculated unit production cost for all CFE and GFE items, yields the cost of spares and repair parts for the initial provisioning period to support the system until the military supply system can provide routine support.

Cost Elements Affected: 211.16, 221.18, 222.19, 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 198. Initial provisioning cost factor (%)

A3 INVENTORY INTRODUCTION ($/item)

This is the nonrecurring management cost of entering an item in inventory. It includes the costs of identification, description, submission to screening, and editing by the data documents center; inclusion in maintenance and supply catalogs; establishment of supply management and inventory and replacement rates; provisioning; requisitioning; and procurement directives. This cost is not normally be used in cost analyses involving Army procurements and does not appear in the Army life cycle cost report format.

Cost Elements Affected: 212.17

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 199. Inventory introduction ($/item)

A4 INVENTORY MANAGEMENT (NSN DOLLAR VALUE UNDER $5,000)($/Yr)

This cost factor covers the annual management cost of inventory line item management of each NSN Item with a dollar value under $5,000. The object of inventory management is to establish a historical base for individual item demand rates and to adjust the provisioning factors as required to improve supply support. As the system progresses through its life cycle, data are collected and analyzed to assess the effectiveness of the supply support capability. Trends and averages are identified using statistical techniques and the results are included in the updating of the provisioning data for future spare/repair part reorders. At the same time, the inventory is evaluated in terms of current assets, average months of supply on hand, costs to procure material and maintain the inventory, and quantity of order. In the event the historical trends indicate that the level of inventory is too much or too little to effectively and efficiently support operational needs, the economic order quantity (EOQ) and quantity of orders are recomputed and future stock orders are either increased or curtailed. This cost should not normally be used in cost analyses involving Army procurements and does not appear in the Army life cycle cost report format.

Cost Elements Affected: 343.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 200. Inventory management (NSN dollar value under $5,000) ($/Yr)

A5 INVENTORY MANAGEMENT (NSN DOLLAR VALUE $5,000 - $49,999)($/Yr)

This cost factor covers the annual management cost of inventory line item management of each NSN Item with a dollar value ranging between $5,000 and $49,999. This cost should not normally be used in cost analyses involving Army procurements and does not appear in the Army life cycle cost report format. For details, see A4.

Cost Elements Affected: 343.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 201. Inventory management (NSN dollar value under $5,000 - $49,999) ($/Yr)

A6 INVENTORY MANAGEMENT (NSN DOLLAR VALUE $50,000 - $500,000)($/NSN/YR)

This is the annual cost to manage each new NSN introduced into the inventory because of the system with a dollar value exceeding $50,000 and less than $500,000. This cost should not normally be used in cost analyses involving Army procurements and does not appear in the Army life cycle cost report format. For details, see A4.

Cost Elements Affected: 343.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 202. Inventory management (NSN dollar value under $50,000 - $500,000) ($/NSN/Yr)

A7 INVENTORY MANAGEMENT (NSN DOLLAR VALUE EXCEEDING $500,000)($/NSN/YR)

This is the annual cost to manage each new NSN introduced into the inventory because of the system with a dollar value exceeding $500,000. This cost should not normally be used in cost analyses involving Army procurements and does not appear in the Army life cycle cost report format. For details, see A4.

Cost Elements Affected: 343.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 203. Inventory management (NSN dollar value exceeding $500,000) ($/NSN/Yr)

A8 MANNING LEVEL (OPERATOR, INDIRECT PERSONNEL)

This is the percent of dedicated operator and indirect (OPRD and INDD) T/O personnel to be charged to the system. This factor will not change costs for shared personnel (OPRS and INDS). If a zero is entered here, no costs will be calculated for operator or indirect personnel.

Cost Elements Affected: 311.1, 311.2 and their subelements

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 204. Manning level (operator, indirect personnel)

A9 DISTANCE FROM ORGANIZATIONAL TO INTERMEDIATE MAINTENANCE SITES (Miles)

This is the average distance in miles between maintenance points at the organizational level and those at intermediate level. It is used to compute the cost for local base transportation of operational material, spare parts and secondary reparables.

Cost Elements Affected: 312.4, 313.4, 321.3, 322.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 205. Distance from organizational to intermediate maintenance sites

A10 DISTANCE FROM DSU TO GSU (Miles)

This is the average distance between direct support maintenance units (DSU) and general support maintenance units (GSU). It is used to compute the cost of transportation of replenishment spares and repair material.

Cost Elements Affected: 322.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 206. Distance from DSU to GSU (Miles)

A11 DISTANCE FROM CONUS INTERMEDIATE SITES TO DEPOT (Miles)

This is the average distance in miles between intermediate maintenance activities in the continental United States (CONUS) and the depot which serves those sites. It used to cost the transportation of secondary reparables between depot and intermediate sites, return of system hardware for depot overhaul, and the transportation of replenishment spares.

Cost Elements Affected: 312.4 313.4 321.3 322.3 323.3 324.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 207. Distance from CONUS intermediate sites to depot (Miles)

A12 DISTANCE FROM EUROPEAN INTERMEDIATE SITES TO DEPOT (Miles)

This is the average distance in miles between intermediate maintenance activities in Europe and the depot which serves those sites. It used to cost the transportation of secondary reparables between depot and intermediate sites, return of system hardware for depot overhaul, and the transportation of replenishment spares.

Cost Elements Affected: 312.4 313.4 321.3 322.3 323.3 324.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 208. Distance from European intermediate sites to depot (Miles)

A13 DISTANCE FROM WESTPAC INTERMEDIATE SITES TO DEPOT (Miles)

This is the average distance in miles between intermediate maintenance activities in the Western Pacific (WESTPAC) and the depot which serves those sites. It used to cost the transportation of secondary reparables between depot and intermediate sites, return of system hardware for depot overhaul, and the transportation of replenishment spares.

Cost Elements Affected: 312.4, 313.4, 321.3, 322.3, 323.3, 324.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

Figure 209. Distance from WESTPAC intermediate sites to depot (Miles)

A14 TRANSPORTATION COST ORGANIZATION TO INTERMEDIATE ($/lb/mi)

This is the average cost to transport a pound of material between organizational and intermediate level maintenance points using organic transportation. This may be set to zero if these costs are to be excluded from the analysis.

Cost Elements Affected: 312.4 313.4 321.3 322.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 210. Transportation cost organization to intermediate ($/lb/mi)

A15 TRANSPORTATION COST INTERMEDIATE TO DEPOT ($/lb/mi)

This is the average cost per pound to transport maintenance items and material between intermediate and depot level maintenance points.

Cost Elements Affected: 312.4 313.4 321.3 322.3 323.3 324.3

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 211. Transportation cost intermediate to depot ($/lb/mi)

A16 OPERATIONAL UNIT TRANSPORTATION-TRUCK ($/ton mile)

This is the average cost per ton mile to transport operational units and materiel by commercial truck for peacetime training exercises.

Cost Elements Affected: 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 212. Operational unit transportation-truck ($/ton/mile)

A17 OPERATIONAL UNIT TRANSPORTATION-RAIL ($/ton mile)

This factor is the average cost per ton mile to transport operational units and materiel by commercial rail for peacetime training exercises.

Cost Elements Affected: 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 213. Operational unit transportation-rail ($/ton/mile)

A18 OPERATIONAL UNIT TRANSPORTATION-SHIP ($/ton mile)

This factor is the average cost per ton mile to transport operational units and materiel by sealift (commercial or military) for peacetime training exercises.

Cost Elements Affected: 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 214. Operational unit transportation-ship ($/ton/mile)

A19 OPERATIONAL UNIT TRANSPORTATION-AIR ($/ton mile)

This is the average cost per ton mile to transport operational units or materiel by airlift (MAC, commercial or organic lift) for peacetime training exercises.

Cost Elements Affected: 316

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 215. Operational unit transportation-air ($/ton/mile)

A20 AVAILABLE MANHOURS/MANYEAR-FIELD MAINTENANCE (hours)

This is the estimated annual military man-hours available, in peacetime, for performance of job-related tasks by maintenance personnel at the organizational (OLM) and intermediate maintenance levels (ILM) and at direct and general support units (DSU and GSU) and their contact teams (DCT and GCT). Excluded from total annual hours available are allowances for leave and holidays, guard duties and sickness, general military and skill level training, physical fitness and other duties not directly related to repair work such as maintenance of tech manuals and stock lists, general facility maintenance and tool issue. This factor is used to determine the adequacy of the maintenance T/O's to meet expected peacetime demand and to compute the weighted average hourly cost for shared maintenance personnel.

Cost Elements Affected: 321.1.1 322.1.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 216. Available manhours/manyear-field maintenance (hrs)

A21 AVAILABLE OPERATOR MAN-HOURS PER YEAR

This factor represents the average annual man-hours available in peacetime for operators to perform job-related tasks. Excluded from total annual man- hours available are allowances for leave and holidays, for sickness and guard duties. Time for individual training may be offset by extended working hours during field exercises. This factor is used to determine the adequacy of the operator T/O to meet expected peacetime demand and to compute the weighted average hourly cost for shared operators.

Cost Elements Affected: 311.11

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 217. Available operator man-hours per year

A22 MANNING LEVEL (FIELD MAINT)

This is the percent of dedicated field maintenance personnel at all levels below depot to be charged to the system. This factor will not influence costs for shared personnel. If a zero is entered, the model will not cost field maintenance personnel.

Cost Elements Affected: 321.1.1 322.1.1

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 218. Manning level (field maint)

A23 ADMINISTRATIVE DELAY TIME (HOURS)

This is the time in hours to accomplish administrative tasks associated with a repair action and which must be added to the MTTR at each level of repair to determine actual time required to return to operational readiness. This factor is only used for computing operational availability and does not influence life cycle cost. It is not required unless operational availability is to be computed.

Cost Elements Affected: NONE

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 219. Administrative delay time (hours)

A24 STORAGE COST FACTOR (%)

This percentage is applied to the value of inventory held. Inventory includes the value of initial spares less a factor for out of stock due to pipline times and the value of all WBS items (e.g., maintenance float and PWRS) (based on U12 or U4) not included in the operating qantity (based on E1). These are costs associated with the care of material, warehousing, inventory operations and training of storage personnel.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 220. Storage cost factor (%)

A25 INVENTORY SHRINKAGE COST FACTOR (% OF INVENTORY HELD)

This percentage is applied to the value of spares and repair material held in inventory (initial inventory less out of stock due to pipeline delays) to yield estimated annual costs caused by losses due to pilferage, shrinkage (misplacements), and inventory adjustments.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 221. Inventory shrinkage cost factor (% of inventory held)

A26 MANUFACTURER'S MANHOURS/MANMONTH (Hrs)

This is the average number of working hours in a manmonth of contract labor. This factor is used to convert manmonth estimates for R&D WBS tasks to manhour estimates for conversion to $ estimates based on contract hourly labor rates.

Cost Elements Affected: 111.11, 121.11 and their subelements

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 222. Manufacture's manhours/manmonths (Hrs)

A27 SUPPLY PERSONNEL COST FACTOR (%)

This percentage factor is applied to the annual cost of maintenance personnel at the organizational and intermediate levels, respectively, to yield estimated costs for supply personnel at those levels to process maintenance related transactions. This excludes costs associated with inventory storage.

Cost Elements Affected: 341.1, 341.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 223. Supply personnel cost factor (%)

A28 DOD DISCOUNT RATE (%)

The discount rate is used to calculate the present value of dollars expected to be spent during future time periods. Since dollars today are worth more than future dollars because of interest costs related to all Government expenditures, costs accruing in the future cannot be compared directly with present investments because of the time value of money. Discounting converts future cash flows to a common point in time to facilitate comparison. For most DOD investments, a discount rate of 10 percent is specified in DOD INST 7041.3.

NOTE: THE DISCOUNT OPTION IS NOT NORMALLY USED WITH MATERIEL ACQUISITION COSTING AND SHOULD NOT BE USED UNLESS SPECIFIED BY THE PROGRAM MANAGER.

Cost Elements Affected: All elements with future expenditures, if the discount option in the LCCM is selected.

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 224. DOD discount rate (%)

A29 MANNING LEVEL (SOFTWARE SUPPORT) (%)

This is the percent of dedicated T/O operational and maintenance software support personnel to be charged to the system. This does not apply to shared personnel. If a zero is entered, the model will not cost software support personnel. Enter as a decimal value, not an integer. E.g., .25 for 25%.

Cost Elements Affected: 325.1 and its subelements

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 225. Manning level (software support) (%)

A30 PIPELINE TIME ORGANIZATION (Days)

This is the number of days for an organizational level supply activity to replace an inventory item issued to organizational maintenance and is used to compute the value of out of stock spares and repair parts. See 5.5.77.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 226. Pipeline time - organization (Days)

A31 PIPELINE TIME - INTERMEDIATE (Days)

This is the average number of days for an intermediate supply activity to replace an inventory item issued to an organizational or intermediate level maintenance activity and is used to compute the value of out of stock spares and repair parts. See 5.5.77.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 227. Pipeline time - intermediate (days)

A32 PIPELINE TIME - DSU (DAYS)

This is the number of days for DSU supply to replace an inventory item issued to a DSU and is used to compute the out of stock spares and repair parts. See 5.5.77.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 228. Pipeline time - DSU (days)

A33 PIPELINE TIME - GSU (Days)

This is the number of days for GSU supply to replace an item issued to a GSU and is used to compute the out of stock spares and repair parts. See 5.5.77.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 229. Pipeline time - GSU (days)

A34 PIPELINE TIME - DEPOT (CONUS)(Days)

This is the average number of days needed for a CONUS depot maintenance activity to replace spares and repair material drawn down for maintenance and is used to compute out of stock values. See 5.5.77.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 230. Pipeline time - depot (CONUS) (days)

A35 PIPELINE TIME - DEPOT (Europe)(Days)

This is the average number of days needed for a European depot maintenance activity to replace spares and repair material drawn down for maintenance and is used to compute out of stock values. See 5.5.77.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 231. Pipeline time - depot (EUROPE) (days)

A36 PIPELINE TIME - DEPOT (WESTPAC)(Days)

This is the average number of days needed for a WESTPAC depot maintenance activity to replace spares and repair material drawn down for maintenance and is used to compute out of stock values. See 5.5.77.

Cost Elements Affected: 343.2

Comments/Calculations:

Budget Category	Expected Value	High Estimate	Low Estimate	FY of Dollars	Reference	Date

FIGURE 232. Pipeline time - depot (WESTPAC) (days)

5.7. WBS. The WBS file can be used to describe the work breakdown structure of any Defense materiel system down to any indenture level appropriate for the analysis being conducted. The minimum indenture level required for any acquisition should be specified in the contract work breakdown structure (CWBS). Lower level entries may be made as necessary to facilitate engineering and cost trade studies. For purposes of economy, the WBS should not be disaggregated below the level of detail at which trades are being made. If detailed trades are being made for a single end item, or if the file exceeds 50 records and many trades are being made on a subset of the WBS, it is more economical to divide the file into subfiles for the trade studies and merge the subfiles whenever a system level cost is required.

5.7.1 WBS file structure. The Model treats each WBS record independently from all other WBS records. Records are numbered sequentially by the Model as they are entered. Each record contains the following logical and physical subsets which have individual worksheets and are defined in the following sections of this handbook:

Worksheet	Section	Figure
a. Classification	5.7.2	233
b. Demonstration and Validation	5.7.3	234
c. Full Scale Development	5.7.3	235
d. Production	5.7.4	236
e. Unit Production Cost	5.7.5	237
f. Equipment	5.7.6	238
g. Maintenance	5.7.7	239

5.7.1.1 Preparation of WBS worksheets. Most life cycle data bases contain large amounts of redundant data in the WBS records. The Model is designed to facilitate the copying of complete records and worksheets within records from previously created WBS files and from records within the current file. To facilitate data entry, worksheets which duplicate data contained on another record should show the WBS file record number which contains the worksheet to be copied at the top of the column. Data elements on the worksheets which are to be unchanged should be left blank. Values which will be different should be entered on the worksheet and changed using the WBS editor after the worksheet has been copied.

5.7.1.2 Copying from previously entered records. To simplify data entry, previously entered records or the logical arrays defined by the worksheets within a record may be copied using the Model. This allows the user to easily duplicate end items and copy or create different operational cost factors or maintenance profiles from other records as necessary.

5.7.1.3 Copying from existing WBS files. If a file exists for another system which has common end items, the analyst may use the Model to GET that file, copy from appropriate records as needed and then delete any unneeded records. It is imperative that all WBS numbers from the source WBS file be reentered if the two materiel systems are not the same MIL-STD-881 weapon system class or the retained records will report at incorrect summary WBS levels since the Model sets report flags at entry of the WBS number.

5.7.2 The WBS classification sheet. The WBS classification sheet (Figure 233) is used to identify and classify each WBS item for calculations. Fields are as follows:

5.7.2.1 Name (optional). Up to 40 characters describing the WBS item.

5.7.2.2 Procurement service. This the buying service in a joint procurement. Use the codes on the input sheet: DOD, ARM, AF, NAV, MC, OTHER

5.7.2.3 Equipment group (required). Integer (1-25). This number is used to associate the hardware end items with personnel assigned the same equipment group number to compute demand to cost manpower for operations and field maintenance. Up to 25 different aggregations of equipment and personnel may be specified. The default value is 1. Typically, equipment groups are used to differentiate between equipments and personnel assigned to different Services; between type forces within a Service which use different intermediate (DSU/GSU) maintenance facilities; and between end item variants.

5.7.2.4 NSN/MPN National Stock Number/Manufacturer Part Number (optional). Up to 16 characters. This is a user option for reports to help keep track of the WBS, CWBS and cross reference to parts lists. Manufacturer's part numbers may be used if a NSN has not been assigned.

5.7.2.5 WBS number (required). Up to 20 characters. The prefix of the WBS number is used to define the MIL-STD-881 and DA-Pam level 3 summary WBS category for reports. The prefix must be one of the MIL-STD-881 summary WBS codes assigned to the materiel system by the Model as detailed in 3.3. The suffix may be any desired coding structure which adequately portrays the location of the WBS item in the hardware tree. The CWBS is the preferred structure.

11.NN.CWBS.CWBS.CWBS

Level 6 - (Optional) Piece Part/LRI

Level 5 - (Optional) Assembly/Subassembly

Level 4 -(Optional) End Item

Level 3 - (Required) Summary WBS # (Use 1-40, depending on the system code in section 3.3. Terminate with a ".")

Level 2 - (Required) Identifies WBS entry for prime mission equipment (Use 11.)

5.7.2.6 Government furnished equipment flag (required). Enter a Y (yes) if the equipment is GFE, a N (no) if it is CFE. If the WBS item is GFE, the Model will skip the R&D and production worksheets.

5.7.2.7 GFE,O&M Base year (required). Integer. Enter as 19XX or XX. This is the base fiscal year for the costs of GFE, operational material, depot labor and material rates, replenishment spares and repair parts entered on the UPC, Equipment and Maintenance worksheets. The Model uses this fiscal year to normalize these WBS item costs to the system base year. This base year does not apply to the R&D or production estimates made for CFE. The base years for the R&D and production estimates are contained on the worksheets for CFE.

5.7.2.8 Learning curve (required). Enter UNI for unit cost learning or CUM for cumulative average learning depending on the historical or expected learning function associated with each production item. This does not apply to GFE. See 5.7.4 for a more detailed discussion on learning curves.

5.7.3 Research & development worksheets. Research and development includes all costs to the Government necessary to bring the WBS item from concept formulation to serial production. The Demonstration and Validation costs include all costs associated with the WBS item's Advanced Development, excluding Research (6.1) and Exploratory Development (6.2) funded efforts. Also excluded are costs applicable to the system as a whole and not directly attributable to the WBS item itself. Full Scale Development includes all engineering, fabrication and testing associated with the WBS item to determine if it is producible, affordable and meets the performance specifications.

5.7.3.1 General. Only contractor efforts are costed using the R&D worksheets. Cost elements in the Demonstration and Validation (DVAL) array are identical to those in the Full Scale Development (FSD) array. The costs for design and development of the WBS item during the Research and Development phases may be entered as a single sum for each phase for any WBS item by making an entry for the fourth element. The Model will automatically skip the remaining fields (except TRACE) if a value is entered for the fourth (phase total) element of either the DVAL or FSD arrays.

5.7.3.1.1 Multiple records. If a WBS item is to be duplicated on multiple records for costing operations and support, all R&D costs should be entered on a single record assigned to the lead Service. If R&D costs are shared between two or more Services, allocate costs to one record for each Service according to the cost sharing agreement between the Services.

5.7.3.2 Cost-realism. The applicability of each of the cost elements provided on the R&D costing worksheet is a function of information available and the degree to which the analyst desires to develop detailed rational for the estimate. The Model will allow very high level estimates for use during early design studies and detailed estimates for use during proposal evaluation for the award of advanced development and full scale development contracts. Careful development of the CWBS and a resource estimate for each of the activities applicable to the development of each WBS item will minimize the risk of underestimating the cost of the technical research and development effort and provide both contractor and Government managers with sufficient detail to determine the adequacy of the estimate based on past corporate performance. Creation and retention of detailed level of effort data provides a sound basis for the development of parametric CER's.

5.7.3.3 Base year $ (YY). Enter as 19YY or YY. Year entries are required by the Model. This is the base fiscal year for R&D dollar entries. The Model will use this base year to convert R&D dollar entries to the system base year, if the two are different.

5.7.3.4 Inflation tables. The analyst may specify any of the following codes to select inflation tables for computing labor and material inflation for the WBS item:

1: Rate 1   2: Rate 2   3: Procurement   4: R&D

The R&D and Procurement rates are OSD deflators contained in the Model's data base and are not subject to change by the analyst. Rate 1 and Rate 2 are specified by the analyst and may be BLS deflators for the commodity being developed, industry deflators or regional deflators. The use of these factors should mirror as closely as possible the historical inflation experienced by the developer for like items. Different tables may be used for labor and material inflation.

5.7.3.5 Phase total D&V,FSD ($)(level 1). If an entry is made for this element, the estimate should reflect all engineering, tooling, manufacturing and testing labor associated with the R&D effort in the phase to develop the hardware or software configuration item described by this WBS record. Only R&D funded efforts should be included. This includes direct and indirect costs including G&A and fee.

5.7.3.6 CER flag (0-4) (level 2). The CER flag is used to tell the Model how to process data on the R&D worksheet when detailed entries are made. CER flag functions are recorded on the worksheets for convenience and are summarized here.

0 Dollar estimate. Treat all values as dollars. This is the default.

1 Manhour estimate. Treat entries for labor cost elements as manhours. Manhours are converted to dollars using weighted average hourly rates for the labor category assigned to the cost element. Weighted average hourly rates are computed for each labor category (drafting, fabrication, quality control, engineering, tooling and producibility engineering) and summary level WBS classification based on entries in the manufacturer's table of organization and the labor hour rate table for each grade and labor category. Labor categories are shown on the worksheets and are defined in 5.8 of this handbook.

2 Ratio estimate. Treat entries greater than 1 as $ values. Treat values between 0 and 1 as ratios of the the phase total. Ratios only apply to level 2 costs, i.e., engineering, production engineering and planning, tooling, prototype manufacturing and other.

3 Parametric estimate. Treat entries as generalized parametric expressions where engineering, tooling and manufacturing costs are computed based on the following equations:

$$\text{Engineering} = F7 + F8*F9^{F10}$$
$$\text{Tooling} = F16 + F17*F18^{F19}$$
$$\text{Manufacturing} = F23 + F24*F25^{F26}$$

* is used to represent multiplication, superscript exponentiation

4 Manloading. Treat labor elements as manloading, i.e., the number of people assigned to the element for the R&D effort associated with the WBS item. Fractional values such as 2.6 may be used. The Model uses the schedule for the R&D item to compute manmonths of effort and the manmonth to manhour conversion factor from the assumption table to compute manhours of effort. The manhours are then converted to dollars using the same techniques used for labor flag 1.

5.7.3.7 Development engineering ($,%,D7+D8*D9^{D10}). Development engineering includes contractor costs for the study, analysis, design, development, evaluation, testing, and redesign of WBS components during the development effort. It includes the design effort of preparing specifications, engineering drawings, parts lists, wiring diagrams, test planning and scheduling, analysis of test results, data reduction, report preparation and establishment of reliability, maintainability and quality assurance control requirements. It also includes the cost of raw and semifabricated material plus purchased parts consumed in the performance of component engineering effort. Included are engineering test equipment such as oscilloscopes, radio transmitters, transducers, receivers, discriminators and other equipment required to accomplish the engineering function for the specified WBS element. This element also includes the engineering efforts in support of Preplanned Product Improvements. Excluded from this element is the engineering effort (Producibility Engineering and Planning) to insure the producibility of the WBS item or system prior to quantity procurement.

5.7.3.7.1 Cost elements affected. 111.11, 121.11 and their subelements

5.7.3.8 Producibility engineering and planning ($,Hrs,%,ML). Producibility engineering and planning (PEP) covers contractor costs associated with assuring the producibility of the WBS item. PEP involves the engineering tasks necessary to insure the timely, efficient and economic production of essential material and is primarily of a planning nature. PEP includes the costs associated with developing the Technical Data Package (TDP), Quality Assurance (QA) plan, and any unique production processes to assess producibility. Also included are development of unique processes essential to the design and manufacture of material and details of performance ratings, dimensional and performance data, manufacturing assembly sequences, schematics, mechanical and electrical connections, physical characteristics including form, fit and finishes, inspection test and evaluation requirements, calibration information and quality control procedures.

5.7.3.8.1 Cost elements affected. 111.11, 121.11 and their subelements

5.7.3.9 Tooling ($,%,D16+D17*D18^{D19}). Tooling includes all contractor costs associated with planning, design, fabrication, assembly, installation, modification, maintenance, and rework of all contractor provided tools, inspection equipment, and test equipment supporting the development of the specified WBS component. It includes all direct labor spent in determination of tool, inspection, and test equipment requirements; planning of fabrication and testing operations; maintenance of tool records; scheduling and control of tool orders; and programming and preparation of tapes for all numerically controlled machine tools used in the fabrication, assembly, installation, modification, maintenance and rework of dies, jigs, fixtures, inspection equipment, material handling equipment, work platforms, and test equipment used to develop the WBS component, as well as tools normally purchased in final form or which require negligible effort to assemble. This covers only R&D "soft" tooling and specifically excludes tooling necessary to meet production rate requirements.

5.7.3.9.1 Cost elements affected. 111.11, 121.11 and their subelements

5.7.3.10 Prototype manufacturing ($,%,D23+D24*D25^{D26}). Prototype manufacturing covers all contractor costs associated with the fabrication, processing, subassembly, final assembly, reworking modification, and installation of parts and equipment, power plants, boosters, electronic equipment, explosives, and other items (including Government Furnished Equipment) and the proving of such equipment and instruments for the WBS component. This includes the construction of piece parts from raw materials (the cutting, forming, stretching and blanking operations performed on materials to make individual parts). It includes bench assemblies of all minor and major assemblies, mating or joining of primary sections, installation of special and general equipment, instruments and accessories performed after the mating, and all other preparation, processing, preflight and production service operations. Also included are the raw and semifabricated material plus purchased parts using the in manufacture of the specified WBS prototype. The cost of prototype spare assemblies and parts are also included in this element.

5.7.3.10.1 Cost elements affected. 111.11, 121.11 and their subelements

5.7.3.11 Other ($,%). Other can be used to account for any factors not already accounted for above. It is provided as a general purpose account to highlight any part of the R&D effort associated with the WBS item. It may be used to account for fee or other indirect costs if a decimal value is entered.

5.7.3.11.1 Cost elements affected. 111.11, 121.11 and their subelements

5.7.3.12 TRACE ($,%). Total risk-assessing cost estimate is for technical risk associated with the R&D effort. The analyst may enter a $ value, or a %. If a number between 0 and 1 is entered, the Model will calculate the amount of TRACE by applying the percentage to the total R&D cost for the WBS item. Use the TRACE cost factor to deal with the estimate of the size of the unknown unknowns.

5.7.3.12.1 Cost elements affected. 111.11, 121.11 and their subelements

5.7.3.13 Schedule (YY,MM,duration)(optional). The start date must follow the system level start date for the R&D phase being costed. The duration, which may be a fractional value, is used to convert manloading data when the CER flag is set to 4 into manhours using the conversion factor in the assumption array. By changing either the start date or the duration, the analyst can determine the cost impact of changes in schedule due to additional work (change in duration) or inflation (change in start date). If the CER flag is not set to 4, these values are used to spread the R&D effort over time. If no values are entered for the schedule, the Model assumes that the event duration is equal to the phase length for the R&D phase(D&V or FSD) being costed and uses the default system level spending rates to cost the task.

5.7.3.13.1 Cost elements affected. 111.11, 121.11 and their subelements

5.7.4 Production worksheets. Production includes all direct and indirect costs attributable to the production of the hardware or software configuration item for the lot described on the UPC worksheet. This includes nonrecurring or start-up costs required to establish the production capability including hard and soft tooling, production fixtures, facilities, production engineering and planning and test equipment. It includes all recurring costs associated with the manufacture and production testing of the hardware or software configuration item except for system level test. Included are fabrication, assembly, quality control, sustaining engineering, design assurance, program management, subcontracted items, raw material, purchased parts, assemblies and packaging.

5.7.4.1 General. Costs entered on the production worksheet are average unit costs for the basis quantity. The basis quantity must include the first unit produced. The basis quantity may be one, in which case theoretical first unit costs for the WBS item may be entered on this worksheet.

5.7.4.1.1 Level of detail. The recurring unit costs to manufacture the hardware or software configuration item may be entered as a single sum for any WBS item by entering a value for the fourth element. The Model will then skip to the nonrecurring cost(s) which may also be a single entry. Entering data for any level 2 element causes the Model to skip to the next level 2 element. Each cost element's level, labor category (if applicable), edit code and CER flag options are shown on the production worksheet.

5.7.4.1.2 Cost-realism. The applicability of each of the cost elements on the production worksheet is a function of information available, contract requirements, and the degree to which the analyst desires to develop detailed rationale for the estimate. The Model allows high level estimates for use during early design studies and detailed estimates for use during proposal evaluation for the award of the production contract. Careful development of the CWBS and a resource estimate for each of the activities applicable to the production of each WBS item minimizes the risk of underestimating the cost of the manufacturing effort and provides both contractor and Government program managers with sufficient detail to determine the adequacy of the estimate based on past corporate performance. Creation and retention of labor, material and schedule data provides a sound basis for program management and the development of parametric CER's.

5.7.4.1.3 Multiple lot procurements. Basis production costs should be recorded on a single record for each Service. If multiple lots are to be procured, a record should be created for each lot by copying the basis production cost record and then entering the number built before the current lot on the UPC worksheet (see 5.7.5). The Model will calculate the average unit cost for each lot based on the buy quantities, learning curves, number previously built and the learning theory selected for the lot. Care should be taken to evaluate the applicability of the basis lot's nonrecurring costs to second and subsequent lots and make changes as required.

5.7.4.1.4 Basis for recurring costs. If labor or material learning curves are used, the recurring production labor and material estimates entered on the production worksheet must either be theoretical first unit costs or the average unit costs for a first lot size specified by the UPC goal (basis) quantity. If actual production history forms the basis for this estimate, then the history for the entire run to date should be used and the appropriate average unit costs calculated based on the lot mid-point calculation explained under the learning curve discussion in 5.7.5.4. Do not use the costs for a subsequent production lot as the basis for this worksheet or the effects of learning will be overstated. The learning curve calculations assume that the basis quantity starts with the first production unit. Either cumulative average or unit cost learning theory may be selected for each lot. The Model computes the average unit cost for each lot using the labor and material learning curves supplied by the analyst, lot size, number previously built and the recurring costs described below. Learning does not apply to purchased parts and assemblies, subcontracted items and program management.

5.7.4.1.5 Realization rates. When making labor estimates, the analyst should be careful to take into consideration nonproductive time (realization rates) associated with production labor.

5.7.4.2 Base year $ (YY) (level 1). Enter as 19YY or YY. Year entries are validated by the Model upon entry. This is the base fiscal year for the production estimates. The Model will use this base year to convert production dollar entries to the system base year, if the two are different.

5.7.4.3 Inflation tables (level 1). The analyst may specify any of the following codes to select inflation tables for computing labor and material inflation for the WBS item:

1: Rate 1; 2: Rate 2; 3: Procurement; 4: R&D

The R&D and Procurement rates are OSD rates contained in the Model's data bases and may not be changed. Rate 1 and Rate 2 are specified by the analyst and may be BLS deflators for the commodity being developed, industry deflators or regional deflators. The use of these factors should mirror as closely as possible the historical labor and material inflation experienced by the developer for like items. The use of these factors will not change the budget category for procurement items. All CFE procurred during the production phase is reported as Procurement funded for the POM/budget report.

5.7.4.4 Recurring production ($) (level 1). If an entry is made for this cost element, the Model will skip to nonrecurring costs. This element should include all efforts with producing the hardware or software configuration item including material, subcontracted items, purchased parts and assemblies, fabrication labor, assembly, support labor, quality control, inspection and test, sustaining engineering, design assurance, packaging, sustaining tooling, program management, overhead, G&A and fee.

5.7.4.4.1 Cost elements affected. 221.11 and its subelements

5.7.4.4.2 Inflation. Uses average of material and labor inflation.

5.7.4.4.3 Learning. Uses average of material and labor learning.

5.7.4.5 CER flag (0-7) (level 2). The CER flag is used to tell the Model how to process data on the production worksheet when detailed entries are made. CER flag functions are recorded on the worksheet for convenience and are summarized here.

0 Dollar estimate. Treat all values as dollars. This is the default.

1 Manhour estimate. Treat entries for labor cost elements as manhours. Manhours are converted to dollars using weighted average hourly rates for the labor category assigned to the cost element. Weighted average hourly rates are computed for each labor category (fabrication, assembly, quality control, engineering, program management, tooling and producibility engineering) and summary level WBS classification based on entries in the manufacturer's production table of organization and the labor hour rate table for each grade and labor category. Labor categories are shown on the worksheets and are defined in 5.8, the personnel data base.

2 Ratio estimate. Treat entries greater than 1 as $ values. Treat values between 0 and 1 as ratios of the next higher level entry with level 1 cost elements, recurring and nonrecurring production, being the highest levels and hence not subject to ratio entries. Level 3 elements are ratios of level 2 elements and level 2 elements are ratios of level 1 elements.

3-7 Parametric estimates. Treat entries as generalized parametric expressions where average unit (recurring) and nonrecurring lot costs are computed based on the following equations if no value has been entered for P4 or P25:

CER FLAG	FORMULA USED
3 Average unit cost	$P4 = P6 + P7*P8^{P9} + P10*P11^{P12} + P13*P14^{P15} + P16*P17^{P18}$
Nonrecurring lot cost	$P25 = P26 + P27*P28^{P29} + P30*P31^{P32}$

CER FLAG	FORMULA USED
4	
Average unit cost	$P4 = P6 + P7*P8^{P9} + P10*P8^{P11} + P12*P8^{P13} + P14*P8^{P15}$
Nonrecurring lot cost	$P25 = P26 + P27*P28^{P29} + P30*P28^{P31}$
5	
Average unit cost	$P4 = P6 + P7*(P8 + P9) + P10*(P11 + P12) + P13*(P14 + P15) + P16*(P17 + P18)$
Nonrecurring lot cost	$P25 = P26 + P27*(P28 + P29) + P30*(P31 + P32)$
6	
Average unit cost	$P4 = P6 + P7*P8^{(P9 + P10)} + P11*P12^{(P13 + P14)} + P15*P16^{(P17 + P18)}$
Nonrecurring lot cost	$P25 = P26 + P27*P28^{(P29 + P30)}$
7	
Average unit cost	$P4 = P6 + P7*P8^{(P9 + P10)} + P11*P8^{(P12 + P13)} + P14*P8^{(P15 + P16)}$
Nonrecurring lot cost	$P25 = P26 + P27*P28^{(P29 + P30)}$

5.7.4.5.1 CER conventions. The following conventions apply to the CER's:

a. Superscripts represent exponentiation, * multiplication.

b. Expressions used as exponents may not exceed 6

c. Expressions raised to a power may not be less than 1.0E-3

d. Expressions which are zero filled or have had not entries made will not process.

e. If an entry is made for either P4 or P25 using the editor after the CER is defined, that entry will process instead of the CER.

5.7.4.6 Production material ($,%,CER) (level 2). Production material includes the burdened cost of raw material, semifinished goods, and purchased parts used in the fabrication of one unit described. It includes the cost of all subassemblies (if any) and material and parts necessary to integrate the unit into the next higher level of the WBS. It excludes the direct labor cost associated with the fabrication, assembly and checkout of parts, subassemblies and major assemblies. Excludes purchased parts and subcontracted items which are not subject to learning.

5.7.4.6.1 Inflation. Uses material inflation

5.7.4.6.2 Learning. Uses material learning

5.7.4.6.3 Cost elements affected. 221.11 and its subelements

5.7.4.7 Subcontracted items ($,%,CER) (level 2). This is the fully burdened cost of finished end items purchased from subcontractors. The cost includes subcontract G&A and fee.

5.7.4.7.1 Inflation. Uses material inflation

5.7.4.7.2 Learning. Learning does not apply

5.7.4.7.3 Cost elements affected. 221.11 and its subelements

5.7.4.8 Purchased parts and subassemblies ($,%,CER) (level 2). This is the fully burdened cost for parts and assemblies purchased from other suppliers. It includes any applicable subcontract G&A. Material learning is not applied to these items.

5.7.4.8.1 Inflation. Uses material inflation

5.7.4.8.2 Learning. Learning does not apply

5.7.4.8.3 Cost elements affected. 221.11 and its subelements

5.7.4.9 Manufacturing labor(Manhours,%,CER) (level 2). Manufacturing labor includes the burdened cost of all direct labor associated with the fabrication, assembly and checkout of parts, subassemblies and major assemblies including GFE. This also includes labor for painting and special coatings. Labor is charged for the prime contractor only based on the assumption that the purchase price of subcontracted and purchased items includes labor in the item cost. Three categories of manufacturing labor are provided: fabrication for skilled labor categories such as machinists; assembly for semiskilled and unskilled workers; and support labor for functions such as tool issue, painting or any other functions which the analyst desires to break out from the fabrication and assembly. When CER flag 1 (manhours) is set, both assembly and support labor use the same weighted average hourly rate based on labor grade ASPD. Fabrication uses a different weighted average hourly rate based on labor grade FAPD. See 5.8 for details of labor hour costing.

5.7.4.9.1 Inflation. Uses labor inflation

5.7.4.9.2 Learning. Uses labor learning

5.7.4.9.3 Cost elements affected. 221.11 and its subelements

5.7.4.10 Quality control and inspection (\$,Manhours,%,CER) (level 2). Quality control and inspection includes the cost of implementation of all controls necessary to insure that the units produced meet prescribed standards. It includes the costs associated with receiving, in process, and final inspections of associated tools, parts, subassemblies complete assemblies, and calibration of tools and test equipment. It also includes costs associated with the establishment and performance of measures for acceptable quality levels, reliability testing, production acceptance tests, stockpile reliability testing, statistical methods for determining performance of manufacturing processes and preparation and review of reports relating to these tasks.

5.7.4.10.1 Inflation. Uses labor inflation

5.7.4.10.2 Learning. Uses labor learning

5.7.4.10.3 Cost elements affected. 221.11 and its subelements

5.7.4.11 Sustaining engineering (\$,Manhours,%,CER) (level 2). Sustaining engineering includes the cost of all engineering performed in support of production after quantity production begins. It includes maintainability and reliability engineering, maintenance engineering, production engineering, special engineering investigations and other sustaining engineering efforts. It also includes redesign, evaluation and other support engineering efforts (either in-house, contract or separate contractor) directly involved with production of the WBS component such as maintenance of the technical data package and analysis of test results. It specifically excludes preparation of engineering change orders (ECO) and engineering change proposals (ECP) which are reported separately based on factors found on the UPC worksheet in 5.7.5.15.

5.7.4.11.1 Inflation. Uses labor inflation

5.7.4.11.2 Learning. Uses labor learning

5.7.4.11.3 Cost elements affected. 221.11 and its subelements

5.7.4.12 Design assurance (\$,Manhours,%,CER)(level 1) (level 2). This is the cost of the engineering effort associated with design interpretation and changes and review of failures for design or specification flaws. These costs may be included under sustaining engineering. This factor is provided for the use of those manufacturers who capture data at this level.

5.7.4.12.1 Inflation. Uses labor inflation

5.7.4.12.2 Learning. Uses labor learning

5.7.4.12.3 Cost elements affected. 221.11 and its subelements

5.7.4.13 Packaging ($,%,CER) (level 2). Packaging includes the cost of all labor and material required to package the system for shipment to the Government acceptance site. It also includes the costs of special preservation measures taken for long term storage of the WBS component. It includes the cost of shipping containers, dunnage, administrative cost, and labor required to prepare the unit/equipment for shipment.

5.7.4.13.1 Inflation. Uses average of labor and material inflation

5.7.4.13.2 Learning. Uses average of labor and material learning

5.7.4.13.3 Cost elements affected. 221.11 and its subelements

5.7.4.14 Sustaining tooling ($,Manhours,%,CER) (level 2). Sustaining tooling is tooling consumed in the production of the WBS component. It includes maintenance of the production line, consumption of tool parts, reprogramming of numerically controlled machines, calibration of production test equipment and any labor or other direct charges associated with production tooling.

5.7.4.14.1 Inflation. Uses average of labor and material inflation

5.7.4.14.2 Learning. Uses average of labor and material learning

5.7.4.14.3 Cost elements affected. 221.11 and its subelements

5.7.4.15 Program management ($,Manhours,%P24) (level 2). This is the cost of planning, directing and controlling production of the hardware or software configuration item. It includes such functions as logistics and logistics support, facilities, maintenance support, personnel support, testing and training. It excludes program management costs attributable to the system as a whole. See 221.12 System/Project Management.

5.7.4.15.1 Inflation. Uses labor inflation

5.7.4.15.2 Learning. Does not use learning

5.7.4.15.3 Cost elements affected. 221.11 and its subelements

5.7.4.16 Other ($,%P25) (level 2). This is any other recurring cost associated with the production of the hardware or software configuration item. It may include such factors as G&A and fee or profit. A value between 0 and 1 may be entered. If this is done, the Model will use this value + 1 as a multiplier for all other recurring costs to account for G&A, fee and burden. If the lot fee is fixed, it should be entered under other nonrecurring costs for the lot, not here.

5.7.4.16.1 Inflation. Uses average of labor and material inflation

5.7.4.16.2 Learning. Uses average of labor and material learning

5.7.4.16.3 Cost elements affected. 221.11 and its subelements

5.7.4.17 Nonrecurring production costs ($) (level 2). Nonrecurring production cost includes all nonrecurring costs associated with the establishment of a particular production capability unique to the hardware or software configuration item. This may include the cost for initial tooling and test equipment, industrial facilities, production engineering, system engineering, and other nonrecurring production costs. Normally, these costs are associated with the system as a whole and cannot easily be allocated to specific units, assemblies and subassemblies within the system. Nonrecurring production costs attributable to the materiel system as a whole or to multiple WBS items should be entered under cost elements 211.12-211.20.

5.7.4.17.1 Inflation. Uses average of labor and material inflation

5.7.4.17.2 Cost elements affected. 211.11 and its subelements

5.7.4.18 Initial tooling ($,%,CER). This is the cost for initial tooling and production line setup required to support low rate and full scale production of the WBS component. It includes cost of labor and material to fabricate, assemble and install tools (including modification and rework of development tools for production purposes), dies, templates, patterns, form block manufacturer, jigs, fixtures, master forms, inspection equipment, material handling equipment, load bars, work platforms (including installation of utilities thereon), and test equipment (such as checkers and analyzers) to support manufacturing. It also includes initial and duplicate sets of tools necessary to reach full rate production plus modification of Low Rate Initial Production (LRIP) tooling for full scale production. This element also includes maintenance of tool records, establishment of make-or-buy and manufacturing plans on nonrecurring tools and equipment, scheduling and control of tool orders, and programming and preparation of software for numerically controlled equipment. It excludes tooling associated with the system as a whole costed under 211.14.1. Tooling which is used on multiple WBS items may be allocated on a pro-rata basis to each item or may be costed under 211.14.1.

5.7.4.18.1 Inflation. Uses average of labor and material inflation

5.7.4.18.2 Cost elements affected. 211.11 and its subelements

5.7.4.19 Production base support ($,%). Production base support is the cost of construction, conversion or expansion of facilities for the production, inventory and maintenance required to establish the production program associated with the WBS item. This effort excludes tooling costs which should be entered separately and any Government facilities or Government owned contractor operated facilities. Normally, production base support costs are associated with the production effort as a whole and are entered under 211.14.3.

5.7.4.19.1 Inflation. Uses average of labor and material inflation

5.7.4.19.2 Cost elements affected. 211.11 and its subelements

5.7.4.20 Engineering ($,Manhours,%). This is the cost of directing and controlling the establishment of the production capability including tooling and production line set-up for the WBS item. It excludes any system level costs reported under 211.14.2.

5.7.4.20.1 Inflation. Uses labor inflation

5.7.4.20.2 Cost elements affected. 211.11 and its subelements

5.7.4.21 Other ($,%). This is the sum of all other procurement funded costs to establish the production capability for the WBS item. This may include G&A and fee. If a value between 0 and 1 is entered, the Model computes a value for this element as a percentage of all other nonrecurring costs. No inflation is applied if a decimal value is entered since inflation is accounted for in the previously entered elements.

5.7.4.21.1 Inflation. Uses average of labor and material inflation

5.7.4.21.2 Cost elements affected. 211.11 and its subelements

5.7.5 Unit production cost worksheet. The unit production cost inputs are designed to compute lot costs based on learning theory, lot size and inflation through use of schedule and production rates. This worksheet is also used to describe costs for Government furnished equipments for R&D and production in lieu of the R&D and production worksheets.

5.7.5.1 R&D GFE quantities (#). R&D GFE quantity is a factor applied against the GFE unit cost (recorded in U7) to account for maintenance and consumption of Government equipment during the R&D phase. It includes the cost of equipment which cannot be returned to the Government in its original form (e.g., equipment destroyed or modified). It specifically excludes the cost of equipment that is used by the contractor during R&D, but returned to the Government in its original condition (e.g., test equipment). The factor may include a fractional value to account for Government costs to maintain GFE during the R&D phase.

5.7.5.1.1 Cost elements affected. 112.11, 122.11 and their subelements

5.7.5.1.2 Note. The GFE flag in the classification record must be set to Y for these values to process.

5.7.5.2 Production GFE quantity (N-R) (#). Nonrecurring production GFE quantity is a factor applied against the unit cost of GFE (recorded in U7) provided to the contractor that is not integrated into the prime mission system but is used as part of the production effort (e.g., test equipment). This excludes the cost of GFE that will be returned to the Government at the end of the production phase. Also excluded are GFE funded by other program offices. This factor should include a fractional value to account for the costs to maintain the GFE during the production phase.

5.7.5.2.1 Cost elements affected. 212.11 and its subelements

5.7.5.2.2 Note. The GFE flag in the classification record must be set to Y for this value to process.

5.7.5.3 Production GFE quantity-recurring (#). This is the number of GFE items provided to the contractor or to the receiving commands to be integrated into the prime mission equipment or system. GFE funded by other program offices and not reimbursed by the program office are excluded from this cost to avoid double counting but should be included under the equipment operating quantity.

5.7.5.3.1 Cost elements affected. 222.11 and its subelements

5.7.5.3.2 Note. The GFE flag in the classification record must be set to Y for this value to process.

5.7.5.4 Unit production cost estimate date (YY MM). This is the year and month of the Production/GFE Unit Cost estimate. This date is used for documentation purposes only and does not affect calculations.

5.7.5.5 Unit production cost goal/GFE unit cost ($/item produced).

5.7.5.5.1 GFE unit cost. If the GFE flag in the classification record is set to "Y", this is the unit cost of GFE furnished to the program including the cost to ship the WBS item to the contractor's facility.

5.7.5.5.2 UPC cost goal. For CFE, the value, as defined herein, is not used by the Model except for reports. This is the current estimate of the average unit cost (in base year $) to produce a fixed number (see below) of prime mission item(s). This estimate is composed of costs specified in the production contract and normally includes contractor nonrecurring and recurring costs (including general and administrative, and fee or profit) associated with the production of hardware and software end items. It normally will not include Government costs, GFE, training, data, peculiar or common support equipment, operational site activation, or initial spares and repair parts. The estimate may include the contractor's system/project management and system test and evaluation if they are included in the contract as costs of the buy quantity. Once this estimate is made, it will be the base figure used to determine the affects of changes in production quantities on the system's cost.

5.7.5.5.3 Inflation. For GFE, uses procurement inflation factor.

5.7.5.5.4 Learning curve. Learning does not apply to GFE.

5.7.5.5.5 Cost elements affected. 321.21, 321.22, 322.21, 322.22, 323.2, 324.2, 330, 222.11 and its subelements
(GFE items only)

5.7.5.6 Unit production cost basis quantity (#). This is the first lot quantity of production items upon which the estimates contained on the production worksheet are based. This quantity is normally specified contractually early in the R&D phase and should not change over the life of the program. All unit production cost estimates for purposes of contractual cost control should be based on this quantity. The calculated unit production cost will be a function of this quantity, buy quantity (lot size), number of units previously built, and learning rates for labor and material (learning curves). If theoretical first unit costs are entered in the production array, enter a 1 here. If this is a follow-on lot of a production effort not begun as part of this program, then this quantity should represent the size of the total production run at the time average unit costs are determined. Costs entered in the production array should be the average unit costs for this number of units.

5.7.5.6.1 Cost elements affected. 321.21, 321.22, 322.22, 323.2, 324.2, 330, 221.11 and its subelements

5.7.5.7 Learning curve slope - material & labor (%). This is the rate at which recurring production costs decline for each doubling of production quantities. E.g., a value of .9 will result in a 10 percent decrease in the unit cost of the last item produced or the average price for all items produced for each doubling of production quantity depending upon which theory is selected. The calculation is made separately for each lot and is the basis for the lot cost. Two different values are provided, one for labor and the other for material. The analyst may select "Boeing" unit cost theory or cumulative average theory. Learning curves do not apply to the following recurring cost categories entered on the Production worksheet: purchased parts and assemblies, subcontracted items and program management. The average of material and labor learning is applied to packaging and tooling if individual tooling costs are not entered.

5.7.5.7.1 Slope. For either the cumulative average or unit cost theory, the slope of the learning curve is calculated by the same method. The value of the learning curve slope, or learning rate, is defined as the ratio of costs at two points, the second of which is at a quantity twice that of the first.

5.7.5.7.2 General learning curve equation. The basic form of the learning curve equation takes the form:

$$C_N = AN^B$$

Where C_N = LOT COST/N for cumulative average theory

C_N = Cost of the Nth production item for unit cost theory

A is the theoretical first unit cost

N is the total number of items built

B = learning function = log Slope/log 2

5.7.5.7.3 Cumulative average theory. The cumulative average theory is used when the production history or expected production history shows a learning behavior which results in a constant decrease in the average unit cost of all units produced for each doubling of total production. The cumulative average learning curve is described by the following formula:

$$C_N = A*N^B$$

Where:

C_N = Total cost for the first N production items/N

N = Cumulative production in units

A = Theoretical first unit cost

B = learning function = log S/log2

S = slope of the learning curve

Cost for the nth item where n<N is:

$$C_n = A*[n^{(1+B)} - (n-1)^{(1+B)}]$$

Total cost for all items to date:

$$TC_N = N*A*N^B$$
$$= A*N^{(1+B)}$$

5.7.5.7.4 Lot midpoint. The average unit cost for the N production items is not the cost of the nth item produced, the N/2 item or for any other item in the lot, but is only the arithmetic mean of the total cost to produce the N items. The only way to compute the unit cost for any item in a production run of size N is to use the above formula for the cost of the n^{th} item in the run.

5.7.5.7.5 Unit cost learning curve. Unit cost learning theory should be selected when the production history or expected production history shows a learning behavior which results in a constant reduction in the cost of the last item produced for each doubling of total production. The unit cost learning curve is described by the formula:

$C_N = AN^B$ where:

C_N = Cost for the Nth production item

N = Total number of items produced

A = Theoretical first unit cost

B = learning function = log S/log 2

S = slope of the learning curve

5.7.5.7.6 Unit and cumulative average theory compared. Both unit and cumulative average theory have the same basic equations. However, the results are vastly different. The unit cost prediction for unit theory is the cost of the last unit produced. The unit cost prediction for cumulative average theory is for the arithmetic mean of all units produced.

The algebraic midpoint for cumulative theory is

$k = n/2$ for a production history over n items

The algebraic midpoint for unit theory is

$k = [n^{(1+B)}/[(n+.05)^{(1+B)} - (1-.5)^{(1+B)}]]^{-1/B}$
for a production run of n items.

Given two production histories which have identical total costs and total numbers produced, unit theory will yield a smaller theoretical first unit cost and a higher last unit cost than will cumulative average theory. In the past, some analysts have demonstrated a tendency to choose unit theory over cumulative average theory since it is easier to determine a lot cost with unit theory. In actual practice, the method chosen should be based on the history of the item being produced, not on ease of calculation since the Model will produce reliable results with either theory given the same information.

5.7.5.7.7 Cost elements affected. 321.21, 321.22, 322.21, 322.22, 323.2, 324.2 330, 221.11 and its subelements

5.7.5.7.8 Note. A value of 1 will result in a "flat" learning curve so that production costs will be insensitive to production volume. Typical values range between .8 and .95. If no entry is made for this factor, the Model will assume a value of 1 and no learning will take place.

5.7.5.8 Lot number. This value is the number of the production lot being described. It is only used for documentation purposes and has no influence on calculations.

5.7.5.9 Lot buy quantity (#). This is the number of WBS items purchased in this lot. Buy quantity (or inventory objective) is the total number of items, by category, to be procured for the system during its life cycle. It may include operational quantities and quantities held in prepositioned war reserve stocks (PWRS), maintenance float (end items, secondary reparables) and any other nonoperational reserve.

5.7.5.9.1 Cost elements affected. 321.21, 321.22, 322.21, 322.22, 323.2, 324.2, 330, 221.11 and its subelements

5.7.5.10 Number previously built (#). This is the number of items built before this lot. The value is used in the unit production cost calculation to compute the average unit cost for the lot by moving the lot cost calculation down the learning curve by this amount. E.g., if the lot buy were 500 and the number previously built were 1000, the Model would calculate the lot costs for the 1001-1500th items.

5.7.5.10.1 Cost elements affected. 321.21, 321.22, 322.21, 322.22, 323.2, 324.2, 330, 221.11 and its subelements

5.7.5.11 Production Rate (#/mo). This is the average number of WBS items produced each month for this lot. This value is used to spread the lot production costs over time. It has no affect on costs except through the action of inflation. This factor is independent optimal production rates.

5.7.5.11.1 Cost elements affected. 321.21, 321.22, 322.21, 322.22, 323.2, 324.2, 330, 221.11 and its subelements

5.7.5.12 Trace ($,%). This is the amount of risk in the current recurring production estimate which the developing contractor's management is unwilling to bear. It is used to increase the size of the calculated unit production cost for the WBS item by the specified dollar amount or percentage if the number entered is between one and zero. This is not a management reserve. The Model does not report it separately as it does TRACE for R&D. It is used to account for the "unknown unknowns" associated with the production estimate and should be reduced in size (if used at all) as the development effort nears an end and design and producibility uncertainties are resolved.

5.7.5.12.1 Cost elements affected. 321.21, 321.22, 322.21, 322.22, 323.2, 324.2, 330, 221.11 and its subelements

5.7.5.13 Reliability improvement warranty ($/YEAR/ITEM). This is the annual per unit cost for the warranty offered by the manufacturer. The final cost is a function of the number of items in the lot, this cost and the length of the warranty period in years. This cost is added to the calculated unit production cost for the item.

5.7.5.13.1 Inflation. Uses average of labor and material inflation

5.7.5.13.2 Learning curve. Learning theory does not apply.

5.7.5.13.3 Cost elements affected. 221.11 and its subelements, 321, 322 and 323 and their subelements

5.7.5.14 Reliability improvement warranty period (YEARS). This is the number of years repair to the WBS item is covered by a warranty. During this period, no charges are made for repair material or transportation. A value should only be entered for items covered by the warranty. Decimal values (e.g., 2.5 years for 30 months) are permitted.

5.7.5.14.1 Cost elements affected. 221.11 and its subelements, 321, 322 and 323 and their subelements

5.7.5.15 Engineering changes ($,%). Engineering changes refers to efforts to redesign and test changes to the WBS component while it is still in the manufacturing process (prior to acceptance by the Service). It applies only to officially sanctioned changes made to production items and does not apply to items already fielded. This cost does not become part of the unit production cost and is reported separately under cost element 221.16 Engineering Changes. This may be a dollar amount or it may be a percentage factor. If a number between zero and one is entered by the analyst, the factor will be multiplied by the average unit production cost (calculated) for the lot to give the lot allowance for engineering changes. If an amount greater than one is entered, that amount will be used as the total cost for engineering changes for the lot, not gor each item.

5.7.5.15.1 Cost element affected. 221.16

5.7.6 Equipment worksheet. The equipment variables describe physical characteristics and selected material costs associated with each WBS item. These factors are used to calculate costs to operate and maintain the post-production system while in hands of the ultimate user. The variables address cost drivers for operational material consumption, energy consumption, repair material costs, reliability and maintainability.

5.7.6.1 General. The variables on this worksheet form the basis for life cycle cost trade studies. The payoff for design which is sensitive to operating costs is obtained by finding engineering solutions which reduce crew size, material consumption and repair times and increase reliability. The Model has been designed to provide both the Government and the design engineer a realistic measure of ownership costs sensitive to variables under the control of design, reliability, logistics and production engineers.

5.7.6.1.1 Cost realism. It is essential that those factors which impact upon ownership costs be carefully thought out and be as as accurate as possible. Underestimates may result in budget shortfalls which could adversely affect operational availability. Underestimates could also lead to loss of confidence in the acquisition program's credibility in other areas such as operational effectiveness and production cost estimates thereby jeopardizing the program. Overestimates may also jeopardize the program or cause the buy quantity to be reduced unnecessarily.

5.7.6.1.2 Base year. Costs entered on the equipment worksheet must be entered in the base year assigned to the WBS item on the WBS classification sheet. These are normalized to the system base year by the Model.

5.7.6.1.3 Percentages. All percentages must be entered as decimal values e.g., enter 10 percent as .10. The Model does not check to verify if a percentage entry has a value greater than one to give analysts the option to have rates greater than 100 percent.

5.7.6.1.4 Cost elements affected. These sections refer the analyst to the operating and support report element affected by the equipment variable. The O&S report elements are contained in 5.5 and document how the equipment variable is used to compute the report cost element.

5.7.6.2 Operating quantity (#). This is the number of WBS items to be operated. It includes those WBS items assigned to active and reserve forces, schools (unless the cost for school operations are included in recurring training costs) and supporting agencies. This number excludes WBS items placed in maintenance float and war reserves. If the WBS component is a subassembly which occurs more than once in the equipment, the operating quantity should be entered as an appropriate multiple of the equipment operating quantity.

5.7.6.2.1 Cost elements affected. 311, 312, 313, 321, 322, 323 and their subelements

5.7.6.3 Annual use (Hrs,MI,KM,RDS/Yr). This is the average number of peacetime training hours, miles, kilometers, rounds, cycles or other measure of life that the WBS item is expected to operate on an annual basis. This value is used to calculate maintenance demand, energy consumption and demand for shared operators. Different units of measure may be appropriate for different types of WBS items (e.g., tank gun in rounds, tank engine in hours and tank suspension in miles or kilometers).

Demand for shared operators is calculated based on the number of shared operators/equipment (E3). Since shared operators are costed on a per hour of work basis, the annual use unit of measure must be hours/year if E3 is greater than 0.

This value may also be different for different WBS items depending upon their relative use within the system. If the operational use varies between using units, the user may enter the WBS item under different equipment group numbers. WBS items assigned to forces with major differences (± 10%) in operational profiles should be entered separately using the Model's copy function.

5.7.6.3.1 Cost elements affected. 311, 312, 313, 321, 322, 323 and their subelements

5.7.6.4 Number of "shared" operators/equipment (#). This is the number of operators (entered in the Table of Organization as OPRS) who are only charged to the materiel system when the WBS item is operating. The assumption is made that they should not be charged to the materiel system being costed when the WBS item is not operating. This factor only applies to WBS items manned by sharable operators. It does not apply to items manned by dedicated (OPRD) operators or to WBS items which are not manned (e.g., subassemblies). The value may be fractional (e.g., 3.5)

5.7.6.4.1 Cost element affected. 311.1

5.7.6.5 WBS item shipping weight (lbs.). This is the packaged shipping weight, in pounds, of the WBS item. This value is used to calculate the cost to ship end items between maintenance facilities for repair and overhaul. If the unit does not require packaging, enter the unpackaged weight in pounds. For WBS items which are subassemblies (LRU's), set this value to zero if the LRU is removed and replaced at the organization (see LRU shipping weight below).

5.7.6.5.1 Cost elements affected. 321.4, 322.4, 323.3, 324.3

5.7.6.6 LRU shipping weight (lbs,%). This is the average packaged weight in pounds of those subassemblies of the WBS item which are shipped, at Government expense, to the various maintenance locations and consumed in the process of repairing the WBS item. Enter a value only if subassemblies are not included in the WBS file and at least one field repair rate is greater than 0. If a ratio (0<x<1) is entered for this factor and the equipment weight is greater than 0, the Model will calculate the LRU weight based on the ratio entered and the WBS item's shipping weight entered above.

5.7.6.6.1 Cost elements affected. 321.4, 322.4, 323.3

5.7.6.7 Average cost of nonreparable line replaceable units (LRU) ($). This is the average cost of nonreparable assemblies and parts (e.g., gaskets and safety wires) which are consumed every time the WBS item fails and LRU's are removed and repaired. It excludes the costs of repair parts and subassemblies consumed in the repair of the WBS item's failed LRU's.

5.7.6.7.1 Cost elements affected. 321.2.2, 322.2.2

5.7.6.8 Average cost of reparable line replaceable units (LRU's) ($,%UPC). This is the average cost of reparable assemblies contained in the WBS item which can be replaced at the organization, intermediate or depot levels. If the WBS item has a calculated unit production cost, that cost will be used if a zero is entered here. If a value between 0 and 1 is entered, and the WBS item has a calculated unit production cost, the Model will use this value to calculate the value of the average reparable LRU as a percentage of the unit production cost. If the reparable assemblies are also entered in the WBS file, set the repair rates for this WBS item to zero to prevent double counting.

5.7.6.8.1 Cost elements affected. 321.2, 322.2, 323.2

5.7.6.9 Repair material cost factor (%). This factor is applied to the cost of an average reparable assembly (entered above or calculated) to yield an estimate of the average cost of repair parts and material consumed for each failure of the WBS item which is repaired vice discarded. This factor is a function of the authorized level of repair, the complexity of the LRU being repaired and the cost of the components which can be removed and replaced. Repair material is not further repaired or salvaged.

5.7.6.9.1 Cost elements affected. 321.2.2, 322.2.2, 323.2

5.7.6.10 Repair material shipping weight (lbs). This is the average packaged weight of repair parts and material shipped at Government expense from depots to field supply/maintenance activities and consumed in the process of repairing LRU's. This does not apply to LRU's which are discarded rather than repaired. This value has no affect if no repairs are made below the depot.

5.7.6.10.1 Cost elements affected. 321.4, 322.4, 323.3

5.7.6.11 Operational material consumption rate (units/year). This is the average amount of operational material (POL (less fuel), ammunition, missiles, and other material such as paper, truck batteries, tank tracks, tires) consumed per year by the end item during unit and individual training. This is a quantity, not a cost. Care must be taken to ensure that units of measure (e.g., gallons, boxes, etc.) are the same as those used for the cost of consumable materials and material weight.

5.7.6.11.1 Cost elements affected. 312 and its subelements

5.7.6.12 Operational material type code (1,2,3). This code is used by the Model to allocate operational material consumption costs for the operating and support reports. The following codes apply:

Code	Type Material
0	No material consumption
1	Oil, lubricants (less fuel)
2	Ammunition/Missiles
3	All other material consumed operating the WBS item

5.7.6.12.1 Cost elements affected. 312 and its subelements

5.7.6.13 Cost of operational material ($/unit). This is the average cost of a unit of material consumed by the WBS item. The }nit of material costed must be consistent with the units used in the material consumption rate.

5.7.6.13.1 Cost elements affected. 312 and its subelements.

5.7.6.14 Shipping weight of operational material (lbs/unit). This is the average shipping weight of a unit of material(s) consumed by an end item during operation. The unit of material shipped must be consistent with the units used for consumption.

5.7.6.14.1 Cost elements affected. 312.4

5.7.6.15 Power consumption (units/operating cycle). This is the average number of units of power consumed by the WBS item over the period of one operating cycle as defined above. Units of measure include gallons/hour, lbs/hour, gallons/mile, kilowatts/hr, watts/hour, fractional battery life/hr., For power source batteries, this value should be 1 divided by the number of operating cycles between battery replacements. This factor is not normally used for vehicle batteries which are costed under operational material consumption.

5.7.6.15.1 Cost elements affected. 313 and its subelements

5.7.6.16 Power type code (0-3). This code is used by the Model to identify the energy source for the operating and support reports. Codes are:

Code	Type of Power	Code	Type of Power
0	No Power Consumption	1	Fuel
2	Electric Power	3	Batteries

5.7.6.16.1 Cost elements affected. 313 and its subelements

5.7.6.17 Field power cost ($/unit). This is the fully burdened cost to procure, store and distribute fuel, batteries or generator power to using units. In the case of generators, the value may be determined by dividing the fully burdened per hour cost of operating the generator by the kilowatts it produces. This includes the cost of fuel and organizational, intermediate and depot maintenance but excludes depot overhaul. For fuel, this would normally apply to packaged fuel consumed in training (i.e., in 55 gallon drums) and not bulk fuels except when bulk fuel is distributed by force units such as Navy tankers or bulk fuel companies rather than base units. For batteries, this would be the cost of militarized batteries vice commercial batteries if both were options.

5.7.6.17.1 Cost elements affected. 313 and its subelements

5.7.6.18 Commercial power cost ($/unit). This is the cost of a unit of fuel, electricity or batteries provided by commercial or base sources to the using unit. This normally does not apply to batteries.

5.7.6.18.1 Cost elements affected. 313 and its subelements

5.7.6.19 Power weight (lbs). This is the weight in pounds of a unit of fuel or batteries to be used by an end item. If a suite of end items is to be powered by a common battery pack, include the pack as a separate WBS item. This factor does not apply to electric (code 2) power. This factor is used to determine the cost to deliver a unit of fuel or batteries to the using activity from a base storage site.

5.7.6.19.1 Cost element affected. 313.4

5.7.6.20 Field power use rate (%). This is the percentage of total operating time that a particular unit/equipment will be powered by field power. This figure may be weighted to reflect differences in the operating use of active and reserve units, supporting agencies, and schools if the analyst chooses not to enter these equipments using separate equipment group codes.

5.7.6.20.1 Cost elements affected. 313 and its subelements

5.7.6.21 Commercial power use rate (%). This is the percentage of total operating time that a particular WBS item will be powered by commercially supplied power. This factor may be weighted to reflect any differences in the operational use of active and reserve units, schools and other supporting agencies if the analyst chooses not to enter these items using separate equipment group codes.

5.7.6.21.1 Cost elements affected. 313 and its subelements

5.7.6.22 Battery use rate (%). This is the percentage of total operating time that the WBS item will be making demands on the operating life of the batteries.

5.7.6.22.1 Cost elements affected. 313.3

5.7.6.23 Mean-time between failures (MTBF) (Hrs,MI,KM,RDS). This is the mean operating cycles between equipment failures during which the WBS item operates as specified. This may be in hours, rounds, miles, events or other measure of life units. This must use the same units of measure as El, Annual use. It is normally determined by taking the total operating cycles of a number of items divided by total number of item failures during that period. This is the major cost driver over which the engineers exercise design control.

5.7.6.23.1 Cost elements affected. 321, 322, 323
and each of their subelements

5.7.6.24 Attrition rate (%). This is the annual loss of the end item due to training accidents or other accidental destruction. This factor is applied to the total operating quantity to determine replacement requirements. It does not apply to losses associated with the supply system.

5.7.6.24.1 Cost elements affected. None. This produces a separate report for planning replacement quantities.

5.7.6.25 Mean time to repair (manhours by level of repair). This is corrective maintenance time, in manhours not clock hours, at each maintenance level. This number is normally different for each WBS item. It includes fault isolation, fault correction (repair/replace), and checkout. Essentially, this means all maintenance actions required of a repairer or team of repairers from the time a failed item is assigned for repair to the time when the item has been restored. It excludes the following activities which are included in repair overhead (M32-M38): travel time, filling out reports, preparation (gathering equipment, manuals, and failed items), clean up time, obtaining replacement parts and quality control by personnel other than the technician doing the actual repair.

5.7.6.25.1 Cost elements affected. 321.1, 322.1, 323.1

5.7.6.26 Average preventive maintenance time (manhours). This is the time in manhours, not wall clock hours, required for actions, scheduled and unscheduled, by organizational maintenance personnel (OLMD or OLMS) (excluding operator actions) to service and inspect, detect and prevent incipient failures. The number of hours may vary with different WBS items.

5.7.6.26.1 Cost elements affected. 321.1

5.7.6.27 Calibration. This is the number of manhours/year that intermediate and depot maintenance personnel must spend to calibrate the WBS component. Only DSU and GSU personnel can be assigned for calibration tasks. For calibration at the depot level, an entry must be made for the depot labor rate (M9).

5.7.6.27.1 Cost element affected. 322.1

5.7.7 Maintenance worksheet. The variables on this worksheet are used to describe the maintenance concept in detail. The Model can be used to conduct level of repair trade studies since the calculations are based on maintenance flow from the operating unit to the depot. This worksheet is intended for use by logistics and maintainability engineers. The design engineer's main input to this data is in the estimate for the manhours for depot overhaul and the number of operating years between overhauls.

5.7.7.1 General. Each WBS record contains its own maintenance concept which may be unique or common to other records. Most systems will require no more than three or four repair strategies in the basic maintenance concept. The ability to define variations on the basyc maintenance concept makes it possible to conduct level of repair analyses to determine the most cost-effective mix of maintenance concepts for each configuration item in the materiel system as a function of operational unit requirements, supporting unit capabilities at each level of repair and Service policy. This capability becomes especially important for developing flexible maintenance concepts for materiel systems which will be employed by different type units (either within a Service or by several Services) which have different organic maintenance capabilities and different support units. To simplify data entry, the Model can be directed to copy any previously defined maintenance concept.

5.7.7.1.1 Percentages. Enter all percentages as decimals, e.g., 25 percent is entered as .25. The Model does not check or reject entries greater than 1.0 as invalid to give the analyst the flexibility to use percentages greater than 100 percent for special cases (e.g., derating an estimate).

5.7.7.1.2 Base year. The base year for depot labor and material rates is the base year entered on Figure 233.

5.7.7.1.3 Cost element affected. These paragraphs refer the analyst to the operating and support cost element affected by the maintenance variable. These cost elements are defined in 5.5 and show how the Model uses these variables to arrive at the maintenance costs for the material system.

5.7.7.1.4 Maintenance Concepts. Three activities are generally involved in modeling a maintenance concept: distribution of labor, consumption of repair parts and discard of reparable assemblies. Labor does not necessarily result in consumption of material e.g., when remove and replacement of failed assemblies is the only function performed. The Model uses three rates at each level of repair to describe a maintenance concept: maintenance rate, repair rate and discard rate. Understanding how these rates work together to describe a maintenance concept is critical to developing correct values for the Model. The following paragraphs describe the rates used by the Model and how they interrelate (see also 5.5.27):

a. Maintenance Rate. The maintenance rate is the percentage of failures requiring maintenance labor (MTTR describes how much labor) at each level of repair. No maintenance labor costs for shared maintenance personnel are calculated unless both the maintenance rate and the MTTR for the level of repair are greater than zero and the accumulated demand exceeds the work capacity of the dedicated maintenance personnel at that site.

The maintenance rate at any level of repair must be less than or equal to one minus the sum of the completion rates (see c. below) for all previous levels or the Model will double count labor. For example, the maintenance rate at the organization might be one hundred percent if all failures resulted in labor (either remove and replace or repair) at that level. However, if some of the failures bypass the organizational maintenance activity and are sent directly to intermediate or depot maintenance sites, the maintenance rate for the organization must be decreased accordingly to reduce labor charges.

By the same reasoning, the maintenance rate at bypassed intermediate repair activites must be decreased to a value less than one minus the sum of the completion rates at all lower level maintenance activities to account for failed items which bypass them. This would happen when the maintenance policy dictates that certain failed reparables be forwarded for repair to a still higher level maintenance activity (e.g., GSU or depot). In other words, the Model does not demand that every maintenance activity work on every failure.

b. Repair Rate. The repair rate is the percentage of maintenance actions (defined by the product of the maintenance rate and the number of failures in the year) at each level of repair which result in a completed repair at that level. The repair rate may vary from 0 to 1.0 at each level of repair and is not dependent on repairs at other levels. The product of the total number of failures and the maintenance and repair rates for each level of repair defines the number of maintenance actions completed at that level of repair.

At levels below depot, the repair rate includes both repair and discard actions. At the depot level, the repair rate includes only the repair actions which result in the item being returned to stock. The discard rate at the depot is 1 minus the repair rate. There are no charges for repair material or discards at levels which do not have a repair rate.

c. Completion Rate. Completion rates are intermediate calculations done by the Model and are not inputs. The completion rate is the percentage of all failures for which maintenance is completed at any level of repair. The completion rate is the product of the maintenance and repair rates at every level of repair below depot. At the depot, the completion rate is the the maintenance.

d. Discard Rate. The discard (or washout) rate is the percentage, at each level of repair, of completed maintenance actions which result in the discard of the reparable LRU rather than its repair. The discard rate may vary from 0 to 1.0 for any given level of repair. The number of discarded items at any level is the product of the number of failures, the calculated completion rate and the discard rate. The number of completed maintenance actions which result in the consumption of repair material rather than replacement of the failed component is the product of the number of failures, the completion rate and one minus the discard rate. The discard rate must be specified for levels below depot. At depot, the discard rate is defined to be 1 minus the repair rate. I.e., at the depot, items not repaired are assumed to be discarded as beyond economic repair.

e. The following example shows how these rates are applied:

(1) Given 200 failures/year for a WBS item based on MTBF, operating quantities and operational use (i.e., failures = operating quantity (E1) * operating cycles/year (E2)/MTBF(E22)). Given three levels of maintenance: organizational, intermediate, and depot. The rates used in this example are as follows:

	Rates Used			
	Maintenance	Repair	Discard	Completion
Organizational	1.0	.2	.1	.2
Intermediate	.75	.5	.05	.375
Depot	.425	.95	.05	.425

(2) At the organizational level, the maintenance rate is 1.0, the repair rate is .2 and the discard rate is .1. All failures result in labor demand at the organizational maintenance site. 20 percent of the failures worked on result in a completed repair at this site. 10 percent of the completed repairs are by discard of the failed item rather than by use of repair parts. The remaining failures (80 percent) are forwarded to either the intermediate or deport repair facility.

The labor required for maintenance actions at the organizational maintenance facility not resulting in final repair would normally be remove, replace and test labor required to restore end item and then forwarding failed LRUs to a higher level of repair.

The model computes these actions as follows. There are 200 x 1.0 = 200 failures require labor by organizational maintenance personnel. 200 x 1.0 x .2 = 40 repairs are completed (repaired or discarded). The completion rate is 1.0 x 0.2 = .2. The number of items discarded as not reparable is 200 x 1.0 x .2 x 0.1 = 4 items. The number of repairs completed by use of repair material is 200 x 1.0 x .2 x (1- .1) = 36 items.

(3) At the intermediate level, the maintenance rate is .75, the repair rate is .5 and the discard rate is .05. The intermediate maintenance rate cannot exceed 80 percent: 1 - .2 = .8 (one minus the completion rate at the organizational level). The intermediate maintenance rate may be less than .8 if any of the failures are sent directly to the depot and do not require intermediate level labor which is the case in this example.

This means that 200 x .75 = 150 items require intermediate level labor and the other 200 x (.8-.75) = 10 are sent directly to depot without generating demand for intermediate personnel. 200 x .75 x .5 = 75 maintenance actions are completed at the intermediate level. The remaining 150 - 75 = 75 require further action by the depot to complete the repair. The intermediate completion rate is .75 x .5 = .375. The number of maintenance actions completed by discard is 200 x .75 x .5 x .05 (the discard rate) = 4. The number of maintenance actions completed by consumption of repair material is 200 x .75 x .5 x (1 -.05) = 71. The actual numbers are 3.75 and 71.25 which are the numbers the Model would use. The rounding shown is for clarity purposes only.

(4) At the depot level, the maintenance rate is .425, the repair rate is .95 and, by definition, the discard rate is .05 = 1.0 - .95. The depot maintenance rate must be equal to 1 minus the sums of the lower level completion rates (.425 = 1 -(.2 + .375)) to account for all incomplete maintenance actions. 200 x .425 = 85 items are sent to the depot (10 from the organizational level and 75 from the intermediate level). Because there is no higher level to refer the item, the depot discard rate must be 1 minus the repair rate or .05.

The depot completion rate is .425 x (.95 + .05) = .425, the same as the maintenance rate. The number of items repaired at the depot level is .95 times 85 = 81 items. The remaining 4 are discarded.

As with the intermediate calculations, the rounding to integer values is for clarity purposes only. The Model would use 3.25 discards and 80.75 repairs.

(5) The distribution of the maintenance actions for the 200 failures in this example are summarized as follows:

	Maintenance Actions			
	Labor Expended	Number Completed	Number Completed Using Repair Parts	Replacement
Organization	200	40	36	4
Intermediate	150	75	71	4
Depot	85	85	81	4

(6) The sum of the completion rates at all levels must be equal to 1 and the number of completed actions at all levels must be equal to the number of failures. The completion rate at levels below depot is the maintenance rate times the repair rate while at the depot level, the completion rate is equal to the maintenance rate.

(7) The Model computes the number of failures and completion rates. The user unfamiliar with the derivation of maintenance, repair and discard rates may wish to use the maintenance worksheet contained on page 3 of Figure 239 in developing maintenance, repair and discard rates for use on pages 1 and 2 of the Figure. The following sections discuss each of the maintenance data inputs contained on pages 1 and 2 of Figure 239.

5.7.7.2 Annual modification cost factor(% of UPC). This is the percentage of the lot cost required to estimate the annual cost for material and labor for official modification work orders to retrofit, convert, remanufacture, or make engineering change to fielded WBS items to enable performance of mission essential tasks (not for creation of a new capability) with improved reliability or reduced maintenance costs. This factor includes both labor and material costs for both field and depot modifications.

5.7.7.2.1 Cost elements affected 330

5.7.7.3 Mean time to modify - depot (manhours). This is the average time, in manhours, required to modify the WBS item at the depot. It includes preparation time (gathering of materials, tools, manuals), the actual installation and test time, and time spent in clerical duties specifically applicable to the modification. This factor is used with buy quantities and the depot modification rate to determine the modification contribution to depot labor costs.

5.7.7.3.1 Cost element affected 323.1

5.7.7.4 Mean time to modify - field (manhours). This is the average time, in manhours, required by field maintenance personnel to modify the WBS item. It includes preparation time (gathering of materials, tools, manuals), installation and test time, and time spent in clerical duties specifically applicable to the modification. Distribution of modification labor between levels of repair is based on the WBS item's completion rate at each level of repair.

5.7.7.4.1 Cost element affected 321.1, 322.1

5.7.7.5 Modification material cost factor (%). This is the percentage of the calculated unit production cost used to estimate the average material cost for field modifications to the WBS item. The Model computes annual modification material costs as the product of the calculated UPC, this factor and the sum of the annual depot and field modification rates.

5.7.7.5.1 Cost element affected 330

5.7.7.6 Annual modification rate - depot (%). This is the percentage of the lot buy quantity which are modified each year at the depot. Depot labor costs (modifications) = lot buy quantity (U12 or U4) * mean time to modify-depot(M2) * modification rate-depot(M5) * depot labor rate(M9). See 5.5.64.

5.7.7.6.1 Cost element affected 323.1, 330

5.7.7.7 Annual modification rate - field (%). This is the percentage of the lot buy quantity which is modified each year by field maintenance personnel. Modification labor is distributed amongst the various repair activities based on the calculated maintenance completion rates (see 5.7.7.1.4) for each level of repair. E.g., if 25 percent of all failures are restored at one level of repair, 25 percent of the modifications will be made by that level. Field labor costs (modifications) = lot buy quantity (U12) X mean time to modify - field (M3) X annual modification rate - field (M6) X completion rate (calculated) X field labor rate (calculated). There is no charge for modification labor if the work is done by dedicated personnel who have the work capacity to do the modification. See 5.8 for a discussion of dedicated and shared labor. The field modification rate is added to the depot modification rate to derive total annual costs for modification material. See also 5.5.64.

5.7.7.7.1 Cost element affected 321.1, 322.1, 330

5.7.7.8 Overhaul schedule (Yrs). This is the average time, in years, between scheduled overhauls of WBS items at the depot level of maintenance. Noninteger values may be used, e.g., 2.5 years.

5.7.7.8.1 Cost elements affected 324.1, 324.2, 324.3

5.7.7.9 Mean time to overhaul (manhours). The average total time required to overhaul the WBS item at the depot. It includes preparation time (gathering of materials, tools, manuals), the actual work time, and time spent in clerical duties specifically applicable to the overhaul.

5.7.7.9.1 Cost elements affected 324.1, 324.2

5.7.7.10 Depot labor rate ($/hr). The fully burdened hourly cost of depot maintenance personnel who perform LRU/module repair and scheduled overhaul.

The factor includes direct labor, production expense and general and administrative expenses. This excludes material expenses which are contained in the depot material rate. This factor depends upon the type of materiel system being supported and the depot providing the support.

5.7.7.10.1 Cost elements affected 323.1, 324.1

5.7.7.11 Depot material rate ($/hr). This is the average cost of repair materials used during one hour of repair at the depot maintenance facility. It is a function of the type materiel system being supported and the depot doing the labor. This is a standard rate available from each service.

5.7.7.11.1 Cost elements affected 323.2, 324.2

5.7.7.12 Discard rate (%). This is the percentage of failed reparable assemblies sent to maintenance facilities for repair (based on the product of the maintenance rate and the repair rate) which are discarded because they are not economically reparable. This applies to all classes of maintenance (ORG, INT, DSU, GSU, DSUCT, GSUCT) below depot. The discard rate at depot is one minus the depot repair rate.

5.7.7.12.1 Cost elements affected 321.22, 322.22

5.7.7.13 Operator maintenance rate (%). This is the percentage of failures addressed by operators. Only operator manhours are increased by use of this factor. No material costs are generated by operator repair. If a value is entered for operator maintenance, it should be in addition to maintenance required by all other maintenance activities, since the assumption is made that operators will not have the authority to discard or repair failed assemblies, but will refer the end item or failed assembly for repair action or screening prior to discard.

5.7.7.13.1 Cost elements affected 311.1.1, 311.1.2

5.7.7.14 Field maintenance rate (%). This is the percentage of failures by level of repair addressed by field maintenance personnel. It is the basis for maintenance manhour and repair material and discard consumption. Consumption of nonreparable LRU's, reparable LRU's by discard and repair parts for reparable LRU's by field maintenance personnel is governed by the product of the repair rate and the field maintenance rate. This product is also referred to as the completion rate.

5.7.7.14.1 Cost elements affected 321.1, 321.2, 322.1, 322.2

5.7.7.15 Depot maintenance rate. This is the estimated percentage of failures which are shipped to the depot for repair. Depot labor costs are based on the number of failures shipped to the depot as determined by this factor, and the number of manhours worked (MTTR + overhead). Material costs for depot repairs are based on manhours worked, the depot material rate (M10), the depot repair rate and the cost for discarded reparable LRU's. See 5.5.43.

5.7.7.15.1 Cost element affected. 323.3

5.7.7.16 Field repair rate (%) This percentage is applied to the number of failed assemblies/LRU's received by field maintenance activities (as determined by product of the maintenance rate for the maintenance activity and the number of failures) to determine the number which will be repaired or discarded. Items not repaired or discarded by the receiving activity (i.e., one minus the repair rate times the number of failures received) are assumed to be sent to a higher echelon for repair.

Repair material costs are calculated for each item repaired based on the repair material rate (E7) and one minus the discard rate. Costs for replacements due to discard are based on the product of the discard rate and the number of repair actions at each level, calculated as stated above. Discard of reparable assemblies/LRU's by organizational maintenance personnel is allowed but this would be rare.

5.7.7.16.1 Cost elements affected 321.2, 321.3 322.2, 322.3

5.7.7.17 Repair rate-depot (%). This is the percentage of failed assemblies/ LRU's sent to the depot for repair which are returned to the user. This factor determines depot labor and material charges for repaired items. There are no labor charges generated for items shipped to the depot for repair but discarded.

5.7.7.17.1 Cost elements affected 323.1, 323.2

5.7.7.18 Repair overhead-field (manhours). Repair overhead is the average time, in addition to actual repair actions, spent by field maintenance personnel in repair related activities which are independent of the item being repaired and hence not subject to influence by design engineers. This includes travel time, filling out reports, preparation (gathering equipment, manuals, and failed items), clean up time, obtaining replacement parts and quality control by personnel other than the technician doing the repair.

5.7.7.18.1 Cost elements affected 321.1, 322.1

5.7.7.19 Repair overhead-depot (manhours). Repair overhead is the average direct labor, in addition to actual repair actions, spent by depot maintenance personnel in repair related activities which are independent of the item being repaired and hence not subject to influence by design engineers. This includes travel time, filling out reports, preparation (gathering equipment, manuals, and failed items), clean up time, obtaining replacement parts and quality control by personnel other than the technician doing the actual repair.

5.7.7.19.1 Cost elements affected 323.1

5.7.7.20 Probability good unit removal (%). This is the probability that maintenance personnel will work on a false failure. It is a function of the degree of discrimination of the built-in and external test equipment, operator training and maintenance training. This factor is used to inflate labor charges for each maintenance action by level of repair. It has no influence on material charges.

5.7.7.20.1 Cost elements affected 321.1, 322.1, 323.1

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ____________

SYSTEM: ____________

WBS ITEM IDENTIFICATION WORKSHEET

	WBS Item Name (40 A/N)	Procuring Service Code	Equipment Group# (1-25)	NSN/MPN/LCN (16 A/N)	WBS# (11.NNN.CWBS)	GFE (Y N)	GFE/O&M Base Year (YY)	Learning Curve (UNI,CUM)
EDIT CODE:	NAMe	SERvice	GROup	NSN	WBS	GFE	DATe	LEArn
1								
2								
3								
4								
5								
6								
7								
8								
9								
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
0								

WBS number should be the CWBS preceded by the MIL-STD 881 level 3 code. E.g., 11.1.CWBS

SERvice Codes: DOD ARM AF NAV MC OTHER.

Learning curve codes: UNI = Unit Cost learning theory; CUM = Cumulative Average learning theory

FIGURE 233. WBS item identification worksheet

Life Cycle Cost Model
for
Defense Materiel Systems

WBS Worksheet - DEMONSTRATION & VALIDATION

SYSTEM: ____________
DATE: ____________

Description	Labor Grade	Level	Edit #	Values/References			
Short Name or record #							
Base Year $ (YY)		<1>	D1				
Inflation Table-Labor(4,1-5)		<1>	D2				
Inflation Table-Material(4,1-5)		<1>	D3				
Demonstration & Validation($)		<1>	*D4				
CER Flag(0-4:$,Mhrs,%,CER,ML)		<2>	D5				
Engineering($,%,D7+D8*$D9^{D10}$)		<2>	*D6				
Mech Eng ($,Hrs,+D8,ML)	(ENDD)	<3>	D7				
Elec Eng ($,Hrs,*D9,ML)	(ENDD)	<3>	D8				
Drafting ($,Hrs,**D10,ML)	(ASDD)	<3>	D9				
DTC/LCC ($,Hrs,ML)	(ENDD)	<3>	D10				
RAM ($,Hrs,ML)	(ENDD)	<3>	D11				
Equipment ($)		<3>	D12				
Other ($)		<3>	D13				
Prod Eng&Plan($,Hrs,%,ML)	(PEDD)	<2>	D14				
Tooling($,%,D16+D17*$D18^{D19}$)		<2>	*D15				
Programs($,Hrs,+D17,ML)	(TODD)	<3>	D16				
Labor($,Hrs,*D18,ML)	(TODD)	<3>	D17				
Material ($,**D19)		<3>	D18				
Mfr Equip ($)		<3>	D19				
Test Equip ($)		<3>	D20				
Other ($)		<3>	D21				
Manufacturing($,%,D23+D24*$D25^{D26}$)		<2>	*D22				
Mfr Labor($,Hrs,+D24,ML)	(FADD)	<3>	D23				
Test Labor($,Hrs,*D25,ML)	(QCDD)	<3>	D24				
Material($,**D26)		<3>	D25				
Purch Parts/Assy($)		<3>	D26				
Other($)		<3>	D27				
Other($,%)		<2>	D28				
TRACE ($,%)		<1>	D29				
Start Year (YY)(CER flag 4)		<2>	D30				
Start Month (MM)(CER flag 4)		<2>	D31				
Duration (months)(CER flag 4)		<2>	D32				

* Entering data causes the Model to skip to the next equal or lower level cost element.
Inflation categories: 1=rate1,2=rate2,3=Procurement,4=R&D,5=O&M
CER FLAGS: 0 = $; 1 = Manhours (Labor grades only apply to flags 1 & 4)
2 = % of D4 (decimals: 25% is .25); 3 = A+B*C^D (E.g., D6=D7+D8*D9**D10)
4 = Manloading (number of personnel assigned to task)
Type SAV at any time to save data during data entry.

FIGURE 234. WBS worksheet - Demonstration & Validation

Life Cycle Cost Model
for
Defense Materiel Systems

WBS Worksheet - FULL SCALE DEVELOPMENT

SYSTEM: ____________
DATE: ____________

Description	Labor Grade	Level	Edit #	Values/References		
Short Name or record #						
Base Year $ (YY)		<1>	F1			
Inflation Table-Labor(4,1-5)		<1>	F2			
Inflation Table-Material(4,1-5)		<1>	F3			
Full Scale Development($)		<1>	*F4			
CER Flag(0-4:$,Mhrs,%,CER,ML)		<2>	F5			
Engineering($,%,$F7+F8*F9^{F10}$)		<2>	*F6			
Mech Eng ($,Hrs,+F8,ML)	(ENFD)	<3>	F7			
Elec Eng ($,Hrs,*F9,ML)	(ENFD)	<3>	F8			
Drafting ($,Hrs,**F10,ML)	(ASFD)	<3>	F9			
DTC/LCC ($,Hrs,ML)	(ENFD)	<3>	F10			
RAM ($,Hrs,ML)	(ENFD)	<3>	F11			
Equipment ($)		<3>	F12			
Other ($)		<3>	F13			
Prod Eng&Plan($,Hrs,%,ML)	(PEFD)	<2>	F14			
Tooling($,%,$F16+F17*F18^{F19}$)		<2>	*F15			
Programs($,Hrs,+F17,ML)	(TOFD)	<3>	F16			
Labor($,Hrs,*F18,ML)	(TOFD)	<3>	F17			
Material ($,**F19)		<3>	F18			
Mfr Equip ($)		<3>	F19			
Test Equip ($)		<3>	F20			
Other ($)		<3>	F21			
Manufacturing($,%,$F23+F24*F25^{F26}$)		<2>	*F22			
Mfr Labor($,Hrs,+F24,ML)	(FAFD)	<3>	F23			
Test Labor($,Hrs,*F25,ML)	(QCFD)	<3>	F24			
Material($,**F26)		<3>	F25			
Purch Parts/Assy($)		<3>	F26			
Other($)		<3>	F27			
Other($,%)		<2>	F28			
TRACE ($,%)		<1>	F29			
Start Year (YY)(CER flag 4)		<2>	F30			
Start Month (MM)(CER flag 4)		<2>	F31			
Duration (months)(CER flag 4)		<2>	F32			

* Entering data causes the Model to skip to the next equal or lower level cost element.
Inflation categories: 1=rate1,2=rate2,3=Procurement,4=R&D,5=O&M
CER FLAGS: 0 = $; 1 = Manhours (Labor grades only apply to flags 1 & 4)
2 = % of F4 (decimals: 25% as .25); 3 = $A+B*C^D$ (E.g., F6=F7+F8*F9**F10)
4 = Manloading (number of personnel assigned to task)
Type SAV at any time to save data during data entry.

FIGURE 235. WBS worksheet - Full Scale Development

Life Cycle Cost Model
for
Defense Materiel Systems

WBS Worksheet - PRODUCTION

SYSTEM: ____________
DATE: ____________

Description	Labor Grade Level	EDITOR #	Value/Reference
Short Name or record #			
Base Year $ (YY)		<1> P1	
Inflation Table-Labor(3,1-8)		<1> P2	
Inflation Table-Material(3,1-8)		<1> P3	
Recurring-Prod($)		<1> P4*	
CER Flag(0-7)		<2> P5	
Material($,%P4,CER)		<2> P6	
Subcontracted Items($,%P4,CER)		<2> P7	
Purch Parts&Assys($,%P4,CER)		<2> P8	
Fabrication($,Hrs,%P4,CER)	(FAPD)	<2> P9	
Assembly($,Hrs,%P4,CER)	(ASPD)	<2> P10	
Supt Labor($,Hrs,%P4,CER)	(ASPD)	<2> P11	
QualCntrl&Insp($,Hrs,%P4,CER)	(QCPD)	<2> P12	
Sustain Eng($,Hrs,%P4,CER)	(ENPD)	<2> P13	
Design Assr($,Hrs,%P4,CER)	(ENPD)	<2> P14	
Packaging($,%P4,CER)		<2> P15	
Sustain Tooling($,%P4,CER)		<2>*P16	
Programs($,Hrs,%P16,CER)	(TOPD)	<3> P17	
Labor($,Hrs,%P16,CER)	(TOPD)	<3> P18	
Material($,%P16)		<3> P19	
Mfr Equip($,%P16)		<3> P20	
Test Equip($,%P16)		<3> P21	
Other($,%P16)		<3> P22	
Program Mgt($,Hrs,%P4)	(PMPD)	<2> P23	
Other($,%P4)		<2> P24	
Non-recurring Prod($)		<1>*P25	
Tooling($,%P25,CER)		<2>*P26	
Programs($,Hrs,%P26,CER)	(TOPD)	<3> P27	
Labor($,Hrs,%P26,CER)	(TOPD)	<3> P28	
Material($,%P26,CER)		<3> P29	
Mfr Equip($,%P26,CER)		<3> P30	
Test Equip($,%P26,CER)		<3> P31	
Other($,%P26,CER)		<3> P32	
Facilities($,%P25)		<2> P33	
Prod Eng&Plan($,Hrs,%P25)	(PEPD)	<2> P34	
Other($,%P25)		<2> P35	

* Entering data here will cause the Model to skip to the next equal or lower level.
Type SAV at any time to save data being entered.
CER Flags 0 = $, 1 = Hrs, 2 = %, 3 = $A + B*C^D + E*F^G +$
$4 = A + B*C^D + E*C^F +$, $5 = A + B*C(D+E) + F*G(H+I) +$
$6 = A + B*C^{(D+E)} + F*G^{(H+I)} +$, $7 = A + B*C^{(D+E)} + F*C^{(G+H)} +$

FIGURE 236. WBS worksheet - production

Life Cycle Cost Model
for
Defense Materiel Systems

WBS Worksheet - UNIT PRODUCTION COST/GFE

SYSTEM: ____________
DATE: ____________

Description	EDITOR #	Value/Reference			
Short Name or record #					
GFE Quantity Dem-Val(#)	U1*				
GFE Quantity FSD (#)	U2*				
GFE Quantity Prod NR(#)	U3*				
GFE Quantity Prod R(#)	U4*				
UPC Estimate Date(YY)	U5				
UPC Estimate Date(MM)	U6				
UPC Goal/GFE Unit cost($)	U7				
Size of Basis Lot(#)	U8				
Learning Curve Labor(%)	U9				
Learning Curve Material(%)	U10				
Lot(#)	U11				
Lot Buy Quantity(#)	U12				
Number Built Before This Lot(#)	U13				
Lot Start Year(YY)	U14				
Lot Start Month(MM)	U15				
Lot Production Rate(#/mo)	U16				
TRACE($,% lot cost)	U17				
RIW($/Unit/Year)	U18				
RIW Period (Years)	U19				
Eng Changes ($,% lot cost)	U20				

Enter % as decimal values e.g., 25% as .25

Type SAV at any time to save data being entered
* The model only prompts for these elements if the GFE flag is set to Yes

FIGURE 237. WBS worksheet - unit production cost/GFE

Life Cycle Cost Model
for
Defense Materiel Systems

WBS Worksheet - EQUIPMENT

SYSTEM: ____________
DATE: ____________

Description	Editor #	Values/References			
Short Name or record #					
Operating Equip Quantity (#)	E1				
Operating Cycle (HRS MI KM RDS/Year)	E2				
Num Shared Opers/Equip(#)	E3				
Equipment Weight (lbs)	E4				
Wt of Average LRU (lbs)	E5				
Avg Discard LRU Cost($)	E6				
Avg Reparable LRU Cost($,% of UPC)	E7				
Repair Material Rate(% of E7)	E8				
Repair Material Wt (lbs,kgm)	E9				
Material Consumption(Units/yr)	E10				
Material Type Code (1, 2, 3)	E11				
Material Cost ($/unit)	E12				
Material Weight (lbs kgm/unit)	E13				
Power Consumption(units/cycle)	E14				
Power Type (1, 2, 3)	E15				
Field Power Cost ($/unit)	E16				
Comm Power Cost ($/unit)	E17				
Wt of Power (lbs kgm/unit)*	E18				
Field Power Use Rate (% of E14)	E19				
Comm Power Use Rate (% of E14)	E20				
Battery Power Use Rate (% of E14)	E21				
MTBF: cycles/failure (hrs mi km rds)	E22				
Attrition Rate (% of E1)	E23				
MTTR Organization (Mhrs)	E24				
MTTR Intermediate (Mhrs)	E25				
MTTR DSU (Mhrs)	E26				
MTTR DSUCT (Mhrs)	E27				
MTTR GSU (Mhrs)	E28				
MTTR GSUCT (Mhrs)	E29				
MTTR Depot (Mhrs)	E30				
Preventive Maint (Mhrs/yr)	E31				
Calibrate DSU(Mhrs/yr)	E32				
Calibrate GSU(Mhrs/yr)	E33				
Calibrate depot(Mhrs/yr)	E34				

* Does not apply to type 2 power (electricity)
Material codes: 1 = POL; 2 = ammunition; 3 = other
Power Codes: 1 = fuel; 2 = electricity; 3 = batteries
Enter rates as decimal values e.g., 25% as .25
Type SAV at any time to save data being entered.

FIGURE 238. WBS worksheet - equipment

Life Cycle Cost Model
for
Defense Materiel Systems

WBS Worksheet - MAINTENANCE

SYSTEM: ____________
DATE: ____________

Description		Values/References			
Short Name or record #					
Ann Mod Cost Fact(lab+mat) (%)	M1*				
Mean Time to Mod-DEP(Mhrs)	M2				
Mean Time to Mod-Fld(Mhrs)	M3				
Mod Mat Cost Fact-Fld(%)	M4				
Mod Rate Depot(%)	M5				
Mod Rate Field (%)	M6				
Overhaul Sched (yrs)	M7				
Mean Overhaul Time (Mhrs)	M8				
Depot Labor Rate($/Mhr)	M9				
Depot Material Rate ($/Mhr)	M10				
Discard Rate Org(%)	M11				
Discard Rate Int(%)	M12				
Discard Rate DSU(%)	M13				
Discard Rate DSUCT(%)	M14				
Discard Rate GSU(%)	M15				
Discard Rate GSUCT(%)	M16				
Maint Rate Operator(%)	M17				
Maint Rate Organization (%)	M18				
Maint Rate Intermediate (%)	M19				
Maint Rate DSU (%)	M20				
Maint Rate DSUCT (%)	M21				
Maint Rate GSU (%)	M22				
Maint Rate GSUCT (%)	M23				
Maint Rate Depot (%)	M24				
Repair Rate Organization (%)	M25				
Repair Rate Intermediate (%)	M26				
Repair Rate DSU (%)	M27				
Repair Rate DSUCT (%)	M28				
Repair Rate GSU (%)	M29				
Repair Rate GSUCT (%)	M30				
Repair Rate Depot (%)	M31				

Enter rates as decimal values. E.g., 25% as .25

Type SAV at any time to save data being entered

*Entering data for M1 will cause the Model to skip to M7

FIGURE 239. WBS worksheet - maintenance

Life Cycle Cost Model
for
Defense Materiel Systems

WBS Worksheet - MAINTENANCE

SYSTEM: ____________
DATE: ____________

Description		Values/References			
Short Name or record #					
Repair Overhead Org (Mhrs)	M32				
Repair Overhead Int (Mhrs)	M33				
Repair Overhead DSU (Mhrs)	M34				
Repair Overhead DSUCT (Mhrs)	M35				
Repair Overhead GSU (Mhrs)	M36				
Repair Overhead GSUCT (Mhrs)	M37				
Repair Overhead Depot (Mhrs)	M38				
Prob Good Unit Rem Org (%)	M39				
Prob Good Unit Rem Int (%)	M40				
Prob Good Unit Rem DSU (%)	M41				
Prob Good Unit Rem DSUCT (%)	M42				
Prob Good Unit Rem GSU (%)	M43				
Prob Good Unit Rem GSUCT (%)	M44				
Prob Good Unit Rem Depot (%)	M45				

Enter rates as decimal values E.g., 10% as .1

FIGURE 239. WBS worksheet - maintenance (continued)

MAINTENANCE WORKSHEET

WBS Item: ______________________ WBS # ______________________
Subassy ID: ______________________ LRU WT(E5) ______________________
Disc LRU Cost (E6) __________ Reparable LRU Cost(E7) __________
Rep Mat Cost Factor(E8) _____ Rep Mat WT(E9) _____ MTBF(E22) _____ PM(E31)

Maintenance Activity	ORG	INT	DSU	DCT	GSU	GCT	DEP
MaintRate(%)							
RepairRate(%)							
Completion Rate = MaintRate*RepRate							
BCM=Maint-ComplRate							
Disc/WashoutRate(%)							NA
RepairOvhd(manhrs)							
ProbGoodUnitRemoval							
Calibrate(manhrs/yr)							
Mean Time to Repair MTTR (manhrs)							

Notes: MAINTENANCE RATE is the percent of failures resulting in labor (MTTR or touch time) at each level of repair. The MAINTENANCE RATE at any level is less than or equal to one minus the sum of the completion rates for all previous levels, i.e., percent failures which were beyond the capability of maintenance (BCM) of the lower maintenance shops.

REPAIR RATE is the percent of maintenance actions at any level which result in final repair at that level.

COMPLETION RATE is the number of completed repair actions at each level of repair and is the product of each level's maintenance and repair rates. This is an intermediate calculation used to determine the number of successful maintenance actions.

BCM is the number of failures which must be refered to higher repair levels and is the basis for their MAINTENANCE RATEs. If no REPAIRABLE LRU cost is entered, the Model assumes that the WBS item is the LRU and uses the calculated UPC for the repair LRU cost. If a decimal value is entered for the reparable LRU cost, the Model calculates the repairable LRU cost as the percentage of the calculated UPC.

The DISCARD LRU cost is the cost of material consumed to remove and replace the WBS item and is applied only to the first level of maintenance. This is not the value of repair parts consumed to repair the failure.

The DISCARD (or washout) RATE is the percentage of LRUs which are discarded rather than repaired. It is applied to the product of the maintenance and repair rates at each level of repair except depot. Repair material cost = MR * RR * (1 - DISC) * LRU cost * REP MAT COST FACTOR. Discard cost = MR * RR * DISC * LRU cost.

FIGURE 239. WBS worksheet - maintenance (continued)

5.8 Personnel. The personnel data base consists of a series of analyst created tables describing Government and contractor manpower assets available to meet demand during a system's life cycle. The Model treats personnel as a resource to be charged to the system based on demand. Demand can be a function of need or policy. Need based demand is charged to the system only if work is required based on calculations made when the WBS file is processed. Policy based demand is charged to the system regardless of the work effort demanded. Personnel assigned on a policy basis are referred to as dedicated.

5.8.1 General concepts. Personnel assets are entered in tables of organization. Each line in a table of organization contains the pay grade, technical specialty (military only), and number of personnel in the line. The line also contains three codes which are used to classify the personnel as a unique labor pool. These codes are also used in the WBS file to classify demand. Demand is then mapped to availability by the model to compute costs. Demand for which no labor is available does not generate costs, but it will generate a warning and a labor shortage report. Except in the case of dedicated personnel, labor for which no demand has been generated does not generate costs.

5.8.1.1 Mapping labor demand to manpower assets. Three codes in each T/O line are used to map manpower assets to labor demand: LEVEL which describes the type demand which may be met, WBS number which describes the type of WBS items (equipments and software) which may generate demand and GROUP which is used to define a unique combination of multiple WBS and personnel assets to the exclusion of other similar assets which may have the same LEVEL and WBS codes. These codes are described in this section and in 5.7. WBS mapping is done at either the system or the third (i.e., summary) level of the WBS. GROUP codes are arbitrary and may follow any scheme which the program manager desires to use to relate manpower and WBS items in a table of organization and equipment. GROUP codes do not apply to manufacturer personnel. LEVEL codes are used to define and limit the type of manpower demand which can be met to demand which has the same LEVEL code. Personnel assigned to one combination of GROUP/WBS/LEVEL codes are not available to satisfy demand generated by WBS items with any other combination of codes except that personnel assigned a system level WBS number (11) may be used to satisfy demand for any lower level WBS item with the same GROUP and LEVEL codes.

5.8.1.2 Trade studies. The cost of manpower to operate, maintain and support the system is the major cost driver for most systems. The Model is designed to give the analyst extensive flexibility in structuring personnel tables to satisfy manpower requirements and to evaluate strategies to reduce those requirements. For costing operating and support manpower, the Model acts as a billet cost Model so that the fully burdened cost of labor demanded by the operational system is used as the basis for trade studies. Recognizing the fully burdened cost for manpower is vital to value engineering.

5.8.1.3 Manufacturer personnel. The analyst may create and use tables of manufacturer personnel to meet expected labor demand for design, development and production efforts. Labor demand is generated by WBS records for which the analyst has set CER flags telling the Model to treat labor entries as manhours or manloading rather than dollars. This capability is provided to facilitate computation of labor impacts during design trades which change demand for contract labor.

If the manloading flag has been set, the Model will recompute demand and costs based on changes in either schedule or manpower assigned to a specific task.

If the manhour flag has been set, costs will only change if the number of hours is changed. Both flags will cause a recomputation for labor if either the T/O or the labor rate table is changed.

If a manufacturer table of organization is created, the analyst must also create a labor rate table to determine the cost for the demand. If no labor rate table is created, the Model will not cost the labor demand generated by a WBS record even though a table of organization has been entered.

If no labor is demanded by the system for manufacturer personnel, no costs are generated. Contractor labor rate tables are not resident in the data base and must be created by the analyst if manufacturer personnel are entered in the T/O data base for costs to be generated.

5.8.1.4 Government manpower cost tables. Costs for military and civil service personnel are contained in files available to the Model. Basic cost factors which are set by law or service policy such as pay and allowances, health care and base operating support costs are kept current by the program support team and may not be changed.

Files which contain replacement training costs for selected military skills are also maintained by the program support team for use by the Model. While these files may not be changed by the analyst, analysts may use the Model to compute system specific military training costs by creating a course cost file and defining training tracks for any line in the table of organization.

Productivity measures such as manning levels and number of direct labor manhours/manyear for Government personnel are controlled by the analyst using the assumption file.

5.8.2 Tables of organization. Figures 240-242 contain worksheets for military, Government civil service and manufacturer tables of organization. Explanations for each of the variables contained on these worksheets are contained in the following paragraphs.

5.8.2.1 Level (required). (4 letter code). Level codes define the functional areas in which personnel entered on each T/O line may work. The level codes map directly to labor demand computed for each WBS record.

The Model will not allow a labor pool defined by one level code to be used to satisfy demand for labor with another level. If demand is generated for a labor level which has no labor resources available, the Model will generate warnings at the time of report computation. Shortfalls, if any, for operating and support labor are reported in the Resource Report.

Level codes are shown in Table III. These codes apply to military, civilian and manufacturer personnel.

5.8.2.1.1 R&D and production program management staff. Military and civilian personnel assigned to R&D and production program management are costed based on the average number of personnel assigned by pay grade and the calculated length of each phase based on the schedule.

Personnel may be assigned on a part time basis. E.g., for personnel assigned to a development effort for 50 percent of their time, enter .5 times the number of people so assigned for the NUMBER. The Model uses phase start and stop dates to calculate time. The first and last months of each phase are fully charged to the system.

Only pay and allowances are charged to the system for personnel (military or civilian) assigned to Government program management staffs

5.8.2.1.2 Shared vs dedicated operators and maintenance personnel. The decision to classify operators or maintenance personnel as shared or dedicated is a policy decision. Operators or maintenance personnel should be classed as shared if they also work on systems other than the system being costed. Personnel should be classed as dedicated if they are integral to the system and, if the system were not purchased, the billet requirement would cease to exist.

For example, a tank crew would be classed as dedicated whereas an engine mechanic working at the organizational or one of the intermediate levels (ILM-GSU) would normally be classed as shared if the mechanic worked on several types of vehicles. Intermediate maintenance personnel who work solely on components of the materiel system being costed such as the M1 tank engine, would be classed as dedicated. Dedicated personnel are fully charged to the materiel system regardless of the amount of work done. Shared personnel are only costed if the system makes a demand for their time.

The Model computes a weighted average manyear cost for all shared personnel with the same WBS/GROUP/LEVEL combination by summing the products of the numbers and the costs for each line in the T/O with that combination and dividing that cost by the sum of the numbers assigned.

5.8.2.1.3 Operators/crews. Dedicated operators are fully costed to the system. Shared operators are costed based on the number of shared operator manhours /equipment operating hour (EQUIP3). If there is operator maintenance, the maintenance workload is split between dedicated and shared operators using the same decision as is used for field maintenance personnel. See 5.8.2.1.5.2.

There is no charge for shared operators unless the system demand for operator time exceeds the availability of dedicated operators. The annual charge for operators is based on the number of equipments operating in each month in the year.

Table III. Table of organization level codes.

Demonstration and Validation

PMDD	Program Management
PEDD	Producibility Eng and Planning
ENDD	Engineering, DTC, RAM
TODD	Tooling
FADD	Fabrication
ASDD	Drafting
QCDD	Quality Control,Testing

Full Scale Development

PMFD	Program Management
PEFD	Producibility Eng and Planning
ENFD	Engineering, DTC, RAM
TOFD	Tooling
FAFD	Fabrication
ASFD	Drafting
QCFD	Quality Control,Testing

Production

PMPD	Program Management
PEPD	Non-recurring Engineering
ENPD	Sustain Engineering, Design Assurance
TOPD	Tooling
FAPD	Fabrication
ASPD	Assembly, Support Labor
QCPD	Quality Control, Inspection, Test

Operations and Support.

OPRS	Operator/Crew-Shared
OPRD	Operator/Crew-Dedicated
INDD	Indirect Personnel-Dedicated only
OLMS	Organizational Level Maintenance-Shared
OLMD	Organizational Level Maintenance-Dedicated
ILMS	Intermediate Level Maintenance-Shared
ILMD	Intermediate Level Maintenance-Dedicated
DSUS	Direct Support Unit-Shared
DSUD	Direct Support Unit-Dedicated
DCTS	Direct Support Unit Contact Team-Shared
DCTD	Direct Support Unit Contact Team-Dedicated
GSUS	General Support Unit-Shared
GSUD	General Support Unit-Dedicated
GCTS	General Support Contact Team-Shared
GCTD	General Support Contact Team-Dedicated
SWPD	Operational Software Personnel
SMPD	Maintenance & Diagnostic Software Personnel
PMOD	Program Management Office - Post Production

5.8.2.1.4 Indirect personnel. These are all personnel below depot who are charged to the materiel system and who are not crew or maintenance but whose billets exist only because of the system being costed. Examples include commanders and their staff and support personnel (communications, transportation).

These personnel are only entered as dedicated. The analyst may control their cost to the system by entering a ratio the NUMBER assigned based on anticipated demand, e.g., enter 50 percent of the number in a command if only 50 percent of their time is dedicated to the system being costed.

5.8.2.1.5 Maintenance personnel. Dedicated maintenance personnel are charged to the system regardless of demand. Shared maintenance personnel are charged to the system only for work demanded by the system based on operational use, level of repair and reliability and maintainability values contained in WBS records.

5.8.2.1.5.1 Partitioning demand for maintenance personnel. Aggregate demand for maintenance personnel is calculated separately for each unique combination of GROUP/WBS/LEVEL codes in the WBS file. Maintenance personnel may be assigned to repair any WBS item in the WBS file by assigning them a system WBS number (11).

Except for personnel qualified to work on the whole system, the Model will not use personnel assigned to repair hardware in one third level WBS category to satisfy maintenance demand generated by hardware with other third level WBS category codes. See 5.8.2.5. Also, the Model will not cross level of repair boundaries or equipment GROUP classifications to satisfy maintenance demand.

Since shared personnel are only costed based on demand, they may be duplicated in the data base under different equipment GROUPs and WBS numbers to account for different operational or maintenance profiles which share a common maintenance facility without fear of double counting.

5.8.2.1.5.2 Using both shared and dedicated maintenance personnel. If both dedicated and shared maintenance personnel are entered with the same combination of GROUP/WBS/LEVEL codes, demand will first be allocated to the work capacity of the dedicated personnel. If the demand exceeds the work capacity of the dedicated personnel, the Model will allocate excess demand to any WBS system maintenance personnel with the same LEVEL and GROUP code.

If there are no dedicated system maintenance personnel available due to prior demand or because none were entered, the Model allocates excess demand to the shared personnel. The Model's resource report displays demand by level of repair and shows cases where the T/O contains either too many or too few personnel relative to demand.

5.8.2.1.5.3 Work capacity. Work capacity of dedicated personnel is the product of the number of personnel assigned in NUMBER and two assumptions: Available Hours/Year for Field Maintenance and Manning Level. Manning level does not apply to civilian personnel. There is no work capacity limit for shared personnel since the Model assumes that shared personnel will be made available as required.

5.8.2.1.6 Software maintenance. Personnel are assigned for software maintenance tasks based on the percentage of their time dedicated to the system. Government personnel are charged for each manyear of effort commencing with the end of contractor support as defined in 5.4 and 5.5.53.

5.8.2.1.7 Post-production program management. Post-production program management personnel are assigned based on the percentage of their time devoted to the system. Costs for post-production program management begin at the termination of the production effort and end with the retirement of the final deployed system.

5.8.2.2 Occupational specialty (OS) (required). Up to 8 alphanumeric. Military only. This can be any current military occupational specialty or skill identifier code assigned by the Services. The user may enter new MOS's if the training track and course files are used to determine training costs. If an existing MOS is entered, the Model will search its internal files for training costs but will use that value only if no training track is entered.

5.8.2.3 Pay grade (required). E1-E9, W1-W4, O1-O10, GS1-16 or analyst selected pay grade for manufacturer personnel only. Enter the expected peacetime staffing pay grade for each line in the table of organization (T/O).

5.8.2.4 Number (required). Any number greater than .01. This is the number of personnel assigned to the T/O line. The number is adjusted to reflect peace time manning levels using the manning level factor in the assumption file. Dedicated personnel may be allocated amongst equipment GROUP/WBS/LEVEL combinations by entering proportions of the number in the T/O on different T/O lines for each combination.

5.8.2.5 Equipment group (required). Integer (1-25). This number is used by the Model to calculate costs for operator and maintenance personnel to satisfy demand created by WBS items with the same equipment GROUP number. The GROUP number allows users to create tables of organization and equipment for different type units or for the same type units with different operating or maintenance profiles.

The same field maintenance personnel (e.g., personnel assigned to an intermediate maintenance facility which supports different type units) may be assigned to support equipment with different equipment GROUP numbers by copying the appropriate T/O lines and using the editor to change the equipment GROUP number. If the personnel are classed as shared (see 5.8.1.2), this will not result in double counting. If the personnel are classed as dedicated, the number assigned to each equipment GROUP should be adjusted based on the ratio of their time which is devoted to each equipment GROUP to avoid double counting.

5.8.2.6 WBS number (required). Up to 20 characters. Separate level codes within the WBS number with a period. The prefix of the WBS number is used by the Model to determine the MIL-STD-881 and DA-Pam level 3 summary WBS category for reports. The prefix must be one of the MIL-STD-881 compatible summary WBS codes assigned to the materiel system in 3.3.

The suffix should be the CWBS but may be any coding scheme which adequately portrays the location of the WBS item in the hardware tree. The WBS numbering scheme should be the same for hardware and personnel. The WBS number is used to limit the types of WBS items which may make demands for labor to personnel who have been assigned to meet that type of demand.

Personnel assigned a third level WBS prefix may not be used to meet demand created by WBS items with different third level WBS prefix. The Model will use maintenance personnel assigned a system level WBS code (11) to satisfy demand created by any third level WBS item if there are inadequate maintenance personnel with the appropriate third level prefix. The Model will not make demand on the system coded level pool of labor until the third level pool, if any, has been completely consumed.

11.NN.CWBS.CWBS.CWBS

Level 6 - (Optional) Piece Part/LRI

Level 5 - (Optional) Assembly/Subassembly

Level 4 -(Optional) End Item

Level 3 - (Required) Summary WBS # (Use 1-40, depending on the system code in section 3.3. Terminate with a ".")

Level 2 - (Required) Identifies WBS entry for prime mission equipment (Use 11.)

5.8.2.7 Training track (optional). Integer. Military only. This value is assigned by the Model to each analyst defined created training track. The Model will compute and use the cost for the training track rather than use the default MOS cost if a valid integer is entered here.

Note: If a training track is entered, the training track must be defined prior to entering the T/O line.

5.8.2.8 RTR (required). Number less than 1 and greater than .001. Military only. RTR (replacement turnover rate) is the percentage of assigned personnel (as defined by number in the T/O line and the manning level) with this grade and skill classifier (MOS) who must be trained each year to maintain a steady state manning level.

This factor is used to compute annual replacement training costs. This factor should consider all expected losses to the T/O line. A general method for computing the RTR would be to divide the number of personnel expected to receive the MOS Service wide each year by the total number of Service wide billets requiring the MOS. The number of billets should be adjusted by manning level to arrive at a final ratio. This method allocates a proportional share of all graduates from the training line to each T/O line in the Service which is generating the demand. Service policy may dictate other methods of computation

5.8.2.9 Service T/O number (optional). Up to 20 alphanumeric. Military only. Only used for documentation purposes when printing the T/O.

5.8.2.10 Service T/O line number (optional). Up to 6 alphanumeric. Military only. Only used for documentation purposes when printing the T/O.

5.8.2.11 Reference. Enter on data collection worksheet only. Although the reference is not used by the Model, it is essential for documenting and tracing the derivation of the estimate.

5.8.3 Manufacturer labor rate table. The manufacturer's labor rate table is created using the worksheet contained in Figure 243. Up to 50 pay grades may be created using any unique four character grade code. The fully burdened cost per hour is entered for each labor grade in the table. The pay grade codes entered in this table must be used on the manufacturer's T/O worksheet.

The Model uses the labor rate table to compute weighted average hourly costs for each LEVEL/WBS combination entered on the T/O worksheet based on the number of personnel by pay grade assigned to the LEVEL/WBS combination. These weighted averages are used to cost WBS labor in records where the CER flag is set for manhours or manloading.

No labor costs are generated for manufacturer T/O entries unless demand is generated.

5.8.3.1 Manufacturer labor rates. Manufacturer labor rates include direct labor, benefits, overhead, G&A and any other contractually negotiated charges. These rates are referred to as burdened labor rates and should be standard rates for each skill level entered in the rate table.

Normally, these rates exclude fee since fee is frequently fixed or incentivized and is not a direct function of labor charges. Fee is normally reported in one of the Other categories provided in the Model's system level cost element structure or the WBS cost element structure. Fee should be computed and reported according to contractual requirements.

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ____________

SYSTEM: ____________

MILITARY TABLE OF ORGANIZATION

Level	MOS NEC OS	Pay Grade	Number	Equip Group No.	WBS Number	Training Track Number*	RTR	Service T/O Number**	Service T/O Line Number**	Ref
1										
2										
3										
4										
5										
6										
7										
8										
9										
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										
0										

* Optional if OS is contained in the LCC OS data base.
** Optional, for reference only. Not used by the model.

FIGURE 240. Table of organization - military

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ______________

SYSTEM: ______________

TABLE OF ORGANIZATION-GOVERNMENT CIVILIAN

Level	Pay Grade	Number	Equipment Group	WBS Number	Ref
1 ____	____	____	____	____	____
2 ____	____	____	____	____	____
3 ____	____	____	____	____	____
4 ____	____	____	____	____	____
5 ____	____	____	____	____	____
6 ____	____	____	____	____	____
7 ____	____	____	____	____	____
8 ____	____	____	____	____	____
9 ____	____	____	____	____	____
0 ____	____	____	____	____	____
1 ____	____	____	____	____	____
2 ____	____	____	____	____	____
3 ____	____	____	____	____	____
4 ____	____	____	____	____	____
5 ____	____	____	____	____	____
6 ____	____	____	____	____	____
7 ____	____	____	____	____	____
8 ____	____	____	____	____	____
9 ____	____	____	____	____	____
0 ____	____	____	____	____	____
1 ____	____	____	____	____	____
2 ____	____	____	____	____	____
3 ____	____	____	____	____	____
4 ____	____	____	____	____	____
5 ____	____	____	____	____	____
6 ____	____	____	____	____	____
7 ____	____	____	____	____	____
8 ____	____	____	____	____	____
9 ____	____	____	____	____	____
0 ____	____	____	____	____	____

Note: The Model will copy fields previously entered if no entry (2 commas together) is made for second and subsequent lines. Use a comma or a space to separate data items on entry.

The Model asks for data in the same order as shown on this sheet.

FIGURE 241. Table of organization - Government civilian

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ______________

SYSTEM: ______________

TABLE OF ORGANIZATION-MANUFACTURER

Level	Pay Grade	Number	Equipment Group	WBS Number	Ref
1 ____	____	____	____	____	____
2 ____	____	____	____	____	____
3 ____	____	____	____	____	____
4 ____	____	____	____	____	____
5 ____	____	____	____	____	____
6 ____	____	____	____	____	____
7 ____	____	____	____	____	____
8 ____	____	____	____	____	____
9 ____	____	____	____	____	____
0 ____	____	____	____	____	____
1 ____	____	____	____	____	____
2 ____	____	____	____	____	____
3 ____	____	____	____	____	____
4 ____	____	____	____	____	____
5 ____	____	____	____	____	____
6 ____	____	____	____	____	____
7 ____	____	____	____	____	____
8 ____	____	____	____	____	____
9 ____	____	____	____	____	____
0 ____	____	____	____	____	____
1 ____	____	____	____	____	____
2 ____	____	____	____	____	____
3 ____	____	____	____	____	____
4 ____	____	____	____	____	____
5 ____	____	____	____	____	____
6 ____	____	____	____	____	____
7 ____	____	____	____	____	____
8 ____	____	____	____	____	____
9 ____	____	____	____	____	____
0 ____	____	____	____	____	____

Note: The Model will copy fields previously entered if no entry (2 commas together) is made for second and subsequent lines. Use a comma or a space to separate data items on entry.

The Model asks for data in the same order as shown on this sheet.

FIGURE 242. Table of organization-manufacturer

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ____________

SYSTEM: ____________

MANUFACTURER LABOR RATE TABLE

BASE YEAR $: ____________

	Pay Grade (4 char)	Burdened Hourly Wage* ($/Hr)
1	______	______
2	______	______
3	______	______
4	______	______
5	______	______
6	______	______
7	______	______
8	______	______
9	______	______
0	______	______
1	______	______
2	______	______
3	______	______
4	______	______
5	______	______
6	______	______
7	______	______
8	______	______
9	______	______
0	______	______
1	______	______
2	______	______
3	______	______
4	______	______
5	______	______
6	______	______
7	______	______
8	______	______
9	______	______
0	______	______

* The burdened rate is the basic hourly wage + fringe + labor overhead + G&A + any other negotiated charge to direct labor. The contractor's fee is normally not included in the labor rate. Fee should be under "Other" costs on the appropriate R&D or Production WBS or System worksheet.

FIGURE 243. Manufacturer labor rate table

5.9 Training track file. Military only. The training track file is designed to allow the analyst to define a sequence of formal (i.e., normally limited to training funded with program element 8 funds) training courses for any line in the Table of Organization. A course cost file must be created prior to defining training tracks. This gives the analyst complete control over recurring training costs as a function of grade, skill identifier (MOS) , and replacement turnover rates.

5.9.1 Computing training costs. The Model uses the following method to compute training costs. Costs include the sum of the direct course costs defined by the analyst for each course in the training track, pay and allowances for the student for the period of the course, per diem and PCS costs.

Daily per diem rates are charged for courses coded as TDY. There are no per diem charges for courses coded as PCS. The course attrition rate is used as a multiplier to increase student pay and allowances, PCS and per diem charges.

There are no charges to the training line for BOS, retirement, medical or transients, prisoners and patients since these are normally included in reported formal school costs. If they are not included in the course costs, a policy decision must be made to increase the course cost to account for them. PCS charges are based on standard rates for officers and enlisted personnel.

Rather than force the analyst to specify the average pay grade for each course in the training line, the Model makes the following simplifying assumptions regarding the average grade for officer and enlisted students. For pay grades less than 5, the student grade is 2, for pay grades 6-7, the student grade is 4, and for grades over 7 the student grade is 6.

Training costs = sum of the following for each course in the track:

[((daily pay + per diem)*course length(in days))
+ PCS * number of PCS moves)*(1 + student attrition rate)
+ school costs(by budget category)]
* number in the T/O line * manning level

5.9.2 Defining training tracks. Figure 244 is used to define and enter training tracks. A training track must consist of at least one course. There is no limit on the number of courses which can make up a training track. The following paragraphs explain the headings for this figure.

a. TRACK NUMBER: No input. The model assigns this number.

b. COURSE ID NUMBER(s): Alphanumeric. 3 letters followed by 1-4 integer number. Enter the course ID number for each course in the training sequence. These numbers are assigned by the Model to each course in the course file as they are entered. User courses must be entered in the course file prior to inclusion in a training track.

c. NUMBER OF PCS MOVES: This is the number of PCS moves made by trainees while completing the training track.

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ______________

SYSTEM: ______________

TRAINING TRACKS

Track #*	Course ID Number	Course ID Number	Course ID Number	Course ID Number	# PCS Moves	Reference**

Enter as many courses per track as required. Courses must be defined before the training track can be defined.

* Track numbers are assigned by the Model.

** References are not entered.

FIGURE 244. Training track

5.10 Course file. The course file allows the analyst to define new and current courses of instruction which are not resident in the Model's internal course data files. Figure 245 contains the worksheet for defining and entering course data. The following paragraphs explain the variables required to enter course data:

a. COURSE ID NUMBER. Not a user input. The Model assigns this number as each course is entered.

b. NAME: (Optional). 20 alphanumeric characters. This is a free text field.

c. SERVICE CIN: (Optional). 14 alphanumeric characters. This should be the current or planned course identification number which will be used to report the cost of formal school training to DoD.

d. LENGTH (Days): Integer. This is the length of the course in days.

e. PCS or TDY: One character. Enter P or T. This code is used to determine the per diem pay status of the average student.

f. ATTRITION RATE: Decimal. This is the course attrition rate. The percentage of students who do not complete the course. This is used to increase charges for student pay and allowances, per diem and PCS moves.

g. BASE YEAR: Integer. YY or YYYY. This is the base year of the course costs. The Model will convert course costs to the materiel system's base year.

h. COST: Decimal. Enter costs by budget category. Do not include student pay or allowances. These are calculated by the Model.

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ______________

SYSTEM: ______________

USER COURSE COSTS

Course ID No.*	Name	Service Course ID # (CIN)	Length (Days)	PCS or TDY	Attrition Rate	Fiscal Year of Cost Data	Cost By Budget Category MP	PROC	O&M	OP	Ref**
USR1											
USR2											
USR3											
USR4											
USR5											
USR6											
USR7											
USR8											
USR9											
USR10											
USR11											
USR12											
USR13											
USR14											
USR15											
USR16											
USR17											
USR18											
USR19											
USR20											

* USR course ID number will be assigned sequentially by the Model
** References from the bibliography. Do not make an entry for reference.

FIGURE 245. User course costs

5.11 Schedule. The schedule file is used to spread costs from milestone 0 to completion of production. The analyst enters start and stop dates for each phase. Each phase may be up to 30 years in length. The Model will calculate spending rates for Government and contractor expenditures for each phase as shown in Table IV. The analyst may also enter and edit spending rates for Government and contractor expenditures for each phase. Production schedules are entered separately for each lot using the UPC worksheet for the WBS record to ensure that the correct inflation factors are applied to each production run. This insures that changes in schedules and individual Service procurements are properly costed when presented in then-year (inflated) dollars. Figure 246 contains the worksheet for entering schedule and spending rates.

Table IV. Default spending rate calculations.

Demonstration and Validation

The total number of months, N, in the phase is calculated. Equal monthly spending rates are computed as follows: monthly rate = 1/N. Annual rates are computed for each fiscal year based on the number of months in the year and the monthly spending rate.

Full Scale Development

The total number of months, N, in the phase is calculated. The following Gompertz function is then used to compute the percentage of the total which has been spent through the end of each month, I:

Cumulative Total(I)= 110.25*(.00907**(.96198**(I*100/N)))/100

The Gompertz function is a growth function based on a regression analysis of spending rates for 10 development efforts: Lance, Pershing, Redeye, Nike-Hercules, Hawk, SAM-D, Sergeant, Chaparral, Mauler and Shillelagh. The Model then calculates the spending for each fiscal year in the phase based on the cumulative spending for the last month in the year less cumulative spending for all prior years and uses this result to spread the costs.

Nonrecurring Production

The total number of months, N, in the phase is calculated. The following Gompertz function is then used to compute cumulative spending through the end of each month, I:

Total(I)= 110.25*(.00907**(.91**(I*100/N)))/100

This function allocates 50 percent of the nonrecurring costs in the first 20 percent of the production schedule, 90 percent in the first 40 percent and 96 percent in the first half. The Model calculates the spending for the last month in each fiscal year of production less cumulative spending for all prior years and uses this result to spread nonrecurring costs.

Table IV. Default spending rate calculations. - Continued.

Recurring Production
The total number of months, N, in the phase is calculated. Equal monthly spending rates are computed as follows: monthly rate = 1/N. Annual rates are computed for each fiscal year based on the number of months in the year and the monthly spending rate. These rates are used for system level cost elements. WBS recurring production costs are based on lot production rates and dates in the Unit Production Cost record for each WBS item.

5.12 Deployment. The deployment file is used to build up an operating equipment density table to compute projections for O&M costs during equipment phase-in and phase-out, as well as for costing depot overhauls. The Model uses percentages as a simplifying assumption rather than forcing the analyst to enter numbers for each month of each year. The Model sorts the deployment schedule into ascending sequence based on the starting year and month of each deployment. The model then calculates the percentage, N, of operating equipments which come on line in each month for each deployment as follows: N = percentage of total to be deployed/Delivery period(months).

These monthly percentages are then summed to the equipment density table to determine overall operating percentages for each month in the operating cycle. The operating cycle begins with the first month of operation and ends when the last equipment deployed has operated for the designated system life. The Model uses the operating equipment density table to compute operating costs costs by year by POM category in both constant and inflated dollars. Figure 247 contains the deployment worksheet.

5.13 Inflation. ASD(C) TOA (total obligational authority) and Outlay inflation indices (deflators) are maintained by the program support team and updated semi-annually or more often as required. Program managers and contracting officers may decide that other indices are more applicable to the system. Rate 1 and Rate 2 are provided for use when rates such as BLS deflators have been specified for a given contract. These rates only apply to manufacturer efforts computed in the WBS file. With the exception of negotiated rates applicable to manufacturer efforts, changes to the ASD(C) deflators available in the Model should be made only with Service approval and their derivation fully documented. When using the ASD(C) inflation tables, the Model will ask whether to use the TOA or Outlay rates. Outlay rates are normally used for weapon system procurements since the outlay rates reflect historical spending patterns and recognize the fact that some spending takes place in years after the year in which the money is obligated. TOA rates assume all spending will be completed in the year the money is obligated. Figure 247 contains the inflation rate worksheet.

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ________

SYSTEM: ________

SCHEDULE

Phase	Start Year	Start Month	End Year	End Month	Reference
Dem&Val					
FSD					
Production					

SPENDING RATES

Phase	Year 1	2	3	4	5	6	7	8	9	10
D&V-GOV										
D&V-CONT										
FSD-GOV										
FSD-GOV										
PROD-NR-G										
PROD-NR-C										
PROD-R-G										
PROD-R-C										

Phase	11	12	13	14	15	16	17	18	19	20
D&V-GOV										
D&V-CONT										
FSD-GOV										
FSD-GOV										
PROD-NR-G										
PROD-NR-C										
PROD-R-G										
PROD-R-C										

FIGURE 246. Schedule/spending rates

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

DATE: ____________

SYSTEM: ____________

DEPLOYMENT/INFLATION

ENTER AT LEAST 1 SHIPMENT

REFERENCE: ____________

DEPLOYMENT/ SHIPMENT	START DATE (YEAR/MO)	% TOTAL EQUIPMENT TO BE FIELDED	DELIVERY PERIOD (NUMBER OF MONTHS)
1	____ ____	________	________
2	____ ____	________	________
3	____ ____	________	________
4	____ ____	________	________
5	____ ____	________	________
6	____ ____	________	________
7	____ ____	________	________
8	____ ____	________	________
9	____ ____	________	________
10	____ ____	________	________
11	____ ____	________	________
12	____ ____	________	________
13	____ ____	________	________
14	____ ____	________	________
15	____ ____	________	________
16	____ ____	________	________
17	____ ____	________	________
18	____ ____	________	________
19	____ ____	________	________
20	____ ____	________	________

INFLATION RATES (OPTIONAL)

Year	Rate 1	Rate 2	R&D	MilCon	Proc	O&M	MilPer	OtherProc
19____	____	____	____	____	____	____	____	____
19____	____	____	____	____	____	____	____	____
19____	____	____	____	____	____	____	____	____
19____	____	____	____	____	____	____	____	____
19____	____	____	____	____	____	____	____	____
19____	____	____	____	____	____	____	____	____
19____	____	____	____	____	____	____	____	____
Outyears	____	____	____	____	____	____	____	____

FIGURE 247. Deployment/inflation

5.14 System cost submodel. This section presents the alternative methodology for estimating system level cost elements. It uses the basic estimating methodologies for WBS costing. This is an option which will produce costs in addition to any directly entered system level costs with the same cost element number. These values are computed before the roll up of the system level costs and therefore will influence the values of any ratios set using the system level cost editor. Figure 248 is the data input worksheet.

5.14.1 Default values. The base year, budget category, inflation category, start dates and activity durations will default to the system's values for the cost element being entered unless different values are entered. If different values are entered for the cost element, these become the default values for the subelements (material, labor, transportation and travel) rather than the system values if no entries are made for the subelements. If the default values are left unchanged, then changes in system base year fields, or schedule will change these records. This is especially important for the POM/Budget report in current rather than constant year dollars. Changes in the budget due to changes in schedule may be determined directly.

5.14.1.1 Schedule. If the cost element has its own schedule, changes in the master or system schedule will not change the cost element's schedule except that each event should fit within the master schedule. Events which fall outside of the master schedule will be costed as scheduled within the record and will be reported in annual reports correctly (i.e., as scheduled at the event level). The Model will generate warnings of any cost element records whose schedule violates the master schedule. If a cost element's schedule extends beyond the phase start date plus 30 years, the excess is reported in the 30th year. If the cost element begins before the phase start date, the phase start date is adjusted to meet the element start date.

5.14.2 Name fields. The name fields are optional for documentation purposes, as are the source fields. Each of these fields is limited to 20 characters.

5.14.3 Subtotal. Up to 5 subtotals for different activities within the record may be entered. If more than five subtotals make up the activity, enter as many additional records with the same WBS number as required to describe each of the activities being costed. The model will ask for the number of subtotals which the user desires to enter.

LIFE CYCLE COST MODEL
FOR
DEFENSE MATERIEL SYSTEMS

SYSTEM: ____________
DATE: ____________

System Cost Element Worksheet

Cost Element______________ Activity Name ________________
Base year(YY) ____ Budget Category (R&D,PROC,O&M,OPROC,MILCON)____
Start Date(YY) _____ Activity Duration (MM) _________

Resource Description	Edit Code	Total 1	2	3	4	5
CER Flag($,mhrs,ML,%,CER)	C1					
Material Total(s)	C2					
Number of Units	C3					
Cost/unit,record #	C4					
Inflation category	C5					
Base Year(YY)	C6					
Budget category	C7					
Description	C8					
Source	C9					
Labor Total(s)	C10					
Number of units	C11					
Level,cost/unit	C12					
Inflation category	C13					
Base Year(YY)	C14					
Budget category	C15					
Description	C16					
Source	C17					
Travel Total(s)	C18					
Number of trips	C19					
Fares/trip	C20					
Days/trip	C21					
Daily per diem	C22					
Car Rental	C23					
#PCS Moves	C24					
Avg Cost/PCS Move	C25					
Inflation category	C26					
Base Year(YY)	C27					
Budget category	C28					
Transportation Total(s)	C29					
Cost/shipment	C30					
Number of shipments	C31					
Inflation category	C32					
Base Year(YY)	C33					
Budget category	C34					
Description	C35					
Source	C36					

FIGURE 248. System cost element worksheet

5.15 Army cost element structure. Table V contains the Army "Big Five" cost element structure. The costs contained in the Army report are the same as those contained in the regular life cycle cost report except that the Army does not include costs which the Army identifies as infrastructure costs. These include inventory introduction and administration costs, retirement liability, medical support, and the factor for transients, prisoners and patients. These costs are included in the basic life cycle cost report for other Services. For Army personnel, these costs are zeroed out will not report in either report.

5.15.1 Phases. The Army report also rearranges the three life cycle cost phases into five activities, adding Military Construction and Fielding as distinct phases. The Model automatically removes the appropriate cost elements from the Production and Operating and Support cost element structures to form these two structures.

Table V. Army "Big Five" cost element structure.

DEFN REF			
1.0	DEVELOPMENT	3.0	MILITARY CONSTRUCTION
1.01	DEVELOPMENT ENG	3.01	TEST CONSTRUCTION
1.011	ENGINEERING	3.02	PROD CONSTRUCTION
1.012	PROD, ENG, & PLAN (PEP)	3.03	OPER/SITE ACT CONSTR
1.013	TOOLING	3.04	OTH MCA FUND CONSTR
1.014	PROTOTYPE MANUFACTURE	4.0	FIELDING
1.02	DATA	4.01	SYSTEM TEST & EVAL
1.021	INT LOG SUP (ILS)	4.02	ILS TRAIN, SERV & EVAL
1.022	NON-ILS	4.03	TRANSPORTATION
1.03	SYSTEM TEST & EVAL	4.04	INITIAL REPAIR PARTS
1.031	ILS	4.05	SYS SPEC BASE OPR
1.032	NON-ILS	4.06	OTH O&M FUND FIELD
1.04	SYS/PROJ MGMT	5.0	SUSTAINMENT
1.05	ILS TRAIN, SERV & ED	5.01	REPLENISHMENT SPARES
1.06	FACILITIES	5.011	O&M REPAIR PARTS
1.07	OTHER RDT&E FUND DEV	5.012	PROCUREMENT SPARES
2.0	PRODUCTION	5.02	PETR, OIL, & LUB
2.01	NON-RECURRING PROD	5.03	TRAINING AMMO/MISL
2.011	PROV IND FACIL (PIF)	5.04	DEPOT MAINTENANCE
2.012	PROD BASE SUPT (PDS)	5.041	CIVILIAN LABOR
2.013	DEP MT PROD ED (DMPE)	5.042	MATERIEL
2.014	OTH NON-RECUR PROD	5.05	FIELD MAINT CIV LAB
2.02	RECURRING PRODUCTION	5.06	TRANSPORTATION
2.021	MANUFACTURING	5.07	SYS SPEC REPL TRAINING
2.022	RECURRING ENG	5.071	AMMO/MSLE/EQUIP.
2.023	SUSTAINING TOOLING	5.072	SERVICES
2.024	QUALITY CONTROL	5.08	MILITARY PERSONNEL
2.03	ENGINEERING CHANGES	5.081	CREW PAY & ALLOWANCES
2.04	DATA	5.082	MAINT PAY & ALLOW
2.041	ILS	5.083	SYS SPEC SUPT P&A
2.042	NON-ILS	5.084	TRAINEE/TRAINER P&A
2.05	SYSTEM TEST & EVAL	5.085	SYS/PROJ MGMT P&A
2.051	ILS	5.086	PERM CHG OF STA (PCS)
2.052	NON-ILS	5.087	OTH MPA FUND SUST
2.06	ILS TRAIN, SERV & ED	5.09	SYS/PROJ MGMT (CIV)
2.07	INITIAL SPARES	5.10	MODIFICATIONS/KITS
2.08	OPERAT/SITE ACTIV	5.11	OTHER SUSTAINMENT
2.09	OTHER PROC FUND PROD	5.111	OTH O&M FUND SUST
		5.112	OTH PROC FUND SUST
			TOTAL LIFE CYCLE COST

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