MIL-HDBK-259 (NAVY)
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Military Handbook

LIFE CYCLE COST IN NAVY ACQUISITIONS

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FSC MISC

DEPARTMENT OF DEFENSE
Washington, DC 20360

Life Cycle Cost in Navy Acquisitions

MIL-HDBK-259 (NAVY)

1. This handbook was prepared by the Naval Material Command to be used by the Command when performing life cycle cost analysis for system and equipment acquisitions. This handbook is not intended to be used to supersede any procurement specification requirements nor is it intended to be referenced in a procurement specification except for informational and instructional purposes.

2. This publication was approved on 1 April 1983 for printing and inclusion in the military standardization handbook series.

3. This handbook provides basic information on life cycle cost analysis as a management tool for controlling and reducing total costs. The emphasis is on what the life cycle cost techniques are rather than on how to implement them. The intent is to furnish an overview of the points to address and the procedures to use when performing life cycle cost analysis so that the analyst, whether government or contractor, will be better able to conform to the acquisition manager's objectives. Without going into great depth, those issues of most interest to the beginner are discussed, thus making this handbook particularly useful as an initial step in learning about and understanding life cycle cost in Navy acquisitions. These issues are:

a. what is life cycle cost
b. what are the objectives and requirements of life cycle cost
c. what costs are relevant and significant
d. what are the analysis procedures
e. what data sources and estimating techniques should be used
f. when and how to choose or develop a computerized model

Experience has shown that these are the most pressing questions for those who are undertaking their first life cycle costing effort, and a document which addresses these questions can in some measure help to instill a cost management discipline which will result in more efficient cost reduction and cost control efforts in Navy acquisitions.

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

Naval Air Engineering Center
Engineering Specifications and Standards Department
Code 9332
Lakehurst, NJ 08733

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

FOREWORD

The Navy faces a difficult problem in resource management. Constrained by a low manpower and high technology situation, the Navy buys, operates, and supports increasingly sophisticated systems and equipment while the financial resources available to pay for them are subject to the demands of all other military acquisitions. In this competitive situation, each level responsible for resource allocation examines alternatives in terms of the total cost including an estimate of future obligations. Life cycle costing is a management tool designed to assist in efficient resource allocation.

The objective of life cycle cost (LCC) analysis is to provide quantified and qualified time-phased cost information to be used for cost measurement which supports resource allocation planning, management, and control. The specific purposes of life cycle costing in acquisition management are:

1. Estimate the total cost to the government, emphasizing the yearly outlays entailed by the acquisition.
2. Reduce total cost through using LCC tradeoffs in the design, operation, maintenance, and support development processes.
3. Control cost through using LCC contractual provisions in procurements.
4. Assist in day-to-day acquisition management actions by providing timely, consistent, and relevant cost information.
5. Help determine whether to procede to subsequent acquisition phases.

Since LCC analyses are typically reviewed in a comparative context, it would be helpful if some criteria were the same for each acquisition submitted for review. This handbook offers consistent summary level (major) cost elements and procedures to promote a uniformity which is desirable at the higher reviewing levels. Conversely, this handbook recommends flexibility for cost structure development and for estimating technique selection to accommodate the individual characteristics and requirements of each acquisition. Additionally, a computerized LCC methodology (i.e. AD A115621) has been made available to any user via the Federal Software Exchange Center.

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1. SCOPE

1.1 General. This handbook provides information on the use of life cycle costing in system and equipment acquisitions. It makes no attempt to develop a LCC standard but rather describes the general methodology and procedures which help make life cycle costing a productive in-house tool as well as a means of program or project evaluation. As inroads are made in the usage of LCC analysis, estimating and implementation techniques should improve, particularly in the operating and support (O&S) cost areas. To maximize their usefulness, LCC analyses should be tailored to the particular needs of an acquisition.

1.2 Purpose. This handbook was developed by the Naval Material Command (NAVMAT) to meet the requirements of SECNAVINST 4000.31 "Life Cycle Costing", which is a response to higher level instructions, directives, and policy guidance fostered in turn by the Defense Acquisition Regulation (section 1-335) which states:

> "Since the cost of operating and supporting the system or equipment for its useful life is substantial and, in many cases, greater than the acquisition cost, it is essential that such costs be considered in development and acquisition decisions in order that proper consideration can be given to those systems or equipments that will result in the lowest life cycle cost to the government".

This handbook is not a procurement guide, but it briefly discusses how life cycle costing can be used to advantage in the procurement process. Although this handbook is primarily for use within a program or project office, it may be helpful to other functions whenever considerations of life cycle economics are relevant. Additionally, portions of the methodology are presented to promote traceability and consistency in LCC reporting for system and equipment acquisitions within NAVMAT.

1.3 Application. This handbook addresses the application of life cycle costing to the acquisition or modification of an alpha-numeric nomenclatured equipment or system (e.g. APX-100, BQQ-6B, A-6E, CVX, and JVX) in terms of management functions and analysis procedures within a program or project office. The methodology can be used on simple non-repairable items (such as aircraft tires) or on complex repairable equipment (such as a ship communications suite requiring specially trained supervisors, operators, and maintenance personnel) or on aggregations of different equipments, i.e. major weapon systems and platforms such as missiles, ships, and aircraft. This handbook is not intended to be applied to the acquisition of buildings and facilities. This subject involves special considerations, peculiar to the architectural disciplines, which are beyond the scope of an introductory document. Reference to the appropriate government and non-government literature should provide a thorough discussion of LCC in this field.

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. These referenced documents can also be treated as a nearly complete bibliography or list of those government publications which are concerned with important aspects of LCC in NAVMAT acquisitions. Non-government publications (articles, papers, and textbooks) are numerous but are not referenced in this handbook. This handbook is not intended to be referenced except for informational purposes, and it does not impose any requirements itself, even though it discusses certain documents below which may impose LCC requirements on a particular acquisition.

STANDARDS

MILITARY

MIL-STD-881 - Work Breakdown Structure for Defense Material Items
MIL-STD-1388 - Logistic Support Analysis
MIL-STD-1390 - Level of Repair

PUBLICATIONS

REGULATIONS

Defense Acquisition Regulation

OMB CIRCULARS

OMB Circular A-94 - Discount Rates to be Used on Evaluating Time-distributed Costs and Benefits

OMB Circular A-104 - Comparative Cost Analysis for Decisions to Lease or Purchase General Purpose Real Property

OMB Circular A-109 - Major System Acqusitions

DIRECTIVES & INSTRUCTIONS

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

DoD Instruction 5000.2 - Major System Acqusition 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 for Resource Management
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
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 Acquistion Review Council (DNSARC)

MANUALS, HANDBOOKS, & GUIDES

DoD 4100.33H - DoD In-House vs. Contract Commercial and Industrial Activities Cost Comparison Handbook
DoD 7110-1-M - Department of Defense Budget Guidance Manual
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 Acquisistions
NAVFAC P442 - Economic Analysis Handbook
NAVMAT P5241 - Contractor Cost Data Reporting (CCDR) System
NAVMAT P5242 - Joint Design to Cost Guide
NAVMAT P9494 - Navy Program Manager's Guide
DCA Circular 600-60-1 - Defense Communications Agency Cost and Planning Factors Manual

(Copies of the 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.)

OMB PUBLICATIONS

Costing Methods and Models for Acquisition Planning, Budgeting and Contracting

(Copies of the preceding document should be obtained from the Executive Office of the President - Office of Management and Budget, Office of Federal Procurement Policy or Federal Acquisition Institute, Washington, D.C. 20503).

OTHER PUBLICATIONS

AD 728481 - Cost Considerations in Systems Analysis

AD 901477L - Military Equipment Cost Analysis

AD A082273 - Naval Material Command Life Cycle Cost Guide for Major Weapon Systems

AD A083845 - Naval Material Command Life Cycle Cost Guide for Equipment Analysis

AD A084170 - Naval Air Systems Command Avionics Level of Repair Model MOD-111 Default Data Guide

AD A085854 - Office of the Secretary of Defense Aircraft Operating and Support Cost Development Guide

AD A091963 - Overhead Cost and Rates in the U.S. Defense Industrial Base

AD A114676 - Report on the Navy Life Cycle Cost Model for the SEA NYMPH Project

(Copies of the preceding documents should be obtained from the Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22314).

AD A115621 - LCC FLEX-9E, Naval Material Command Life Cycle Cost Methodology computer tape (version for IBM 360 or equivalent)

AD A115622 - User's Guide for Naval Material Command's Life Cycle Cost (FLEX) Model (version for IBM 360 or equivalent)

(Copies of the preceding magnetic tape and user's guide should be obtained from the National Technical Information Service, Federal Software Exchange Center, 5285 Port Royal Road, Springfield, Virginia 22161.)

3. DEFINITIONS

3.1 General. These economic and acquisition management related terms are defined in the context of system and equipment acquisitions and are general in nature. Reference to DoD Instruction 5000.33, DoD Instruction 7000.11, NAVMAT P5241, and MIL-STD-881 will lead to more detailed information on cost terms and work breakdown structures. More specific definitions and explanations of technical terms used in discussing the different disciplines of cost analysis, logistics, and management can be found in the documents referenced in this handbook.

3.2 Product. As used in this handbook "product" refers to the system or equipment being acquired or modified.

3.2.1 System. In this handbook "system" refers to a weapon system which is a composite of equipment, facilities, and services which make up an entity. The complete weapon system includes the prime and all support related equipment, materials, facilities, and personnel required for obtaining, operating, and maintaining the system (e.g. aircraft carrier, submarine, aircraft, missile, torpedo, etc.).

3.2.2 Equipment. In this handbook "equipment" refers collectively to an item, component, or subsystem procured for installation in a system or to support a system (e.g. sonar, radio, radar, test set, periscope, engine, etc.).

3.3 Life cycle cost. LCC is the sum total of the direct, indirect, recurring, non-recurring, and other related costs incurred, or estimated to be incurred in the design, research and development (R&D), investment, operation, maintenance, and support of a product over its life cycle, i.e. its anticipated useful life span. It is the total cost of the R&D, investment, O&S and, where applicable, disposal phases of the life cycle. All relevant costs should be included regardless of funding source or management control.

3.3.1 Acquisition cost. Acquisition cost is the sum of R&D cost and investment cost.

3.3.1.1 Research and development. R&D cost is the sum of all contract and in-house costs required to bring a product's development from concept to production including engineering design, analysis, development, test, evaluation, and management. Applicable funds are: exploratory development (6.2 appropriation), advanced development (6.3a appropriation), systems development (6.3b appropriation), and engineering development (6.4 and 6.5 appropriations). Normally, research (6.1 appropriation) is not acquisition related and therefore not usually considered part of the R&D cost. (See paragraph 5.3.1 for more information on R&D cost.)

3.3.1.2 Investment cost. Investment (procurement or production) cost is the sum of all contract and in-house costs, both non-recurring and recurring, required to transform the results of R&D into a fully deployed operational system or equipment. (See paragraph 5.3.2 for more information on investment cost.)

3.3.2 Operating and support cost. O&S cost is the sum of all costs, including contract support, associated with the operations and maintenance of a system or equipment. (See paragraph 5.3.3 for more information on O&S cost.)

3.3.3 Disposal cost. Disposal cost is the sum of all contract and in-house costs required to remove the system or equipment from the inventory, and which may be offset by some residual value (e.g. salvage or resale).

3.4 Life cycle costing. Life cycle costing is the usage of LCC (or segments thereof) in various decisions associated with acquiring a product.

3.4.1 Life cycle cost analysis. LCC analysis is the identification, quantification, and qualification of LCC by segment with the purpose of establishing the cost interrelationships and the effect of each contributor to the total LCC.

3.4.1.1 Cost element. A cost element is the lowest level identified cost for a given LCC analysis. A cost element is further broken down into variables, rates, factors, or constants related mathematically which produce a dollar amount corresponding to an aspect of the product under investigation. The term 'major cost element' refers to the summary level elements: R&D cost, investment cost, O&S cost, and disposal cost.

3.4.1.2 Cost element structure. A cost element structure (cost breakdown structure) is a set of cost elements arranged in a heirarchy according to the LCC objectives. The cost element structure may be different in each phase of the life cycle.

3.5 Work breakdown structure (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.

3.5.1 Program/project WBS. 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.

3.5.2 Contract WBS. The CWBS is the complete WBS covering a particular contractor on a particular procurement.

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

ADP - automatic data processing
ASU - approval for services use
CAIG - Cost Analysis Improvement Group
CCDR - Contractor Cost Data Reporting
CER - cost estimating relationship
CFE - contractor furnished equipment
CNO - Chief of Naval Operations
CPR - Cost Performance Reports
CWBS - contract work breakdown structure
DCP - decision coordinating paper

DNSARC	- Department of the Navy Systems Acquisition Review Council
DoD	- Department of Defense
DSARC	- Defense Systems Acquisition Review Council
DTC	- design-to-cost (design-to-life-cycle-cost)
ECP	- engineering change proposal
FMS	- foreign military sales
FYDP	- five year defense program
GFE	- government furnished equipment
ILS	- integrated logistic support
ILSP	- integrated logistic support plan
JMSNS	- justification for major system new starts
LCC	- life cycle cost
LOR	- level of repair
LORA	- level of repair analysis
LRG	- logistics review group
LSA	- logistic support analysis
LSAR	- logistic support analysis record
MCON	- military construction appropriation, Navy
MPN	- military personnel appropriation, Navy
MTBF	- mean time between failures
NAVAIR	- Naval Air Systems Command
NAVELEX	- Naval Electronics Systems Command
NAVMAT	- Naval Material Command
NAVSEA	- Naval Sea Systems Command
OMB	- Office of Management and Budget
O&S	- operating and support
O&MN	- operations and maintenance appropriation, Navy
OSD	- Office of the Secretary of Defense
POM	- program objective memorandum
PPBS	- programming, planning, and budgeting system
PWBS	- program/project work breakdown structure
R&D	- research and development
RDT&EN	- research, development, test and evaluation appropriation, Navy
RFP	- request for proposal
RIW	- reliability improvement warranty
SAR	- Selected Acquisition Report
SSEB	- source selection evaluation board
VAMOSC	- Visibility and Management of Operating and Support Cost
WBS	- work breakdown structure

4. LCC IN ACQUISITION MANAGEMENT

4.1 General. Life cycle costing has an important role in the management of Navy acquisitions. It gives quantitative guidance in the program and project office for making tradeoffs among manpower, cost, schedule, performance, and logistic support; it provides access to the contractor's design through government LCC reviews; and it affords the Navy an indirect means of controlling the effect of the new system or equipment on fleet readiness via a cost-effectiveness type of evaluation. Therefore, life cycle costing should be an integral part of management's cost control and reduction effort. This management tool translates the different elements of an acquisition into a common basis for measurement and evaluation -- dollars. Describing diverse acquisition elements in terms of dollars can simplify management decisions and is essential to an effective cost control effort. However, it should be pointed out that this quantification is not a substitute for decision making but an examination of the probable cost consequences of acquisition decisions. A comprehensive management approach would further include readiness and other such benefit considerations.

4.2 Affordability. One of the most persistant challenges confronting the Department of Defense (DoD) is the ability to provide adequate resources for the acquisition, operation, and support of systems and equipment. In an effort to maintain an effective, modern force in an acquisition environment constrained by finite resources and rising costs, an affordability acquisition policy has been adopted by DoD. The keystone of the affordability policy is an estimate of the total cost of a program or project over its useful life, i.e. its LCC. Also there is the consideration whether or not one can afford a product which provides a predicted level of effectiveness versus a combination of products which provide a different predicted level of effectiveness in a multimission senario or environment. In addition to the expected cost of acquiring a product, the manager should include the cost of ownership (i.e operating and supporting the fielded product) when making acquisition decisions.

4.2.1 Importance of total cost. From a fiscal perspective, the LCC process as applied to an investment opportunity means that alternative courses of action are considered before a set of options is selected. (An investment opportunity used in this context is meant to be an option to take some defined action which will incur cost to obtain some specified future benefit.) During the concept exploration phase, many alternative designs and processes are considered as ways to meet the requirements. Some of the more effectual designs, technically, may first seem to be prohibitively expensive as a development approach; yet after consideration of such factors as subsequent value engineering, producibility, etc., the design approach may be favorable from a production or support standpoint. The point to be made is that the total cost, not just the initial near term costs, should be considered as an input to the decision process. Conceptually, then, the evaluation of an acquisition can be considered a two step process. First, a selection of the apparent best alternatives is made. Next, the alternatives are costed out and either accepted or rejected (in part based upon a cost-benefit decision).

4.2.2 LCC management. Life cycle costing is one of the many simultaneous functional requirements placed on the acquisition manager. But life cycle costing is more than just another requirement. Properly implemented it becomes a basic way of doing business -- making decisions in terms of meeting requirements at the least total cost. Properly implemented it integrates other related functional areas with a single cost data mechanism making it easier for the acquisition manager to exercise influence on funding claimants and sponsors, so that the major cost drivers are identified, managed, and controlled. The following list gives an idea of the number and variety of planning and decision tasks the acquisition manager faces which call for cost information:

a. acquisition strategy planning

b. budget planning and tracking

c. establishing performance and quantity requirements

d. concept selection

e. design and schedule tradeoffs

f. operational and deployment concept evaluations

g. maintenance and support approach evaluations

h. spares requirements determination

i. support and test equipment selection

j. LCC tracking and monitoring

k. contractual source selection

l. special contract provision evaluation

m. meeting milestones and acquisition reviews

n. measurement of acquisition progress

There is a need for a coherent effort in LCC management to support these decision processes. Effective LCC management plans and implements a LCC program which can assure the reviewing authorities that the acquisition could achieve the lowest LCC (assuming all other requirements are met) and enables the acquisition manager to make the proper design, procurement, and support decisions so that the lowest LCC can be achieved. To be effective, acquisition life cycle costing begins in concept exploration and continues throughout the acquisition phases. Figure 1 groups the acquisition's LCC tasks into three general areas and relates them to the acquisition phases. (More information on the responsibilities of acquisition management may be found in the "Navy Program Manager's Guide" NAVMAT P9494.)

4.2.3 Budgeting. The analysis of costs for alternative investment opportunities should not be confused with the budget estimating process. While much of the analytical efforts involved in LCC estimating result in information and data which may aid in developing budget submissions or in providing inputs to the programming, planning and budgeting system (PPBS), life cycle costing is not first and foremost a budgeting process.

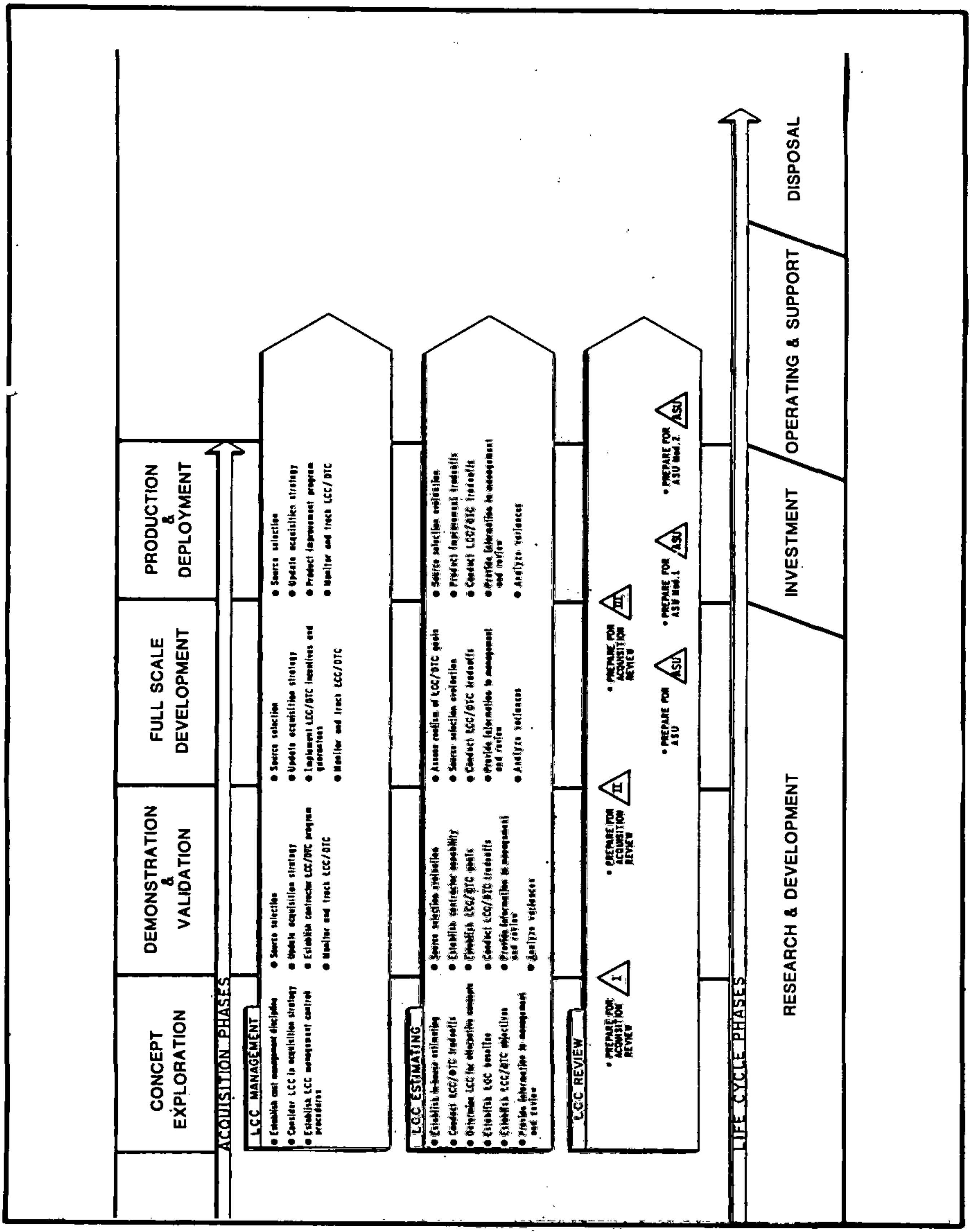

FIGURE 1. LCC in Navy acquisitions

4.2.4 External costs. In a typical acquisition environment, authority does not usually extend as far as the manager's responsibility. External factors often drive the LCC. Changes in direction and constraints (e.g. quantity, schedule, funding, and mission) occur frequently. Some acquisition elements may not be under the acquisition manager's control (e.g. construction, installation, and test equipment). An effective LCC management program provides the necessary visibility and the vehicle which enables the acquisition manager to exercise influence over these externally generated costs. One way to approach problems of this type is to use the acquisition LCC methodology with the approval for service use (ASU) review process to cause external funding claimants (e.g. Ship Parts Control Center, Naval Supply Systems Command, Naval Military Personnel Command, and the fleet type commanders) to make appropriate budgetary plans. OPNAVINST 4720.9 "Approval of Systems and Equipments for Service Use" requires that funding claimants certify that the expected O&S costs are programmed and are acceptable. Taking advantage of this requirement, the acquisition manager may implement LCC management techniques as follows:

a. all costs are incorporated into the acquisition office's LCC model

b. pertinent LCC model information is sent to all external funding claimants (figure 2 is an example of an LCC managment report for such a claimant, i.e. the type commander)

c. all claimants are requested to endorse the applicable acquisition office estimate

d. the endorsements and the LCC model are used for ASU review

Actions of this kind are needed to avoid the disruptions to the acquisition process (e.g. insufficient resources for installation, deployment, and operation) which could occur later on if such external factors were ignored.

4.3 Objectives and requirements. Life cycle costing is usually a response to external requirements imposed upon the acquisition or to internal requirements set by acquisition management. A review of OMB Circular A-109, DoD Directive 5000.1, DoD Directive 5000.3, OPNAVINST 3960.10, DoD Directive 4245.3, DoD Directive 5000.37, DoD Directive 5000.39, DoD Instruction 5000.2, and SECNAVINST 5000.1 discloses various LCC related requirements concerning affordability, LCC tradeoffs, using LCC as a design factor, using LCC in commercial product acquisition, using LCC in test and evaluation, and using LCC as an integrated logistic support (ILS) management factor. Some equipment (vice system) acquisitions may also be large enough to be subject to such requirements. LCC review requirements may apply like those discussed in DoD Directive 5000.4 (CAIG), DoD Directive 5000.26 (DSARC), DoD Instruction 7000.3 (SAR), NAVMATINST 5000.23 (DSARC), and NAVMATINST 5420.172 (DNSARC). (OPNAVINST 5000.42 shows which level of review may be required for any given acquisition.) All acquisitions, however, require LCC as a part of the request for ASU as provided for in OPNAVINST 4720.9 and as a certification factor for the logistics review group (LRG) as discussed in NAVMATINST 4105.3. These requirements may be in force from the early phases of the acquisition onward (e.g. affordability), or they may only apply at certain points during the acquisition process (e.g. ASU). In addition to these general requirements, the acquisition manager may provide LCC information to functions such as design review, planning, budgeting, and other management efforts. All LCC requirements, both external and internal to the acquisition, help define the LCC objectives.

DATE 8/25/83 NAVMAT LCC FLEX METHODOLOGY: MIL-HDBK-259(NAVY) EXAMPLE OF A WEAPON SYSTEM LCC

ANNUAL COST BY FUNDING TYPE TYPE=CMD

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

< - FUNDING TYPE - >

YEAR	RDT&EN	SCN	MCON	O&MN	MPN	OPN	TOTAL
FY80	0	0	0	0	0	0	0
FY81	0	0	0	0	0	0	0
FY82	0	0	0	0	0	0	0
FY83	0	0	3,648	0	0	0	3,648
FY84	0	0	3,828	957	5,143	0	9,928
FY85	0	0	4,020	2,010	5,761	0	11,791
FY86	0	0	0	3,166	6,575	0	9,740
FY87	0	0	0	4,431	7,526	0	11,957
FY88	0	0	0	4,653	7,903	0	12,556
FY89	0	0	0	4,887	8,300	0	13,187
FY90	0	0	0	5,130	8,713	0	13,843
FY91	0	0	0	5,388	9,151	0	14,539
FY92	0	0	0	2,829	9,610	0	12,439
FY93	0	0	0	2,970	10,089	0	13,059
FY94	0	0	0	3,118	10,593	0	13,711
FY95	0	0	0	3,274	11,123	0	14,397
FY96	0	0	0	6,876	11,678	0	18,554
FY97	0	0	0	7,221	12,264	0	19,485
FY98	0	0	0	7,581	12,876	0	20,457
FY99	0	0	0	7,959	13,518	0	21,477
FY00	0	0	0	8,358	14,195	0	22,553
FY01	0	0	0	8,775	14,903	0	23,678
FY02	0	0	0	9,216	15,652	0	24,868
FY03	0	0	0	9,675	16,432	0	26,107
FY04	0	0	0	10,158	17,252	0	27,410
FY05	0	0	0	8,001	16,378	0	24,379
FY06	0	0	0	5,599	16,048	0	21,647
FY07	0	0	0	2,940	15,196	0	18,136
TOTAL	0	0	11,496	135,173	276,878	0	423,847

FIGURE 2. Sample LCC management report for tracking external cost responsibility

4.4 LCC management program. A LCC management program can be seen as the acquisition manager's acknowledgement of the need to meet LCC and other related requirements in a logical and orderly way, taking advantage of the interrelationships with other management functions to satisfy a broad range of acquisition management tasks (see paragraph 4.2.2). If a LCC management effort is structured properly in the concept exploration phase, its usefulness to the acqusition manager outweighs the loss of resources dedicated to support it. The key to successful LCC management is developing and implementing a LCC methodology which relates to the management and control of the acquisition funding. The fundamental management relationship in any acquisition is the relationship of the WBS to the resource expenditures and commitments. Correlating the cost element structure with the PWBS and the CWBS ensures the consistency of LCC with design to cost (DTC), program objective memorandum (POM), PPBS, cost performance report (CPR), CCDR, logistic support analysis record (LSAR), level of repair analysis (LORA), funding appropriation types, and responsibility codes. Figure 3 gives an example of LCC management information which can be provided by this method. The objectives of a LCC management program are:

a. instill a cost management discipline throughout the acquisition effort

b. organize the separate LCC related tasks into a coherent effort

c. develop a LCC methodology which is sensitive to the important characteristics of the acquisition

d. establish cost control procedures

e. provide information accurately and quickly

f. place LCC tools in the hands of the designers

An effective LCC management program not only requires specialized expertise, it also requires an attitude of cost consciousness and a plan for reducing and controlling costs.

4.5 LCC plan. Life cycle costing, as a responsibility of acquisition management, should be the subject of formal planning throughout the acquisition phases. The first step in addressing LCC planning is setting the LCC objectives and choosing the suitable alternatives or ways to meet the LCC objectives. A LCC plan can be used to structure the LCC effort and is begun when these important guidelines have been determined. The development of a LCC plan is not necessary to satisfy higher authority's needs but to ensure that all aspects of the LCC effort are defined and integrated. The purpose of the LCC plan is to define the approach for using life cycle costing to influence management, design, production, operation, maintenance, and support decisions; for meeting LCC requirements in the procurement process; for using LCC in correlating management decisions with in-house budgeting and the PPBS; and for providing LCC information to meet review and milestone requirements. The LCC plan explains how life cycle costing interacts with and supports other management functions, and it defines the government-contractor relationship including LCC provisions for the statement of work, request for proposal (RFP), data item descriptions, source selection procedures, and resources to support the source selection evaluation board (SSEB) and subsequent LCC monitoring and contractor performance tracking.

DATE 8/25/83 NAVMAT WCB FLEX METHODOLOGY: MIL-HDBK-259(NAVY) EXAMPLE OF A WEAPON SYSTEM LCC

FUNDING VS. COGNIZANT OFFICE

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

COG. OFFICE	RDT&EN	SCN	MCON	O&MN	MPN	OPN	COG. OFFICE TOTAL
PROG MGR	6,883	127	0	621	0	13,251	20,881
% COGNIZANT OFFICE TOTAL	33.0	0.6	0.0	3.0	0.0	63.5	100.0
% OF FUNDING TYPE TOTAL	8.7	0.0	0.0	0.1	0.0	13.3	1.2
NAVALSTA	0	0	0	42,519	0	0	42,519
% COGNIZANT OFFICE TOTAL	0.0	0.0	0.0	100.0	0.0	0.0	100.0
% OF FUNDING TYPE TOTAL	0.0	0.0	0.0	8.4	0.0	0.0	2.5
CONTRACT	72,296	474,616	114,576	35,436	6,783	2,387	706,093
% COGNIZANT OFFICE TOTAL	10.2	67.2	16.2	5.0	1.0	0.3	100.0
% OF FUNDING TYPE TOTAL	91.2	100.0	74.9	7.0	1.9	2.4	42.1
NESSEC	0	0	26,908	228,382	8,519	420	264,229
% COGNIZANT OFFICE TOTAL	0.0	0.0	10.2	86.4	3.2	0.2	100.0
% OF FUNDING TYPE TOTAL	0.0	0.0	17.6	45.0	2.4	0.4	15.8
EMET	109	0	0	18,177	0	2,484	20,771
% COGNIZANT OFFICE TOTAL	0.5	0.0	0.0	87.5	0.0	12.0	100.0
% OF FUNDING TYPE TOTAL	0.1	0.0	0.0	3.6	0.0	2.5	1.2
SPCC	0	0	0	0	0	64,056	64,056
% COGNIZANT OFFICE TOTAL	0.0	0.0	0.0	0.0	0.0	100.0	100.0
% OF FUNDING TYPE TOTAL	0.0	0.0	0.0	0.0	0.0	64.3	3.8
TYPE-CMD	0	0	11,496	135,173	276,878	0	423,547
% COGNIZANT OFFICE TOTAL	0.0	0.0	2.7	31.9	65.4	0.0	100.0
% OF FUNDING TYPE TOTAL	0.0	0.0	7.5	26.6	76.6	0.0	25.3
NAVSUP	0	0	0	11,260	0	243	11,503
% COGNIZANT OFFICE TOTAL	0.0	0.0	0.0	97.9	0.0	2.1	100.0
% OF FUNDING TYPE TOTAL	0.0	0.0	0.0	2.2	0.0	0.2	0.7
NAVFAC	0	0	0	454	0	0	454
% COGNIZANT OFFICE TOTAL	0.0	0.0	0.0	100.0	0.0	0.0	100.0
% OF FUNDING TYPE TOTAL	0.0	0.0	0.0	0.1	0.0	0.0	0.0
RM(LOG)	0	0	0	35,990	69,152	16,790	121,931
% COGNIZANT OFFICE TOTAL	0.0	0.0	0.0	29.5	56.7	13.8	100.0
% OF FUNDING TYPE TOTAL	0.0	0.0	0.0	7.1	19.1	16.9	7.3
FUNDING TYPE TOTAL	79,288	474,743	152,980	508,013	361,331	99,630	1,675,985
% OF LIFE CYCLE COST	4.7	28.3	9.1	30.3	21.6	5.9	100.0

FIGURE 3. Sample LCC management report for total responsibility funding

4.5.1 LCC technical control. This part of the plan addresses: the management control functions including authority and responsibility for conducting the LCC effort; the schedule and the interfacing milestones; the specific tasks and the level of effort to be applied; the data flow and the management interfaces among the functions both inside and outside the acquisition office; the government LCC review team; and other related efforts such as reliability, maintainability, DTC, logistic support analysis (LSA), LORA, ILS, training, support and test equipment, foreign military sales (FMS), subcontractors, vendors, and government furnished equipment (GFE) contractors.

4.5.1.1 LCC tasks. The LCC plan should discuss the ways and means of accomplishing the following tasks as applicable (figure 1 summarizes these tasks and relates them to the life cycle phases):

a. management - establish a cost management discipline by developing and controlling the acquisition LCC methodology (tailor methodology to provide design tools and management tools; set ground rules, procedures, and conventions; develop standard data and factors; and establish a common data base); provide special information and assistance (select acquisition strategy which supports the LCC objectives; resource allocation planning and budgeting; influence external costs; and coordinate effort with interfacing areas); establish control procedures for in-house and contractor (monitor LCC and DTC objectives and goals); and provide other services (recommend procurement strategy; plan for support required to incorporate LCC and DTC into statement of work, data item descriptions, RFP's, source selection evaluation procedures, SSEB participation; and implementing and monitoring special LCC contract provisions).

b. estimating - establish in-house and contractor LCC and DTC capability; establish LCC and DTC baseline; establish LCC and DTC objectives and goals and analyze variances; provide information for management and review preparation tasks; and evaluate alternatives (concept, design, logistics, maintenance, support, alteration, modification, engineering change proposal (ECP), product improvement, force level, multi-year procurement, production rate, operating scenerio, deployment, schedule, and quantity).

c. review preparation - define acquisition, logistic, and ASU review requirements; define responsibilities and schedules; and prepare special review estimating procedures.

4.5.2 LCC analysis. This part of the plan sets the ground rules for the analysis procedures. Included are discussion of and justification for alternatives, major assumptions, cost estimating techniques, cost element structure, uncertainty considerations, automatic data processing (ADP) considerations, procedures for updating and verifying LCC data, and documentation (including tracking and justification of deviations from standardized or required methodologies and procedures).

4.6 Modeling and ADP. In the early phases of the acquisition, the cost element structure is likely to be relatively simple. Cost estimating could be done more efficiently by hand than by computer. However, product characteristics and quantities are constantly changing, and usually many estimates are needed based on different assumptions. A computerized cost model can produce these estimates quickly and efficiently with the added advantage that differences in estimated costs are not caused by changes in methodology or by errors in computation. Developing a computerized model flexible enough to meet the growing needs of the program or project throughout the acquisition effort can consume significant resources. Consequently, a LCC management effort should include a thorough search for an existing LCC model which has been used successfully in the past and which can satisfy the present LCC analysis requirements. Given the extensive development of computerized LCC models in government and industry over the last two decades, developing new computer programs without checking existing ones first would be imprudent. A list of successful cost models can be found in "Costing Methods and Models for Acquisition Planning, Budgeting and Contracting" by the Office of Management and Budget (OMB). Other sources include the Defense Logistics Studies Information Exchange (U.S. Army Logistics Management Center, Fort Lee, Virginia 23801), the Defense Technical Information Center, and the Federal Software Exchange Center. In addition, NAVMAT has prepared and made available the "Life Cycle Cost Guide for Major Weapon Systems" (AD A082273) and the "Life Cycle Cost Guide for Equipment Analysis" (AD A083845) along with a computerized LCC methodology (AD A115621) and user's guide (AD A115622) which can be used in most applications of this handbook. NAVMAT (MAT 01F4) maintains and supports LCC models as do the Naval Electronics Systems Command (NAVELEX, code ELEX 82B) and the Naval Air Systems Command (NAVAIR, code AIR 524). Chief of Naval Operations (CNO, code OP 112C) has developed and made available the HARDMAN LCC model. More information on LCC models can be found in paragraph 5.6.2.

4.7 Cost control techniques. The most important task of LCC management is to support the cost control function. Previous paragraphs discussed in-house aspects of controlling costs. The development and production contractors, however, are responsible for the largest part of the acquisition cost, and the acquisition manager has a corresponding need to control them. Generally, the following three techniques are available for this purpose: DTC, reliability improvement warranty (RIW), and LCC procurement. DTC (also called design-to-life-cycle-cost) is a management technique for controlling LCC via the early quantification and tracking of cost objectives and goals during the development process. Compared to life cycle costing as an estimating technique, DTC is more of a cost control approach. Fundamentally intended to be a LCC related discipline, DTC has up until recently primarily been used to control production cost. That is, its application as a managerial control technique has focused on the investment cost with emphasis on design-to-unit production cost. A more detailed discussion of each cost control technique follows. Guidance relative to the applicability and implementation is also referenced.

4.7.1 DTC. Life cycle costing and DTC are complementary management strategies to control and reduce the cost of Navy acquisitions. DoD Directive 4245.3 covers the implementation of DTC. In DTC, cost objectives and goals are established early in the R&D phase of the life cycle for measurable cost drivers such as the average unit production cost or for measurable cost driving parameters such as reliability and maintainability or for portions of the O&S cost such as manpower, support equipment, and spares. Life cycle costing considers LCC in decisions associated with developing, procuring, maintaining, modifying or replacing a system or equipment. As such, life cycle costing can be used in assessing most decisions, including the establishment and adjustment of DTC objectives and goals. Alternatively, DTC is a technique for minimizing LCC by realistically constraining the recurring portion of the production cost, and also to help control the future O&S cost by establishing objectives and goals which can be monitored during test and evaluation. The principles of DTC include provisions for tradeoffs between performance and cost to help keep the acquisition within its cost goals. In general, DTC is implemented by establishing a top level or system wide cost objective or goal. This goal is based on estimates derived from actual costs of prior systems or equipments. Once established, the DTC goal is subdivided and delegated to designers who can be held accountable for designing a product which is producible within the specific cost envelope. To achieve this, the designers should identify significant cost drivers and determine ways to control them. Cost estimators, reviewers, and production personnel can assist in the design efforts by identifying acceptable existing designs by developing design options which can reduce production cost or by definitizing cost reducing production techniques. During the early stages of layout and design, production cost estimates are made for each level of design. (Cost estimating techniques described in paragraph 5.7 can be used for this purpose.) Once derived, these estimates should be linked to design characteristics which are clearly identified at each level of the product's design. Since these estimates are merely a comparative baseline for evaluating DTC performance, a method for collecting and reporting the unit production cost data should be established before DTC can serve as an effective control technique. Management should have the capability to ensure that the production related cost thresholds are not breached without commensurate reductions in LCC or without major mission or acquisition structure changes. (The application of the DTC concept together with guidance is further provided in the "Joint Design to Cost Guide" NAVMAT P5242). Since the DTC implementation described above can significantly influence the O&S cost incurred during the deployment portion of the production & deployment phase, a more detailed description of DTC implementation is provided below.

4.7.1.1 DTC implementation. The successful implementation of DTC is normally contractually dependent; that is, with some exceptions (like preliminary ship design or early system feasibility studies which may be done in-house) the contractor has the most significant role to play. The DTC criteria and standards which are to be used throughout the acquisition process should be delineated in the RFP which precedes each contractual effort. The RFP should stipulate the recurring and nonrecurring components of the target unit production cost and any O&S related DTC goals in constant year dollars (see paragraph 5.5.3). The product which is to be covered by the DTC plan should be explicitly identified in the RFP; a differentiation between GFE and contractor furnished equipment (CFE) should also be made in the RFP. In addition to delineating the product to be covered, the RFP should prioritize the required performance characteristics but should allow the contractor enough flexibility to incorporate cost saving design features. Finally, the RFP should require that the contractor formally describe the method by which DTC will be implemented, including the techniques to be used to evaluate design options or design changes from a DTC point of view. When responses to the RFP have been received, acquisition management personnel should ensure that the source selection process appraises the contractor's ability to meet the DTC goals and evaluates the contractor's method for conducting the performance and cost tradeoffs. Specifically, the source selection process should evaluate how the contractor will establish the production and O&S cost goals, how these goals are allocated to design teams and subcontractors, and how the performance of these organizational entities will be evaluated relative to the cost goals. The fundamental purpose of this effort is to ensure that the contractor's approach to DTC is meaningful and measurable. From a contractual provisions standpoint, one should consider such things as tradeoffs, subcontractors, and incentives. The contract should stipulate the prerogatives granted to the contractor for tradeoff decisions. Methods for facilitating this objective include the creation of a performance priority guide by the government and the formalized requirement for the contractor to demonstrate the full cost effect of design changes. Furthermore, the acquisition office should ensure that the contractor passes along DTC goals to the subcontractors, where reasonable, thereby reducing the risk of undue subcontractor influence upon the prime contractor. Finally, incentives are an extremely effective device for motivating contractor DTC performance, particularly when there is little or no competition. To be effective, however, DTC incentives should be specific so that both parties understand what the incentives are and how they will be applied. The enactment of a clear and concise contractual document does not, in and of itself, guarantee the successful implementation of a DTC plan. DTC management is essential. The following recommendations are intended to assist acquisition managers in effectively using DTC as a LCC control device:

a. Minimize changes to the DTC plan.

b. When required, make changes to the DTC plan as early in the life cycle as possible.

c. When changes are proposed, rapid decisions regarding these proposals is essential to ensure suboptimal DTC decisions are minimized.

d. Concentrate management attention on cost drivers.

e. Examine the contractor's DTC technique, the contractor's internal communication network (both formal and informal), and the costing tools the contractor makes available to designers (including feedback mechanisms).

4.7.2. RIW. A RIW is fundamentally a fixed price contractual provision which establishes incentives for field reliability and maintainability improvements whereby the contractor is committed to repair specified equipment failures for fielded systems or equipment during a specified warranty period. The intent of this control mechanism is to economically motivate the contractors to design and produce products with low field failure rates, decreased isolation time, and decreased module replacement time, thereby increasing the operational availability as well as reducing the cost of operational support. The use of RIWs to increase contractor responsibility for fielded products increases the probability that the contractor will use failure feedback techniques to initiate design improvements. However, it should be recognized that such improvement will take place only as long as the contractor perceives it to be economically beneficial. A prerequisite to the use of a RIW contract as a practical LCC control technique is the ability of both contractual parties to identify the realistic potential for reliability and maintainability improvements vis-a-vis the estimated support costs. For this to be achievable at the time a firm fixed priced proposal is solicited, the ability to evaluate and compare all associated costs should exist. The cost of a warranty option should be compared with the relevant cost of organic (in-house) support. Such a comparison is not only useful in evaluating the efficiency of a RIW but, once selected, can be used in negotiating the final price of the contract. The desirability of using a RIW contract is understood better when its three major characteristics are considered:

a. The contract covers an extended period of time to ensure that the contractor has long term interest in the acquisition effort and that failure feedback from the operational environment can influence the design changes.

b. The bidding and award of a firm fixed price RIW contractual commitment is implemented with the contractual effort for production. Risk and benefit is equitably apportioned between the contractor and the government. Generally, a mean time between failures (MTBF) guarantee is procured in association with the RIW.

c. The contractor assumes complete responsibility for the type and extent of repairs agreed to between the contractor and the government for a stipulated period of time. The government does not usually create redundant organic repair capability during the warranty period but imposes serial number inventory control procedures to ensure that contractual commitments are met. The contractor usually implements, at no cost to the government, ECPs which reduce the maintenance costs, provided the cost of incorporating ECPs into the product design is less than the maintenance cost savings. Note that the government pays for maintenance not covered by the RIW.

4.7.2.1 RIW implementation. Contractually, a RIW is implemented via a firm fixed price contract. While competition is desired, it is not a prerequisite for engaging in a RIW contractual effort. It is necessary, however, for the product to have advanced beyond the paper design stage before a RFP is solicited. Furthermore, a somewhat predictable operational environment as well as some preliminary product testing increase the practicality of using a RIW contract as a control device, because this will afford a better understanding of the reliability and maintainability characteristics of the product. The use of RIW as a LCC control mechanism is limited to the production & deployment phase of the acquisition cycle. Despite this fact, the acquisition phase prior to the production & deployment phase is integral to the RIW process due to its preparatory focus. Therefore, RIW as a control technique is a two step process.

a. Step one occurs in the concept exploration, demonstration & validation, and full scale development phases of the acquisition. During the concept exploration phase, background studies exploring reliability and maintainability options of a product relative to its anticipated LCC can be conducted. A portion of these studies should consider RIW as a potential mechanism for achieving the stated goals and for reducing LCC. The demonstration & validation phase is concerned with further definition of the product being acquired. At this point, the possibility of using a RIW during production can affect the design characteristics. Consequently, the product developer should be made to understand the extent to which

RIW may be used in the production efforts. During the full scale development phase, the product design is modified and refined to a preproduction quality. RIW proposals received from the prospective contractors should reflect all product revisions to facilitate the RIW evaluation and usage decisions. Specifically, the following evolutions should take place during this phase: the development of final RIW provisions, the incorporation of RIW provisions in the production RFP, the proposal review, the RIW decision, and the RIW negotiation.

b. Step two occurs in the production & deployment phase, that portion of the acquisition which RIW can serve as a life cycle control mechanism. RIW tasks administered during this phase include: the development of RIW management procedures (including false removal determination and disposition), the review of the contractor's RIW data plan, the coordination of contract administration functions, the ECP processing, the review of contractor RIW facilities, the technical data review, and the development of user data transmittal methods. The O&S portion of a RIW effort begins with the inital deployment of operational units and terminates upon the expiration of the warranty period. Specific acquisition management tasks include: monitoring the implementation, monitoring the RIW logistics flow, contract administration, the ECP review, the post-RIW support study, and the post-RIW support negotiations.

4.7.2.2 RIW summary. A final word at this point is necessary about the practical aspects of the implementation of RIW as a control mechanism. As indicated earlier, the contractor is made to be contractually responsible for providing the depot level repair services for a fixed operating time, calendar time, or a combination thereof. As a result, the Navy's initial quantities of spares, manuals, training equipment, and test equipment is reduced from what it might otherwise be. The Navy's risk of increased cost, precipitated by design changes, is reduced by postponing the procurement of inital spare parts until the transition has occurred. Finally, if a MTBF guarantee is incorporated into the RIW contract, the contractor bears the burden of correcting the MTBF deficiencies. For an expanded consideration of RIW, information may be obtained from textbooks and papers on logistics, reliability, and LCC. Other RIW information may be obtained from the Defense Logistics Studies Information Exchange and the Defense Technical Information Center.

4.7.3 LCC procurement. An effective way to manage total system or equipment cost is to use LCC or segments of it in procurements. LCC considerations when translated into contractual provisions and applied to source selection, pre-award testing, acceptance criteria, incentives, and design tradeoff studies strengthen management's control of the magnitude and distribution of the system's or equipment's annual draw upon the Navy's resources and enhance management's ability to reduce the eventual overall cost to the government. (It should be noted that LCC contractual provisions can be used to advantage in both non-competitive and competitive procurements.) The effective use of LCC in procurements requires the planning, coordination, and execution of many complex activities. The LCC plan (see paragraph 4.5) should cover all aspects of LCC involvement in the procurement process. LCC procurement planning should begin early in the contractual effort when the most advantageous procurement strategies can be adopted. Important points to address include the preparation of the statement of work, the proposal instructions, the evaluation criteria, the evaluation process, data responsibility, interfaces with other related areas, and documentation. Typical documentation requirements for an RFP concern input data values and sources, methodology, ADP materials, status reports, analysis reports, and change tracking and justification. (Care must be taken to constrain the competing bidders such that the LCC results are comparable without restricting their freedom to propose innovative designs.) A LCC procurement is a control method intended to stimulate long term contractor interest in an acquisition effort. The contractor is motivated to assume a higher risk in return for an opportunity to derive an economic benefit by either meeting or exceeding the contractually mandated goals or targets. Generally, a LCC procurement is appropriate whenever significant O&S cost savings can be achieved. For this to be a realistic option, the product's design and operational environment should be known or predictable. The implementation of a LCC procurement begins with the selection of a LCC procurement technique and the formulation of a specific approach. Solicitation packages are prepared and responses evaluated for suitability. Once a contractor is selected and begins work, the Navy assumes complete responsibility for tracking and monitoring the LCC performance. There are three basic LCC procurement techniques which can be used, either independently or together. First, the source selection criteria can be used as a LCC control device. Another is the explicit incorporation of LCC incentives within the contract. Finally, the acquisition office can ensure that precise contractor LCC guarantees are included in the terms of the contract.

4.7.3.1 Source selection. LCC as a source selection factor motivates the bidder to address LCC during preparation of the offer. The first LCC procurement technique, that of using source selection criteria, can use the lowest LCC proposed as a factor in the contract award decision. However, as an alternative, one can consider the amount and level of understanding of the LCC requirements that the bidder demonstrates, by virtue of the planned effort as described in the proposal. (The point here is that the best contractor may not be the one that proposes or estimates the least LCC. It may be the one that more thoroughly demonstrates an understanding of the discipline, its uses, and its limitations. For example, important criteria other than cost could be the use and understanding of LCC techniques, the credibility of inputs, consistency with the rest of the proposal, the application of LCC in the acquisition management process, and the planned use of LCC in the design process.) Naturally, it presumes that the minimum performance and the contractual requirements stipulated in the RFP are accommodated. For the RFP responses to facilitate an effective source selection, the following items should be clarified in the RFP: (It should be mutually understood by both the government and the offeror that these factors would serve as the minimum basis upon which the contract award would be determined. DoD Directive 4105.62 and NAVMATINST 4200.49 discuss the source selection process.)

4.7.3.1.1 Cost element structure. The cost element structure used in source selection is normally an adaptation of the acquisition cost element structure (see paragraph 5.4). Its purpose is to provide the SSEB part of the information necessary to determine which bidder is more likely to be successful in achieving the least LCC. The stage of product development influences the approach to preparing a source selection cost element structure. In the early phases of the acquisition when competing designs may be quite different and critical input data may be questionable, the bidder's approach to LCC and the bidder's demonstration of an understanding of how LCC is to be implemented may be better indications of the best prop· ·l than the LCC estimate itself. Later on when the design has stabilized and the input data is more credible, the emphasis may shift to the bidder's LCC estimate. In any case, when actual LCC estimates are to be used as one of the selection criteria, the cost elements chosen should be measurable, relevant, and significant. (This means that cost elements which may become subjects of misunderstanding and controversy should be avoided). When emphasis is on LCC criteria other than the bidder's LCC estimate, the bidder should be allowed more freedom in developing the cost element structure. In this case, the government may define a general cost element structure (which is the same for all bidders) down to a certain level of detail below which each bidder may introduce unique cost elements. In such a way comparability is maintained while each bidder is allowed to prepare a cost element structure reflecting a unique design approach. A greater level of effort in proposal preparation and evaluation by the acquisition management office is necessary when the bidder's LCC estimate is used as a selection criterion. Credibility and validation become important issues when this approach is taken. It may become necessary to include RIWs, guarantees, incentives, or penalties along with the proposed LCC estimate to curb bidder optimism. In other words, if a contract award is based partly on a proposed LCC, it is normally expected that the selected contractor will either have to demonstrate performance through formal testing of key parameters (e.g. reliability demonstrations) or be held responsible for performance (e.g. contractual penalties and guarantees). Either way, using the bidder's LCC estimate as a selection criterion does not usually facilitate the source selection process and should be avoided where a fair selection could be made on a combination of other criteria as discussed in paragraph 4.7.3.1 above. If the bidder's LCC estimate is used as a selection criterion, it is recommended that the LCC be expressed as a high and low variant rather than a point estimate.

4.7.3.1.2 <u>LCC model</u>. The LCC model used for making LCC estimates should be compatible with the LCC element definitions and with the stipulated data requirements. It should be defined in a clear, concise manner and should delineate the known cost driver elements (see paragraphs 5.6.2 and 5.6.3). The LCC model calculations could be done in-house by requiring the bidders to submit the necessary data, or the acquisition office could supply the LCC model to each bidder with the government data and instructions.

4.7.3.1.3 <u>Data</u>. The contractor's data should be capable of being independently validated by the Navy. Government supplied data should be as specific as possible to the particular acquisition effort. It should include the cost estimating factors common to all competing designs (e.g. fuel costs, personnel costs, production quantity, and delivery schedule).

4.7.3.1.4 <u>Ground rules</u>. Instructions, information, and ground rules pertinent to the source selection should be succinct but should provide the bidder with as much information as possible. Data provided by the government should include: the planned operational and support scenario; the quantities to be acquired; the deployment schedule; the desired acquisition schedule; the assumed attrition rates; the constraints imposed upon testing requirements and schedules or upon the maintenance and supply policies; the LCC model to be used; the rules for applying the LCC model (including a delineation of the offeror's autonomy regarding model modification); the format, the timing, and the use of government supplied background data; the formats to be used for the LCC proposal; and the assumptions and contraints pertaining to interfacing areas (e.g. reliability).

4.7.3.1.5 Proposal evaluation. The evaluation of proposals can be based upon testing, sensitivity analyses, correlation analyses with previous test results, independent cost estimates, and plausibility and consistency checks. While it is not necessary to articulate the details of an evaluation process, the consistency among proposals can be enhanced if the offerors are made aware of the general approach to be used in evaluating the proposals. Using LCC in the following provisions as well as in the source selection will further motivate the contractor to propose low LCC designs.

4.7.3.2 Incentives. Incentive provisions motivate the selected bidder to deliver a product with lower LCC. These provisions are included to obtain a commitment from the contractor to reduce LCC by either achieving or exceeding the proposed cost goals. The commitment is derived through the contractual imposition of economic influences. There are two general categories of economic LCC motivators: incentive fee contracts and award fee contracts.

4.7.3.2.1 Incentive fee. An incentive fee contract can be structured so that a contractor experiences economic gain or loss based upon contractually imposed LCC performance criteria. Procedurally, the Navy and the contractor negotiate the economic targets and agree to the methods to be used to evaluate the contractor's LCC performance. The resulting contract stipulates the LCC goals and delineates a variable price adjustment formula. Subsequent to initiation, periodic estimates of LCC are applied to the formula to determine the magnitude of the contractor's economic gain or loss.

4.7.3.2.2 Award fee. An award fee contract is an economic motivator which can be used in acquisition efforts where the evaluation criteria for measuring LCC performance cannot be explicitly stipulated in a contract. In this case, a fixed amount of money is set aside to reward the contractor for outstanding performance. These funds should be substantial enough to stimulate LCC reduction initiatives by the contractor. The decision to reward the contractor for such initiative, as well as the amount to be paid, is made unilaterally by the Navy based upon a subjective, though presumedly well structured and well documented, appraisal of the contractor's performance. The award or non-award decision, like most award fee provisions, is normally nonappealable. While the magnitude of the award and the criteria for making it should be made known to the contractor ahead of time, the leverage afforded the Navy to motivate the contractor as to LCC performance is significant and very real.

4.7.3.2.3 Summary. There is no simple answer to how much fee is sufficient to incentivize. Obviously each situation is unique. The key point is that the acquisition manager should consider the use of contract incentives and seek specialized assistance in determining the most effective type and level of funding.

4.7.3.3 LCC guarantee. A LCC guarantee differs from LCC motivators in that the contractor is contractually committed to meeting a specified LCC value. Although there is at present little experience with this type of contractual approach, it is based on the contractor not being rewarded for exceeding a certain threshold but, instead, being responsible for taking whatever steps are required to meet the established LCC value. The contractor assumes complete financial responsibility for making any modification needed to ensure that LCC commitments are met. The contract is the forum through which the required LCC values are stipulated. Furthermore, the contract formalizes the extent of the contractor's liability if the required LCC values are not achieved. The Navy is responsible for evaluating the LCC performance and, if necessary, for enforcing the correction of deficiency clauses. In theory at least, LCC guarantees can be used with the incentive features addressed earlier.

4.7.3.4 Cost control techniques summary. Regardless of which LCC procurement technique is ultimately chosen, the measurement of contractor performance is basic to the successful implementation of them all. Reliability and maintainability demonstrations, cost audits, and logistics studies are all practical measurement methods but, whenever it can be accommodated, the testing of the actual product is one of the more accurate techniques. Generally, life cycle costs are extrapolated for the entire acquisition effort based upon the performance of cost controlling product parameters evaluated during sample testing. Actual costs experienced during sample testing are not used unless there is a high correlation to the entire acquisition effort. The factors which can significantly influence the LCC derived in such a manner include: the method chosen for sample selection, the state of product evolution, the volume and magnitude of ECPs, the length and the extent of testing, the type of failures experienced, and the method of testing and reporting selected. Irrespective of the cost control technique used, many factors should be considered in the implementation effort. Whether the effort is being done by the contractor, by the government, or by both, it is imperative that all LCC terms be adequately defined. Also, the contractor responsibilities as well as the government responsibilities relative to the acquisition's LCC should be formally specified in the contractual documents. The realities of a dynamic environment dictate that, where contractors are involved, the contract should make allowances for inflation, delivery schedule changes, and modification of production quantities or rates. Finally, the contractual environment should be flexible enough to accommodate the modifications in technical requirements which either reduce the total cost or respond to changes in the operational need.

4.7.4 Contracting recommendations. Prior paragraphs have dealt with contractual arrangements for controlling LCC. Whether used separately or together, DTC, RIW, and LCC procurement (i.e. source selection criteria, incentive and award fee LCC motivators, and LCC guarantees) provide a graduated means of controlling the contractor throughout the acquisition process. LCC criteria should be formally incorporated into the contractual agreements as early in the acquisition as possible. This is consistent with previous statements regarding the use of LCC as a design criteria. The commitment of both contractual parties to such a requirement during the early design stages of an acquisition effort offers the best opportunity for both parties to reduce their respective financial risk. The effective communication of contractual desires and requirements between the contractual parties during the pre-award evolutions can avoid inefficiencies.

If the Navy provides a complete explanation of its LCC control provisions and the potential contractors ensure that their respective organizations understand the intent of these contractual requirements, it is possible to incentivize product improvement without precipitating cost growth. While details relevant to the control devices should be explicit, the contractor should be granted as much design autonomy as possible. Contractual specifications should be results, not means, oriented. A consideration should exist for the government specifications to be tailored whenever there is an opportunity for either contractual party to be innovative in the interest of lowering the LCC.

5. LCC METHODOLOGY

5.1 General. One of the major objectives of the LCC management effort is to develop and implement an acquisition sensitive LCC methodology. LCC analysis is used to produce cost estimates for evaluating alternatives on a life cycle basis. This is a type of analysis which, according to the "DoD Economic Analysis Handbook" serves as "a conceptual framework for systematically investigating problems of choice." As such, it is a process which is explicitly governed by the procedures delineated in DoD Instruction 7041.3 entitled "Economic Analysis and Program Evaluation for Resource Management" (as implemented by SECNAVINST 7000.14 series). SECNAVINST 7000.14 establishes the framework for applying economic analysis in Navy programs and projects. LCC analysis should be used with other decision making tools (e.g. cost-effectiveness analysis, benefit-cost analysis, systems effectiveness analysis, and decision-risk analysis), taking advantage of the interrelationship of these analytical techniques.

5.2 Methodology application. LCC estimating should begin as early in the acquisition process as possible to facilitate the control of the entire acqusition cost. Its successful implementation requires a commitment from management to ensure that LCC is included along with the schedule, performance, and short term costs as a major factor in any decision making process. This can only be achieved if the cost targets for the acquisition effort are established using LCC as a primary planning parameter.

5.2.1 Planning. The use of LCC as a major decision variable means that the cost targets be realistically organized and scheduled within a comprehensive plan of action (see paragraph 4.5). A wide range of functional disciplines is needed to develop a plan which ensures that cost targets can be achieved. Consequently, it is recommended that a team of individuals from various functional backgrounds be used to develop an integrated LCC management plan which delineates the resource requirements and the performance evaluation criteria. To ensure that the plan is objective and addresses the specific acquisition effort in a comprehensive fashion, it is recommended that the integrated management team include expertise in the following disciplines: cost estimating and analysis, production processes, logistic support, operations, manpower, system engineering, test and evaluation, reliability and maintainability, and ADP and modeling.

5.2.2 Implementation. After the objectives and requirements have been incorporated into a plan of action, implementation should occur in a timely and effective manner. To this end, review, evaluation, feedback, and management control processes should be activated. As the acquisition effort progresses through its various stages, an assessment of the LCC estimates relative to the planning targets can be made. When significant variances occur, resource allocation is examined and, when required, corrective action is undertaken. Corrective action can take the form of design changes, resource reallocation, target revision, product modification, or O&S policy changes.

5.2.3 Incremental and negligible costs. Life cycle costing can serve as an analytical tool for evaluating investment opportunities. Its use is often initially limited to the evaluation of alternative designs, production methodologies, and logistic support concepts. In this context, costs which are evaluated as being approximately equal for each alternative (i.e. nonincremental in nature) can be considered irrelevant and can be omitted initially from the comparative analyses. Furthermore, negligible costs, or those costs for which the uncertainty of the estimates exceeds the difference in cost among alternatives (particularly those which are difficult to estimate or allocate) can be initially ignored. The resulting estimates can be used to help select among investment alternatives. Once a particular alternative is selected, its total cost can then be estimated; that is, the common costs and costs initially excluded due to uncertainty are added.

5.2.4 Summary. Thus, LCC estimating is a tool for assessing the total resource requirements. As such it can become a valuable input to the decision process for allocating or reallocating resources to maximize utility. Given the constraints every acquisition office experiences, it is ultimately management's ability to judge the relative importance of LCC with other equally important considerations that determine the development characteristics of the acquired equipment or system. The value of life cycle costing as a management technique, as well as the success of its implementation, is entirely dependent upon management's commitment to it.

5.3 The life cycle and relevant costs. It should be kept in mind that in any LCC analysis, interest centers principally on future costs regardless of whether or not they are under the acquisition manager's control. Costs that have been previously incurred or committed are often not relevant to acquisition decisions. However, information on such sunk costs can be useful for comparision or reference purposes. A basic rule to follow when deciding which costs are relevant to the analysis at hand is to address those elements which may change as a result of introducing the proposed product. Since DoD Directive 5000.1 requires that the magnitude and adequacy of acquisition resources be addressed at every milestone, the types of costs delineated in SECNAVINST 7000.14 should be addressed to some extent throughout a program's or project's life. Accordingly, the following paragraphs correlate each of these types of costs to the product's life cycle. Although the types of costs cited are not intended to be inclusive, the acquisition manager can use the following paragraphs to list the major cost drivers (i.e. significant costs that can be influenced by planning and design decisions) applicable to that acquisition. When cost elements are tracked according to funding type or budget appropriation category as is common in many LCC management efforts, the analyst should refer to the "DoD Budget Guidance Manual" and DoD Instruction 7000.2 for assistance. As an aside, it should be noted that not all products have the same proportions in terms of the relative dollar amounts for each phase of their life cycle. For example, for certain products (like mines, torpedoes, missiles, and satellites), the cost for the O&S phase of the life cycle may be far overshadowed by the investment cost. For other products (like aircraft, avionics, and shipboard systems) the reverse relationship may be true. The point to be made is that the question of cost relevancy is unique for each acquisition.

5.3.1 R&D costs. All of the expenses incurred during the concept exploration, demonstration & validation, and full scale development phases of the acquisition which result in the engineering drawings, specifications, and other documents necessary to enter the investment phase of the life cycle are classified as R&D

costs. Research (6.1 appropriation) costs are normally committed prior to acquisition initiation are considered sunk costs and are not relevant costs for life cycle costing purposes. Relevant costs per SECNAVINST 7000.14 and DoD Instruction 5000.33 include expenditures made by the government or the contractor for:

a. costs of WBS elements of system/equipment, system/project management, test and evaluation, training, peculiar support equipment, data, operational/site activation, and industrial facilities (system/project management should be included as a subset of the element system/equipment)

b. other costs as applicable (e.g. specialized equipment, instrumentation, and test facilities required to support the R&D contractor or government installation)

While the above list may not be complete, it is meant to illustrate the types of constituents of R&D cost from a LCC standpoint.

5.3.2 Investment costs. Investment costs are usually incurred during the production & deployment phase. While some investment expenditures can occur during the latter part of the full scale development phase as well as during the early part of the O&S phase, the investment phase is normally synonomous with production & deployment. Dollars benefits for offsets to the investment cost such as residual value and FMS benefits should not be included with investment costs, since this would distort the LCC analysis. This type of benefit should be considered separately. Residual value of general purpose real property should be determined in accordance with OMB Circular A-104. Other costs, per SECNAVINST 7000.14 and DoD Instruction 5000.33, are:

a. costs of WBS elements of system/equipment, system/project management, test and evaluation, training, peculiar support equipment, data, operational/site activation, initial spares and repair parts, common support equipment, and industrial facilities (system/project management should be included as a subset of the element system/equipment)

b. other costs as applicable (e.g. engineering changes, warranties, first destination transportation, and introducing unique repairables into the federal supply inventory)

Costs incurred or committed at the time of the analysis are sunk costs and should not be included when alternatives are compared. However, the imputed value of existing assets to be employed for the acquisition are considered investment costs. This means that if these on hand assets are in use or have an alternative planned use in connection with some other acquisition or operational system or equipment, or are intended for sale, or if their use would result in a cash outlay for some other acquisition which would otherwise not occur, they should be included at their fair market value (as measured by market price, replacement, scrap, resale value, or alternative use).

5.3.3 O&S costs. O&S costs can be the largest component of LCC. All such costs are normally incurred during the O&S phase of the life cycle and consist of personnel, material, and overhead costs used in operating a system or equipment or in providing the services required to support it. O&S costs per SECNAVINST 7000.14 and CAIG O&S cost guidance (e.g. AD A085854) include expenditures such as:

a. personnel costs (including officer, enlisted, civilian, and temporary additional duty pay)

b. O&S consumables (including energy consumption, material, and training expendable stores)

c. direct depot maintenance (including overhaul and repair of common and peculiar equipments and components)

d. sustaining investment (including common and peculiar replenishment spares and equipment, modifications, and software upkeep, and modifications for reliability, maintainability, and safety)

e. other direct costs not included above (e.g. system and inventory management, depot technical support, second destination transportation, calibration, supply system management, yearly federal stock number maintenance for unique repairables, etc.)

f. indirect O&S costs (including the costs of other relevant services, support personnel, and non-investment items that are required during the life of the system or equipment but are not directly relatable to a particular product such as base support, medical, real property upkeep, recruiting, initial training, and upgrade training in support of the weapon system or equipment. Unless these cost elements are relevant to or could be affected by the acquisition decision process, they may be included via standard planning factors or billet cost models)

Although product specific estimates of O&S costs are required by OMB Circular A-109 as a part of the life cycle costing process, such estimates at early milestones are at best mere orders of magnitude rather than accurate estimates. Early O&S estimates made in either the concept exploration or the demonstration & validation phases are highly sensitive to such assumptions as the number and delivery sequence of units which will become operational and the operational scenario planned for these units. Operational policies affect maintenance polices, both of which are manpower dependent. While recent initiatives have made manpower considerations a part of the design tradeoff decisions occurring during the early phases of the acquisition, long term manpower policies which can significantly affect O&S cost are often established independently of the acquisition process. Therefore, an assessment of the most reasonable and realistic manpower estimates should be carefully made. Manpower estimates usually vary significantly during the early phases of the acquisition, and care should be taken to ensure that the latest assessment is used. Long term considerations not only of manpower policies but also of fuel cost (which can be a driving cost in O&S), operational scenarios, etc. tend to change with time. Sensitivity analyses are often used to assess the effect of these long term factors. Even after relative design stability has been attained (i.e. milestone II and production go-ahead) and O&S cost estimates seem to have achieved a relatively higher degree of confidence, sensitivity to such external factors should be addressed. Furthermore, there are two basic considerations for dealing with personnel costs. The first is whether to use manhours or manning levels. The second is whether to use billet costs or pay and allowance. The choice depends upon the LCC objectives and requirements. For example, CAIG recommends basing personnel costs on manning levels and skill categories rather than on the hourly cost, because reducing manhours doesn't necessarily decrease cost even though the reduction may have other benefits (e.g. increased readiness). On the other har [illegible] es are done on a manhour basis (e.g. LORA) and much of the avai [illegible] to reported in terms of manhours (e.g. maintenance manhours and contractor labor rates). Personnel costs should be treated as a step function, and changes in cost only come about through increasing or decreasing the number of people or skill levels. Benefits from manhour savings should be handled separately. Labor rates can be calculated on the basis of pay and allowance or billet costs. Billet costs are higher than personnel pay and allowance rates because a billet cost includes indirect costs (e.g. recruitment costs and retirement benefits). For most analysis the billet cost is the best choice, because normally the indirect costs do not change from alternative to alternative. However, a detailed analysis may necessitate the use of pay and allowance. This implies that the relevant indirect costs are considered elsewhere in the analysis. Since billet cost lumps different appropriations together, funding visibility would require a break-out of the billet cost into pay and allowance plus the various indirect costs.

5.3.4 Disposal costs. At the end of the life cycle the system or equipment is phased out of the inventory. It may be sold or destroyed or used to support some other function (e.g. Navy Reserve). Analysts usually assume that any disposal cost is offset by salvage or resale value. This is a reasonable assumption in many cases, but some products require a more detailed analysis. For example, such items as nuclear products and dangerous chemicals could incur a large disposal cost, and others such as aircraft could be expected to have a resale value.

5.3.5 Excluded costs. Costs should not be excluded from the analysis on the basis of funding source or management control. The Office of the Secretary of Defense (OSD) has identified certain costs which may be excluded from the cost element structure. These can be described generally as fixed costs. Relating principally to the O&S phase, these fixed costs include the pay, allowances, and operating funds associated with the central (host) command functions. Excluded costs tend to be invariant with the size and mix of the deployed forces. For example, such non-Navy costs as family housing and Navy veterans benefits are normally excluded. Sunk costs pertaining to the system or equipment may not be relevant to acquisition decisions. Excluded costs should be examined by the analyst on a case by case basis. For example, an altimeter in an aircraft does not incur operator costs whereas a sonar system aboard a submarine normally does. Displaying zero value cost elements in the cost element structure is a useful way to identify costs judged as negligible but pertinent enough to have been evaluated by the analyst. OSD has prepared a more thorough consideration of which costs to include and which cost to exclude in such guidance material as the "Aircraft Operating and Support Cost Development Guide" (AD A085854).

5.4 Cost element structure. This handbook recognizes that differences among programs and projects (shipboard electronics, avionics, missiles, mines, etc.) and among functions within acquisition offices (budgeting, milestone reviews, source selections, logistics tradeoffs, and design tradeoffs) call for flexibility in developing the cost element structure. Considering these differences, it is difficult to produce a single cost structure for all LCC applications. For example, if the LCC plan called for LCC information to support the PPBS, the cost elements may be structured to budgeting and accounting criteria. If the design function were to be served, a structure composed of cost elements related to product characteristics such as weight or reliability would be necessary to investigate the cost impact of alternative designs. Moreover, there may be a requirement such as a CAIG review. In such cases, reference to appropriate directives, instructions, and organizational guidance establishes the rules for the cost element structure. The general framework of the cost element structure should not change. Rather, within the framework, the cost element structure should be expanded to levels of detail to meet the requirements of the various LCC applications as the acquisition advances through its phases. Thus, consistency can be maintained while allowing visibility and flexibility for the various LCC applications. To sum up, a cost element structure may be imposed as a requirement, or it may be developed by the analyst for a specific purpose. The recommended general framework of the cost element structure would have acquisition costs consistent with MIL-STD-881, and O&S costs according to CAIG guidance. OSD is preparing guidance embodied in the form of a generic cost structure which may be issued as a DoD cost development guide. Until this is available, MIL-STD-881, DoD Directive 5000.4, NAVMAT P5241, and AD A085854 (OSD Aircraft O&S Cost Development Guide) may be used in developing cost element structures. Figure 4 illustrates a sample cost element structure, tabulating costs by cognizant office and funding type. (Note that computer round off procedures cause the individual values to be independent of their totals.)

5.5. Temporal dimension of cost. It is widely recognized that costs occur in a particular pattern over the life cycle. For some purposes, the shape of the pattern is unimportant -- only its subtotals and total matter. For other purposes, i.e. discounting and cost escalation, the shape is crucial. At some point in the acquisition process, it will generally be necessary (see DoD Instruction 5000.2) to construct a time-phasing of estimated costs. (Detailed discussions of price escalation and de-escalation can be found in SECNAVINST 7000.14 as well as in the "Economic Analysis Handbook" NAVFAC P-442.).

5.5.1 Discounting. In economic analyses, the timing of cash flows and the time value of money can significantly influence the evaluation and selection process applicable to mutually exclusive investment decisions. Discounting is an analytic device which recognizes the significance of these factors in determining the present value of future cash flows.

5.5.1.1 Discount rate. Integral to the discounting process is the selection of a discount rate which implicitly reflects the influence of opportunity cost upon the value of fiscal resources. Opportunity cost is the fundamental component of any discount rate. It reflects the alternative benefit which can be derived from an investment opportunity other than the one being considered. The discount rate used within DoD is mandated by the OMB Circular A-94 and DoD Instruction 7041.3 "Economic Analysis Program Evaluation for Resource Management." This mandated rate excludes risk factors and links the government's discount rate to private sector rates of return. Although DoD Instruction 7041.3 mandates the use of a 10% midyear discount rate, it also gives the analyst the option to use other discount rates. Presuming that the funds would not be diverted from the

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GENERAL FUNDING REPORT

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

COST BREAKDOWN STRUCTURE NUMBER	COST BREAKDOWN STRUCTURE ELEMENT		<- - - - - - - - - - GENERAL TYPE OF FUNDING - - - - - - - - - ->						
			RDT&EN	SCN	MCON	O&MN	MPN	OPN	TOTAL
000000	TOTAL LIFE CYCLE COST		79,288	474,743	152,980	508,013	361,331	99,630	1,675,985
100000	RESEARCH & DEVELOPMENT		79,288	0	11,580	5,211	0	0	96,079
110000	CONCEPT EXPLORATION		5,098	0	0	0	0	0	5,098
111000	GOVERNMENT		978	0	0	0	0	0	978
111100	ACQUISITION MANAGEMENT	PROG MGR	515	0	0	0	0	0	515
111200	NAVY LABS	PROG MGR	463	0	0	0	0	0	463
112000	CONCEPT EXPLORATION CONTRACTOR	CONTRACT	4,120	0	0	0	0	0	4,120
120000	DEMONSTRATION & VALIDATION		16,074	0	0	0	0	0	16,074
121000	GOVERNMENT		5,358	0	0	0	0	0	5,358
121100	ACQUISITION MANAGEMENT	PROG MGR	53	0	0	0	0	0	53
121200	NAVY LABS	PROG MGR	5,305	0	0	0	0	0	5,305
122000	DEV CONTRACTOR		10,716	0	0	0	0	0	10,716
122100	TEST HARDWARE	CONTRACT	6,366	0	0	0	0	0	6,366
122200	SYSTEM TEST & EVALUATION	CONTRACT	2,122	0	0	0	0	0	2,122
122300	DATA	CONTRACT	106	0	0	0	0	0	106
122400	PECULIAR SUPPORT EQUIPMENT	CONTRACT	2,122	0	0	0	0	0	2,122
130000	FULL SCALE DEVELOPMENT		58,115	0	11,580	5,211	0	0	74,906
131000	GOVERNMENT		21,969	0	11,580	0	0	0	33,549
131100	ACQUISITION MANAGEMENT	PROG MGR	546	0	0	0	0	0	546
131200	NAVY LABS	CONTRACT	21,313	0	0	0	0	0	21,313
131300	TRAINING	CNET	109	0	0	0	0	0	109
131400	OPERATIONAL/SITE ACTIVATION	NESSEC	0	0	11,580	0	0	0	11,580
132000	FSD CONTRACTOR		36,146	0	0	5,211	0	0	41,357
132100	TEST HARDWARE	CONTRACT	1,093	0	0	0	0	0	1,093
132200	SYSTEM TEST & EVALUATION		3,825	0	0	5,211	0	0	9,036
132210	DEVELOPMENT T&E	CONTRACT	0	0	0	2,316	0	0	2,316
132220	OPERATIONAL T&E	CONTRACT	0	0	0	2,895	0	0	2,895
132230	MOCKUPS	CONTRACT	546	0	0	0	0	0	546
132240	T&E SUPPORT	CONTRACT	546	0	0	0	0	0	546
132250	TEST FACILITIES	CONTRACT	2,732	0	0	0	0	0	2,732
132300	TRAINING	CONTRACT	1,093	0	0	0	0	0	1,093
132400	DATA	CONTRACT	545	0	0	0	0	0	546
132500	PECULIAR SUPPORT EQUIPMENT	CONTRACT	8,744	0	0	0	0	0	8,744
132600	INDUSTRIAL FACILITIES	CONTRACT	20,844	0	0	0	0	0	20,844
200000	INVESTMENT (PRODUCTION & DEPLOYMENT)		0	474,743	141,400	621	0	18,365	635,129
210000	GOVERNMENT		0	127	26,824	621	0	15,978	43,550
211000	ACQUISITION MANAGEMENT	PROG MGR	0	0	0	0	0	634	634
212000	GFE/GFM	PROG MGR	0	0	0	0	0	4,968	4,968
213000	TRAINING	CNET	0	0	0	0	0	2,484	2,484
214000	DATA	PROG MGR	0	127	0	0	0	0	127
215000	COMMON SUPPORT EQUIPMENT	PROG MGR	0	0	0	0	0	7,649	7,649
216000	OPERATIONAL/SITE ACTIVATION		0	0	26,824	0	0	0	26,824
216100	OPERATIONAL SITES	TYPE-CMD	0	0	11,496	0	0	0	11,496
216200	MAINTENANCE SITES	NESSEC	0	0	15,328	0	0	0	15,328

FIGURE 4. Sample LCC management report to illustrate a cost element structure

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GENERAL FUNDING REPORT

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

COST BREAKDOWN STRUCTURE NUMBER	COST BREAKDOWN STRUCTURE ELEMENT		<- - - - - -	- - GENERAL TYPE	OF FUNDING - -	- - - -	- - ->		
			RDT&EN	SCN	MCON	O&MN	MPN	OPN	TOTAL
217000	INITIAL TRAVEL	PROG MGR	0	0	0	248	0	0	248
218000	FIRST DESTINATION TRANSPORTATION	PROG MGR	0	0	0	373	0	0	373
219000	SUPPLY INTRODUCTION	NAVSUP	0	0	0	0	0	243	243
220000	PRODUCTION CONTRACTOR		0	474,616	114,576	0	0	2,387	591,579
221000	PRODUCTION HARDWARE	CONTRACT	0	452,112	0	0	0	0	452,112
222000	TRAINING	CONTRACT	0	0	0	0	0	2,387	2,387
223000	DATA	CONTRACT	0	1,242	0	0	0	0	1,242
224000	PECULIAR SUPPORT EQUIPMENT	CONTRACT	0	12,674	0	0	0	0	12,674
225000	INDUSTRIAL FACILITIES	CONTRACT	0	0	114,576	0	0	0	114,576
226000	INITIAL STOCK LEVELS	CONTRACT	0	2,387	0	0	0	0	2,387
227000	INITIAL SPARES & REPAIR PARTS	CONTRACT	0	3,617	0	0	0	0	3,617
228000	WAR RESERVE SPARES & REPAIR PARTS	CONTRACT	0	2,583	0	0	0	0	2,583
300000	OPERATING & SUPPORT		0	0	0	502,181	361,331	81,265	944,777
310000	PERSONNEL (PAY AND ALLOWANCE)		0	0	0	16,352	342,504	0	358,855
311000	CREW/OPERATORS		0	0	0	0	92,580	0	92,580
311100	OFFICERS	TYPE-CMD	0	0	0	0	19,649	0	19,649
311200	ENLISTED	TYPE-CMD	0	0	0	0	9,824	0	9,824
311300	CIVILIAN	PM(LOG)	0	0	0	0	63,107	0	63,107
312000	MAINTENANCE		0	0	0	14,888	176,726	0	191,613
312100	OFFICERS	TYPE-CMD	0	0	0	0	126,213	0	126,213
312200	ENLISTED	TYPE-CMD	0	0	0	0	50,512	0	50,512
312300	CIVILIAN	PM(LOG)	0	0	0	14,888	0	0	14,888
313000	OTHER		0	0	0	1,464	70,679	0	72,143
313100	OFFICER	TYPE-CMD	0	0	0	0	1,836	0	1,836
313200	ENLISTED	TYPE-CMD	0	0	0	0	68,843	0	68,843
313300	CIVILIAN	PM(LOG)	0	0	0	1,464	0	0	1,464
314000	TEMPORARY (ADDITIONAL) DUTY	PM(LOG)	0	0	0	0	2,520	0	2,520
320000	O&S CONSUMABLES		0	0	0	147,186	0	0	147,186
321000	ENERGY CONSUMPTION		0	0	0	126,162	0	0	126,162
321100	POL	TYPE-CMD	0	0	0	126,162	0	0	126,162
321200	COMMERCIAL POWER	NESSEC	0	0	0	0	0	0	0
321300	NUCLEAR	NESSEC	0	0	0	0	0	0	0
322000	MAINTENANCE MATERIAL	TYPE-CMD	0	0	0	9,012	0	0	9,012
323000	PERSONNEL SUPPORT SUPPLIES	NESSEC	0	0	0	5,282	0	0	5,282
324000	OPERATIONAL MATERIAL	NESSEC	0	0	0	4,703	0	0	4,703
325000	TRAINING EXPENDABLE STORES	NESSEC	0	0	0	2,027	0	0	2,027
330000	DIRECT DEPOT MAINTENANCE		0	0	0	232,130	0	0	232,130
331000	SYSTEM OVERHAUL		0	0	0	51,682	0	0	51,682
331100	LABOR	NESSEC	0	0	0	42,670	0	0	42,670
331200	MATERIAL	NESSEC	0	0	0	9,012	0	0	9,012
332000	COMPONENT REPAIR		0	0	0	180,449	0	0	180,449
332100	ORGANIC (NAVY)		0	0	0	150,224	0	0	150,224
332110	LABOR	NESSEC	0	0	0	149,194	0	0	149,194
332120	MATERIAL	NESSEC	0	0	0	1,030	0	0	1,030
332200	CONTRACTOR		0	0	0	20,000	0	0	20,000

FIGURE 4. Sample LCC management report to illustrate a cost element structure-Continued

DATE 2/25/83 NAVMAT LCC FLEX METHODOLOGY: MIL-HDBK-259(NAVY) EXAMPLE OF A WEAPON SYSTEM LCC

GENERAL FUNDING REPORT

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

COST BREAKDOWN STRUCTURE NUMBER	COST BREAKDOWN STRUCTURE ELEMENT		<- - GENERAL TYPE OF FUNDING - -> RDT&EN	SCN	MCON	O&MN	MPN	OPN	TOTAL
332200	CONTRACTOR	CONTRACT	0	0	0	30,225	0	0	30,225
340000	SUSTAINING INVESTMENTS		0	0	0	8,017	0	81,265	89,282
341000	REPLENISHMENT SPARES	SPCC	0	0	0	0	0	64,056	64,056
342000	MODIFICATIONS		0	0	0	0	0	14,903	14,903
342100	MODIFICATION KITS	PM(LOG)	0	0	0	0	0	14,483	14,483
342200	MODIFICATION INSTALLATION	NESSEC	0	0	0	0	0	420	420
343000	SOFTWARE SUPPORT	PM(LOG)	0	0	0	8,017	0	0	8,017
344000	SUPPORT EQUIPMENT REPLACEMENT	PM(LOG)	0	0	0	0	0	2,307	2,307
350000	CONTRACT UNIT LEVEL SUPPORT		0	0	0	0	6,783	0	6,783
351000	PERSONNEL	CONTRACT	0	0	0	0	6,067	0	6,067
352000	MATERIAL	CONTRACT	0	0	0	0	715	0	715
353000	OTHER	CONTRACT	0	0	0	0	0	0	0
360000	OTHER DIRECT O&S COSTS		0	0	0	55,977	12,045	0	68,022
361000	INTERMEDIATE MAINTENANCE FACILITIES		0	0	0	3,692	0	0	3,692
361100	SHOP SPACE	NESSEC	0	0	0	2,556	0	0	2,556
361200	INVENTORY STORAGE ← SEE FIGURE 11 FOR EXAMPLE OF ANALYSIS DOCUMENTATION	NESSEC	0	0	0	682	0	0	682
361300	SITE MAINTENANCE	NAVFAC	0	0	0	454	0	0	454
362000	TRAINING		0	0	0	18,177	0	0	18,177
362100	O/I MAINTENANCE	CNET	0	0	0	1,934	0	0	1,934
362200	DEPOT MAINTENANCE	CNET	0	0	0	1,813	0	0	1,813
362300	CREW	CNET	0	0	0	14,430	0	0	14,430
363000	DOCUMENTATION MAINTENANCE	PM(LOG)	0	0	0	11,621	0	0	11,621
364000	SUPPLY SYSTEM MANAGEMENT	NAVSUP	0	0	0	11,260	0	0	11,260
365000	SECOND DESTINATION TRANSPORTATION	NESSEC	0	0	0	11,227	0	0	11,227
366000	TECHNICAL DEPOT SUPPORT	NESSEC	0	0	0	0	8,519	0	8,519
367000	MAINTENANCE OF TRAINERS & SIMULATORS	PM(LOG)	0	0	0	0	3,525	0	3,525
370000	INDIRECT O&S COSTS		0	0	0	42,519	0	0	42,519
371000	INSTALLATION SUPPORT PERSONNEL		0	0	0	23,988	0	0	23,988
371100	BASE OPERATING SUPPORT	NAVALSTA	0	0	0	20,173	0	0	20,173
371200	MEDICAL & DENTAL PERSONNEL	NAVALSTA	0	0	0	3,815	0	0	3,815
372000	INDIRECT PERSONNEL SUPPORT		0	0	0	11,568	0	0	11,568
372100	BASE OPERATIONS & MAINTENANCE	NAVALSTA	0	0	0	3,253	0	0	3,253
372200	MEDICAL O&M	NAVALSTA	0	0	0	5,191	0	0	5,191
372300	PERMANENT CHANGE OF STATION	NAVALSTA	0	0	0	3,124	0	0	3,124
373000	PERSONNEL ACQUISITION & TRAINING		0	0	0	6,963	0	0	6,963
373100	ACQUISITION	NAVALSTA	0	0	0	5,064	0	0	5,064
373200	INDIVIDUAL ENTRY TRAINING	NAVALSTA	0	0	0	1,899	0	0	1,899
600000	DISPOSAL-ASSUMED EQUAL TO SALVAGE VALUE	PM(LOG)	0	0	0	0	0	0	0

FIGURE 4. Sample LCC management report to illustrate a cost element structure–Continued

private sector unless the acquisition being considered was at least as productive as the average private sector alternatives, the OMB Circular A-94 discount rate represents an estimate of the average private sector rate of return before taxes and after inflation.

5.5.1.2 Summary. Discounting in theory can serve as an effective device for determining the cash flow scenario which achieves the lowest LCC. Once the optimum timing of fiscal resource requirements has been determined, the undiscounted value of these requirements can be used as one of a number of inputs to budget estimating evolutions. The reader should be aware of the controversial nature of the subject of discounting and that historically within DoD there has been no unanimously agreed-to constituents of the discount rate, nor the rate to be used under a given set of circumstances. One significant reason for this is that within DoD much of the emphasis in cost analysis has been the determination of estimated fiscal requirements for alternatives, given a specific time-phasing of events. This time-phasing has included use of DoD approved inflation and expenditure rates, but not a discount rate as such. Another factor is that its use may tend to distort the procurement decisions in favor of deferral instead of the, admittedly subjective, criteria for replacement now and improvement later. In those cases where the discount rate may make a difference in the ranking of alternatives, the question of the appropriate discount rate should be faced and specialized assistance should be sought by the acquisition manager from the financial community. In general, it is only reasonable to discount where alternatives have differing expenditure patterns. To get around using an absolute discount rate, the analyst should determine which rate would change the ranking of alternatives. Then, the appropriate discount rate is left to the decision maker.

5.5.2 An illustration. The following serves as a simplified example of the acquisition evaluation process described above including, in an elementary way, the effect of discounting. Three types of investment opportunities exist within this imaginary program: modify system A, develop new system B, or buy existing system C. These are mutually exclusive investment alternatives. The operational requirement, which could be supported by any one of the three alternatives, is anticipated to be valid for the next thirty years, the time period of the analysis. The following scenario applies:

a. Existing weapon system A will be retired in 10 years unless modified to extend its useful life. The current system costs $50 million per year to operate and support. Modification of the system will extend its useful life by 20 years at a cost of $500 million. Modification costs will be evenly distributed over the next two years and will not change the annual O&S cost.

b. An alternative to modifying system A is the development and fielding of replacement system B. Development and production costs will amount to $800 million and will be evenly distributed over an 8 year period beginning in two years. Beginning in the eleventh year, O&S costs will be $20 million per year. At the end of system B's 20 year life, it will have a disposal cost of $40 million.

c. Another alternative involves replacing system A with system C. System C will be purchased off-the-shelf at an expenditure rate of $300 million per year for three years starting eight years from now. Once again, O&S costs will be $20 million per year starting in the eleventh year. At the end of system C's 20 year life, it will have a disposal cost of $60 million.

5.5.2.1 The analysis. On the sole basis of the undiscounted acquisition cost of each alternative, the modification of system A appears to be the least costly alternative. The modification effort requires an expenditure of $500 million compared to the acquisition price of $800 million and $900 million respectively. When the acquisition cost, the O&S costs, and the disposal cost of each alternative are considered in a LCC context, system B appears to be the least costly alternative. On an undiscounted basis, system B involves a cash outflow of $1740 million while systems A and C experience cash flows of $2000 million and $1860 million respectively. So far, the timing of cash flows and the time value of money has not been considered. As was discussed in paragraph 5.5.1.1 the concept of discounting is, at best, controversial and its use should be carefully assessed. However, as an elementary way to demonstrate one possible effect of its use, it is being included in the example. (A midyear discount rate of 10% will be used in the following analysis to illustrate the significance of this factor.) To aid in this analysis, the example has been prepared to depict how expenditures, applicable to each alternative, are sequenced. The following example illustrates how the timing of these expenditures affect the net present values of the three alternatives and the investment decision process. Dollars are expressed in millions. (Constant dollars have been used in the example for simplicity and to aid in comparisons.)

1. Modify system A:

Net present value of $250 m expended each year in years 1 and 2 on modification work	$455.2m
Net present value of $50 m expended in years 1 through 30 for current and modified system operation and support	$494.6m
Total net present value	$949.8m

2. Develop system B:

Net present value of $100m expended each year in years 3 through 10 to develop and produce hardware	$462.6m
Net present value of $50m expended in years 1 through 10 for current system operation and support	$322.4m
Net present value of $20m expended in years 11 through 30 for new system operation and support	$68.9m

Net present value of $40m disposal cost in year 30 . . . . $2.4m

Total new present value $856.3m

3. Procure system C:

Net present value of $300m expended each year in years 8, 9, and 10 to procure hardware $401.7m

Net present value of $50m expended in years 1 through 10 for current system operation and support. . . $322.4m

Net present value of $20m expended in years 11 through 30 for new system operation and support. $68.9m

Net present value of $60m disposal cost in year 30 . . . .$3.6m

Total net present value $796.6m

5.5.2.2 Summary analysis. Without discounting to represent the significance of the time value of money and the s‹ encing of cash flows, the least costly alternative (i.e. system B at $1740M) would be selected. The asterisked figures in the following matrix illustrate how the selection of the least costly alternative would have varied according to the three analytic techniques described above.

	CONSTANT YEAR DOLLARS Acquisition Cost only	CONSTANT YEAR DOLLARS Acquisition, Operating/Support & Disposal Cost	DISCOUNTED DOLLARS Acquisition, Operating/Support & Disposal Cost
SYSTEM A	**$500m**	$2000m	$949.8m
SYSTEM B	$800m	**$1740m**	$856.3m
SYSTEM C	$900m	$1860m	**$796.6m**

5.5.3 Constant versus then-year dollars. Cost estimates made in a given year, i.e. those which have not been adjusted to reflect inflation, are called constant dollar estimates. However, while constant dollar estimates are unaffected by future price level changes, they include the effect of price level changes up to the base year whenever costs prior to the base year are included. Constant dollars are treated as equivalent in purchasing power regardless of the timing of such expenditures. The use of constant dollars as an economic technique for evaluating investment alternatives is logical and procedurally simple. Therefore, as a first step, the comparison of alternatives should be made ignoring general price level changes caused by monetary phenomena like changing values of money. In the final analysis, however, financial plans should be expressed in dollars which reflect the expectations about future price levels. Dollars which account for the influence of monetary phenomena, such as inflation, are referred to as then-year dollars. (For more information on constant and then-year dollars see SECNAVINST 7000.14.)

5.5.4 Summary. Regardless of the theory and controversy surrounding time value of money analysis, most acquisition reviews require costs displayed in one or more of four types of dollars and the LCC analyst should have the capability and understanding to escalate and de-escalate costs in these terms:

a. constant dollars of the base year - comparisons may be made of the original estimate in base year dollars with the current estimate in base year dollars (e.g. SAR and DTC). For example, DTC contractual goals are established during the R&D phase of the life cycle for a given unit in production, in a given constant year dollar. Actuals, adjusted to the constant year dollars, are tracked to determine if the goal is reached.

b. constant dollars of the current fiscal year - normally, LCC analyses are prepared in constant fiscal year dollars and continually updated to reflect the best available information. The resulting costs are described as being in constant dollars of the current fiscal year. This type of dollar is used, for example, in CAIG reviews.

c. discounted constant dollars - whatever may be said about discounting, the analyst may find it necessary to present results in discounted dollars. Normally, discounting is done on constant dollars, but it is conceivable that investigations of the effect of discounting on then-year dollars may be requested of the analyst, because different categories of costs (see below then-year dollars) escalate at different rates.

d. then-year (inflated) dollars - for LCC to support in-house funding projections, POM submissions, the five year defense program (FYDP), and the extended planning annex it may become necessary for the analyst to use the OSD inflation tables and the acquisition's expenditure pattern to project then-year costs. For this to be practical the cost element structure should be able to provide a cross-walk to budget appropriations, i.e. research, development, test and evaluation (RDT&EN), military construction (MCON), procurement, operation and maintenance (O&MN), and military personnel (MPN) as well as fuel cost and civilian pay. Tradeoffs in terms of then-year dollars are also possible. For example, the analyst may investigate the effect on budget planning of compressed or expanded production schedules.

Ordinarily, an ongoing LCC management effort is based upon current senario, design, and logistics information which directly provides costs in terms of constant dollars of the current fiscal year. These costs can be escalated as necessary using indices provided by the OSD Comptroller or de-escalated by using the actual prior year inflation rates.

5.6 Use of LCC models. Cost models are one of the principal devices for estimating LCC. Cost models are step-by-step procedures for calculating cost estimates. They are automated or manual tools for estimating the LCC of systems or equipment. They are either general purpose or acquisition specific analytical mechanisms for estimating costs based upon inputs which are either probabilistic or deterministic in nature. Regardless of their composition, it is important that potential users of these models understand not only the nature and characteristics of such models but also their intended use. Models should be viewed as useful tools rather than constraints within which management actions take place.

5.6.1 Types of models. There are a number of different cost models which can contribute to the estimation of LCC. They address, in varying degrees of complexity, some aspects of LCC. To provide a better understanding of the variety of cost estimating models which are available, the following is a partial list of general cost models:

a. economic analysis model - considers the time value of money, specific acquisition schedule, and tradeoff analyses between cost and the timing of investment.

b. accounting model - aggregates the individual costs, including personnel and material costs, into the total system or equipment LCC.

c. cost factors - determines factors for key parameters based upon the cost experience of analogous systems, subsystems, or equipment and uses these factors to estimate cost elements.

d. cost estimating relationship (CER) model - statistically derives equations relating cost to a product's design, performance, operating, and logistics characteristics.

e. logistic support cost simulation model - determines impact of operational maintenance, provisioning, and resource allocation options on support cost via computer similation.

f. LORA model - determines the optimum maintenance process for a specific product based upon maintenance plan options.

g. reliability improvement cost model - specifies the mathematical relationship between cost and product reliability tradeoffs.

h. inventory management model - determines the optimum provisioning levels for a specific system or equipment based upon cost and operational readiness constraints.

i. maintenance personnel planning model - evaluates the effect on cost of various maintenance personnel options or the effect on maintenance personnel requirements of product design alternatives.

j. warranty model - evaluates the cost comparability of organic maintenance concepts versus contractor warranty maintenance options.

Although cost models in general are excellent tools for evaluating a variety of acquisition related decision issues, including subsets of the LCC itself, some models which involve the total LCC can be complex and difficult to effectively update or tailor. The analysis of specific sub-level issues requires models which are narrower in scope and easier to use. As a result, it is recommended that the acquisition office not use general purpose total LCC models which are oriented to a wide range of acquisition related decision issues and equipments or which require extensive, nonroutine input data without first understanding the model's limitations and second considering the possibility of tailoring or modifying specific aspects of the model. It is recognized, however, that the cost of developing special purpose models generally precipitates the adaptation of existing general purpose models for use in a new acquisition. This being the case, acquisition personnel, particularly the product technical specialists as well as the cost analysts, should become actively involved in the modification, development, and use of cost models. Through this interaction the acquisition office can ensure that LCC models incorporate the design and performance characteristics which facilitate the analysis of expected decision issues.

5.6.2 Model characteristics. For a LCC model to be useful in analyzing specific decision issues, certain characteristics should be incorporated, to some extent, in the model design. The following list is provided for use by the analyst in developing or evaluating LCC models.

a. The model should be useful to the acquisition management process as well as to the review process. The application of the model to day-to-day decision making is an important consideration. Consequently, the model should be responsive to management control factors, design changes, and varied operational scenarios (e.g. reliability, maintainability, manpower, operating tempo, funding types, funding claimants, and sponsors).

b. All significant cost drivers which are relevant to the issue under consideration should be incorporated into the model as clearly as possible.

c. The development, alteration, updating, and operation of a model should be as inexpensive as possible. Documentation should be readily available and clearly written and understandable for each model.

d. The model should be easy to operate by either designers or acquisition office personnel, i.e. it should be user oriented and not require programmer support.

e. The model should be sensitive to design parameters or acquisition characteristics which affect the cost of investment alternatives.

f. Valid, relevant input data should be readily available.

g. The model should be flexible, capable of accommodating the growing complexity of an acquisition, and it should allow for the adjustment of inflation, discounting, and learning curve factors.

h. The model should be separated into interactive modules for easier modification.

i. Inputs and outputs should be expressed in terms which are familiar to users and which can be verified to ensure credibility.

j. Outputs should be reliable, i.e. results should be repeatable.

Regardless of its ultimate design, the model should be capable of assisting the analyst in the following manner, as a minimum:

k. compare and evaluate alternative investment options or strategies

l. identify areas and degrees of uncertainty

m. conduct sensitivity analysis

n. analyze and track the acquisition effort on a total life cycle basis

NAVMAT has published the "User's Guide for Naval Material Command's Life Cycle Cost (FLEX) Model" (AD A115622) and computer tape (AD A115621) to satisfy the above criteria. This LCC methodology was developed (through eight years of feedback from users in government and industry) to provide a general purpose computerized methodology which can be easily tailored by the user to a particular application. The HARDMAN LCC modeling effort (OP 112C), on the other hand, is preparing special purpose LCC models for specific applications (e.g. a LCC computer model for shipboard digital electronics has been published and one for avionics is being prepared). ELEX 82B has developed a LCC computer model for NAVELEX applications. In addition, there are proprietary LCC computer models available commercially as well as models developed by other services and agencies.

5.6.3 Validity of LCC estimates. In the context of this handbook, the validity of the estimate means to minimize the application of a bias. The use of LCC models can obviously precipitate erroneous decisions if care is not taken to properly interpret and evaluate the LCC related input data, the methodology, and the results. From a LCC standpoint, the potential for biased estimating can be significantly reduced by:

a. specifying the LCC model against which the potential contractor's data will be applied

b. specifying uniform data requirements for all potential contractors

c. recognizing the limitations of the LCC model

d. understanding the accuracy of data bases and data inputs

e. understanding how acquisition resource constraints affect model useage and data validity

f. imposing LCC discipline upon the acquisition office and its contractors as early in the concept exploration phase as possible

5.7 Cost estimating techniques and applicability. Paragraph 5.3 outlined the range of costs which may be incurred within each phase of the life cycle. Differences in the composition of such costs and the availability of the cost data (see paragraph 5.9) necessitates the use of a variety of cost estimating techniques throughout the acquisition process. There are three general techniques for estimating costs: analogy, parametric, and the engineering estimate, plus an extension of these techniques -- the projection of actuals. Each of these methods contain varying degrees of applicability to each of the life cycle phases. Ideally, the different techniques can be used independently or interactively in all life cycle phases. While the methods do complement one another as the equipment matures and as the system evolves, the degree of product refinement (be it for an entire system or merely a component of one) determines the applicability of technique. In general, analogy and parametric are most useful during the early stages of a product's life, serving as an order-of-magnitude estimate of the potential costs. As the design stabilizes and more information becomes available, parametric cost estimating becomes a more useful technique. Later, when the detailed product design has occurred and specific tasking requirements can be levied, engineering estimates and the projection of actuals may become a more appropriate device for estimating cost. Regardless of the techniques selected to estimate LCC, the results will be more reliable if the acquisition office develops a cost element structure for the acquisition effort as discussed in paragraph 5.4. Obviously, the degree of detail achievable for a cost breakdown is dependent upon the amount and quality of the information available to the acquisition office. Consequently, the complexity and detail of the cost element structure varies with time. In establishing a cost element structure the degree of detail applicable to it and the costing criteria associated with it should be consistently applied to all alternatives being considered.

5.7.1 Analogy. This technique relates the cost of a current acquisition or alternative acquisition under consideration to that of similar previous acquisitions. The method may be applied either to an entire acquisition or to its components. Its use depends upon the feasibility or viability of correlating the configuration or functional characteristics between the previous efforts and the presently considered efforts. Based upon a comparative analysis of an acquisition (or its components), the actual historical costs of previous acquisitions are adjusted to compensate for inflation and differences in technology, geography, configuration, specifications, operational environment, quantities, and schedule. The accuracy of these calculations depends upon an ability to perceive the acquisition differences and to properly allocate the acquisition costs. Since a comparative analysis can involve components from totally unrelated systems, subsystems are often further subdivided to facilitate use of the analogy method. The system being acquired is subdivided in a manner which corresponds with the subsystem or component structure of previously acquired products. Differences between the products are analyzed and an estimate is made of the effect these differences will have on historical cost data. Estimates by analogy are easy to relate to and are, therefore, easy to understand. While such cost estimates are applicable to all life cycle phases, the following paragraphs discuss, in general terms, the use of analogy to calculate the relevant costs encountered within each phase of the life cycle:

5.7.1.1 R&D cost. Analogy is the easiest technique for estimating R&D costs when little product specific information or preparatory work is available. When historical cost data for similar systems or components can be obtained and factored to account for the differences in technology or approach, analogous costing can be used. Care must be exercised to ensure that the effect of technological or state-of-the-art advances are adequately accounted for. However, since it involves subjective judgement, it is not as preferred as parametric estimating.

5.7.1.2 Investment cost. For the production & deployment phase costs, estimates by analogy are preferred when the investment costs for a similar product constitute the most reliable cost basis available. In that event, the differences between the cost elements of previous production efforts and the current effort should be analyzed and, where applicable, adjusted.

5.7.1.3 O&S cost. Since O&S costs can be the largest portion of product related costs, the analogy technique provides an excellent device for estimating the recurring costs whenever specific product related O&S costs are not known. Although the estimation of O&S cost is an uncertain process, the uncertainty can be reduced by comparing the proposed deployment patterns, maintenance procedures, provisioning plans, training requirements, and support equipment requirements with those of fielded products. The efficacy this technique improves when similar facilities and manpower resources are required to operate and support the analogous products. Although scaling might be required, aggregated cost data relevant to the O&S phase of similar products is available. It is generally less subjective in nature than other types of historical cost. However, perhaps the most significant present day factor is assessing the effect of changes in the technological sophistication of products. This can significantly affect the maintenance support (e.g. micro-circuit maintenance capability) and should be carefully factored into the support equipment, training, and personnel cost estimates.

5.7.2 Parametric. This method of estimating is based upon a relationship between some variable characteristic and the cost of a product. These explanatory variables can relate physical attributes (e.g. weight, volume, and dimension), or performance characteristics (e.g. speed, power, thrust, range, and MTBF) to cost; they can even relate other cost elements to cost. While such a CER can be expressed non-mathematically, they are generally expressed in linear or non-linear mathematical forms. Wherever possible, mathematical equations should be used to facilitate cost estimation. Simple examples of CERs involve such ratios as dollars per pound, dollars per ton, dollars per square foot, dollars per unit of volume, dollars per mile of range, or dollars per maintenance action. It offers the acquisition manager a valuable method for cost estimating. Since limited acquisition specific information is available in the early stages of a new product's life cycle, the parametric technique is of great value. Parametric estimating should be based upon historical data. Caution should be exercised to make sure the historical data is applicable to the product being analyzed. An excellent source of historical data on production costs is the CCDR. DoD Instruction 7000.11 established a requirement for such cost data reporting on certain contracts. (This is a primary data source for indpendent cost estimates by CAIG.) For technically unique items, much of the existing historical data base may be inappropriate, making parametric costing impractical. Once aware of the advantages and disadvantages associated with parametric cost estimating, the analyst can employ the technique not only during the concept exploration and demonstration & validation phases of the acquisition, but during all phases. The use of parametric costing for computing the relevant costs for each phase of the life cycle follows:

5.7.2.1 R&D cost. Parametric costing is the most efficient way of calculating this type of cost. R&D costs should be estimated based on historical data as a function of the physical attributes or performance characteristics. This may be difficult when dealing with small historical data samples. If R&D costs become a function of unique design processes, uniquely tailored test events, and the like, they generally are not amenable to parametric costing. Although CERs may be useful for evaluating the sensitivity of cost to design changes (e.g. frequency, operational requirements, range, etc.), the cost of developing and updating such CERs may be high when compared with the incremental value of the resulting information. The use of CERs relating variables such as physical characteristics or performance factors to R&D cost is primarily seen where the sample size is sufficiently large.

5.7.2.2 Investment cost. Parametric methods can be used to estimate various types of investment costs, including manufacturing, tooling, and quality control. Depending on the availability of data, it has application to estimating raw material, purchased parts, and purchased equipment costs as well. Parametrically, for investment costs, material and overhead costs can often be assumed to have some proportional relationship to the direct labor required for a specific task. Consequently, the total cost of production can be correlated to the sum of direct labor costs required to support a production effort. While the degree of correlation is unique to and will vary with each task, this fundamental relationship sometimes makes possible the estimation of investment costs by CERs. (In October 1980, a report entitled, "Overhead Cost and Rates in the U.S. Defense Industrial Base" (AD A091963) was completed under an Office of Naval Research contract. Since the purpose of this project was to establish analytical benchmarks and techniques for Navy acquisition managers, it serves as one of the data sources which are available for use by acquisition offices or their analysts in conducting parametric calculations of investment cost.) Depending upon the industry, direct labor can be calculated as either a function of the product's weight or volume, the density of electronic components, or the amount of machining required. (The direct labor cost for military equipment is usually based upon product weight.) Refinement of this elementary costing technique addresses such factors as the production quantity, performance criteria, production schedule, and electronic complexity. Although many industrial organizations have developed CERs applicable to a specific corporate environment, they are frequently proprietary in nature.

5.7.2.3 O&S cost. The estimation of operating, logistics, and other support costs with parametric relationships is a particularly difficult task. Parametric O&S costing can be a viable technique during the later stages of the full scale development phase when the contractor has been able to collect preliminary data relevant to component failure rates, repair costs, and other logistics related parameters for engineering models or early operational models. However, when an acquisition is in its earlier phases, parametric costing of O&S is difficult at best. Parametric relationships for O&S which correlate to the type of generic design parameters employed during the early engineering and design phases are essentially nonexistent. Compounding this problem is the lack of an effective data collection process for accumulating and aggregating the historical O&S costs of major weapon systems. Elaborate techniques exist for collecting data on such sublevel items as part demand rates, maintenance actions, and other logistics factors, but these discrete methods support specific logistic management functions which do not provide an interactive data base for deriving CERs. However, the availability of Visibility and Management of Operating and Support Cost (VAMOSC) data has begun to alleviate this problem. The Naval Air Logistics Center (NALC-04B3) and SEA 01732V for the Naval Sea Systems Command (NAVSEA) are responsive to VAMOSC related matters.

5.7.3 Engineering estimate. In contrast to the analogy and parametric techniques which estimate acquisition costs in a "top down", holistic manner, engineering estimates are "bottom up" estimates which synthesize the detailed costs associated with each part of the acquisition. It is the most detailed way of estimating costs. Material, labor, direct, and overhead costs, as well as profit, are treated as individual cost elements affecting the acquisition cost. Estimates for these cost elements are generally derived from historical data bases which can also be used to definitize the interrelationships of LCC elements inherent in an acquisition effort. Data requirements differ from either the analogy or parametric estimating techniques in that detailed estimates are normally derived for specific types of labor and material. In this case, the design details and the expected value of material and labor are used to estimate costs. Since the total production quantity is known, or can be estimated, the resulting cost estimates tend to be more detailed than those from either analogy or the parametric estimating methods. The primary advantage engineering estimating has over other methods discussed is that it makes the cost of particular details visible. The technique can thus be applied independently to various parts, components, subsystems or phases of the acquisition effort. Estimates derived in this manner are more conducive to sensitivity analysis. The incorporation of expert opinion at the cost element level makes the estimate of R&D and investment costs easier but introduces subjectivity. A major encumbrance to the use of the engineering technique is that the requirements for detailed information can make it a more costly and time consuming process than either analogy or parametric costing. Also, it has for many purposes been found to be less accurate than estimates made statistically. The whole often turns out to be less than the sum of the parts; engineering estimates tend to be optimistic, assuming away the setbacks that are normally encountered during an acquisition. Although it has equal applicability to all phases of the life cycle, the potential of this technique for developing budget quality estimates make it a particularly valuable tool for estimating costs after the demonstration & validation phase. A brief discussion regarding the use of engineering estimates for computing the relevant costs for each life cycle phase follows:

5.7.3.1 R&D cost. R&D costs are composed of non-recurring costs to design and develop and recurring costs to produce test hardware. Whenever it is feasible to clearly describe the development tasks which will be assigned an organization, engineering estimates derived by these organizational entities can be a method for estimating R&D costs. These estimates should be derived from an initial tasking which delineates such things as performance specifications, data requirements, test criteria, training (required to support prototype development, operations, and support), and a preliminary work schedule. The sum of the task oriented estimates prepared by each organization represents the total estimated R&D cost.

5.7.3.2 Investment cost. As with R&D cost, the itemized estimates of task oriented costs are summed and represent the total estimate of investment costs.

Estimates are usually based upon cost data derived from previous efforts which are adapted for application to the current task. Although in principle this is quite similar to the analogy estimating technique for investment cost, this method is much more detailed. For example, the direct labor hours applicable to certain assembly and testing operations can be calculated on the basis of the standard hours estimated to perform these operations, realization rates, and learning curves. Quality assurance hours can be estimated as a percentage of the direct fabrication hours. Other types of direct labor can also be estimated such as engineering support and testing. Production overhead costs, which can comprise a significant portion of the final cost estimate, can be estimated separately, based in part on historical performance and forecasted workload. In addition, miscellaneous costs (which are generally considered recurring in nature and include overtime, general and administrative cost, and profit) should be included. While the sum of component and material costs, direct labor costs, other direct labor costs, overhead costs, and other miscellaneous recurring costs represent, as accurately as possible, the estimate of recurring investment costs, the total investment cost should also include engineering estimates of major nonrecurring costs such as initial training, acceptance and field qualification testing, first destination transportation, and initial facilitization.

5.7.3.3 O&S cost. O&S cost estimating requires an understanding of the various methods of employment, maintenance, and logistics. The determination of O&S costs is an iterative process which should be based upon an operation plan (delineating operation, integration, operational environment, force composition, deployment schedule, use, and personnel requirements). During the concept exploration and demonstration & validation phases, only a preliminary ILSP is normally prepared. During these phases engineering estimates have little or no relevance. Although the actual design, fabrication, and testing of hardware begins to occur during the latter stages of the demonstration & validation phase, it is not until the full scale development phase that the scope of such work can be definitized to the extent that engineering estimating becomes a practical cost estimating technique. Therefore, the use of O&S engineering estimating should occur in the full scale development and production & deployment phases.

5.7.4 Projection of actuals. Near the end of the R&D phase of the life cycle, the characteristics of the product and its operating scenario become known in detail. By this time the design has solidified as developmental and production prototypes and, possibly, pilot production models. The best source of information for many cost elements becomes this 'actual' data (i.e. the description of current product characteristics). For example, reliability and maintainability performance has been indicated by test and evaluation; weights and costs of replacable items are reasonably well known; training requirements are firmed-up; and skill levels, maintenance requirements, and manhour rates are well defined. Some elements of production cost may be reported periodically via CCDRs. Using CCDR data adjusted to constant dollars, projections can be made via learning curve techniques to make estimates of the production cost. Many procurements have the requirement to submit CCDRs (see DoD Instruction 7000.11). The analyst should use actuals as they become available, because they are often the most credible source of information.

5.7.5 Summary. Each of these techniques has its own advantages and disadvantages. Analogy is useful when few similar systems or equipment are available for comparison. Parametric can be the most accurate prior to actuals but requires a proper data base and careful application. Engineering estimates provide useful detail but do not usually account for engineering changes and redesign where analogy and parametric estimates normally do. Projection of actuals provides the most confidence, but this information is not available until the latter phases of the acquisition. As has been described above, the selection of a cost estimating technique depends upon many factors. The most critical of these factors is the level of detailed data which is available at the time an estimate is prepared. As indicated, the amount and quality of detailed information about an acquisition effort increases as the undertaking progresses through the life cycle. As more information becomes available, the use of more detailed estimating techniques becomes more practical. For example, at milestone I a statistical CER may be the best method to use. However, at milestone II better information allows some cost elements to be developed by engineering analysis. Generally, by the production review, design sensitive parameters should be developed by engineering analysis to address the issues normally raised at this review. Finally, as information on actuals becomes available, analytical projection techniques may be employed at detailed levels of the cost element structure. Since estimation by analogy or the use of parametrics is normally less costly than the more detailed engineering estimation technique, it is important for the acquisition office to decide whether the more detailed estimate is worth the higher cost. The intended use of the estimate should be the primary decision variable in this regard. However, the acquisition office should recognize that more detailed estimating techniques do not necessarily provide more accurate estimates. The accuracy and scope of the information upon which estimates are based have a more profound effect on the accuracy of an estimate than does the technique. In concluding this topic, it is necessary to recognize that no LCC estimate is based entirely upon one estimating technique. Practically speaking, cost estimates are a combination of the techniques discussed above.

5.8 Treatment of uncertainty. Any description of future events or circumstances is speculative and inherently uncertain; but to perform a LCC analysis, the product under investigation should have an adequate description of such aspects as design, manufacture, testing, training, delivery, deployment, operation, and support. These descriptions are made through the complementary steps of formulating assumptions and performing uncertainty analysis. Both of these actions are important to the integrity of the LCC analysis. Those aspects of the acquisition which have the greatest effect on cost (major cost drivers) or on the ranking of alternatives should receive the most analytical attention in terms of the adequacy of the assumptions and the thoroughness of the uncertainty analysis. Refer to DoD Instruction 7041.3, AD 728481, and AD A085854 for more information on the treatment of uncertainty.

5.8.1 Assumptions. The assumptions used either explicitly or implicitly to obtain cost estimates have a significant effect on the LCC estimate. Explicit and valid assumptions are critical to the usefulness and acceptance of an analysis. Therefore, assumptions should be critically examined at the beginning and reviewed throughout the course of the analysis for consistency, acceptability, and applicability. Justification and documentation are a necessary part of making assumptions explicit (see paragraph 5.10.5).

5.8.2 Uncertainty analysis. There are as many ways to treat cost uncertainty, and there are as many sources of uncertainty, as there are methods for estimating costs. Uncertainty analysis is especially important with respect to large acquisition cost elements such as unit production cost, and to important O&S cost contributors such as personnel and depot maintenance. In the very early stages of product development (when uncertainty is greatest) it should at least be possible to bound a most likely estimate with a high and low variant. The high and low estimates should preferably reflect actual cost experience with other systems or equipment or be based on the outcome of certain events or policy decisions rather than being arbitrary percentage adjustments to the orginal estimate. As the effort proceeds further into the acquisition phases, more thorough uncertainty analysis should be possible. Description of uncertainty as a probability distribution (often subjectively derived) is a widely and effectively used practice. Interpretation of the cost estimates is facilitated by a narrative explanation of factors contributing to its uncertainty. When there is a direct relationship between a cost element and a product parameter which itself is uncertain, examination of the cost consequences of various plausible values of the parameter (i.e. sensitivity analysis) can be quite useful. In summary, a LCC analysis is simply incomplete if no attention is paid to uncertainty analysis. Numerical descriptions of uncertainty should not be treated as precise mathematical measurements.

5.9 Data availability. Data is usually scarce and incomplete during the early stages of development. Here the analyst should rely on expert opinion and investigations of similar systems or equipment. As the design matures, the quality and extent of information improves. Engineering estimates may become practical and actual values should begin to replace estimates. Given sufficient resources the analyst should be able to obtain useable LCC data in any phase of the product's life cycle.

5.9.1 Concept exploration phase data. Early in the acquisition detailed information on system or equipment characterisitics and costs is not available. However, information may be developed from previous studies, associated documents, and investigations of similar systems or equipment (see example in paragraph 5.10.1). Some of these sources are:

a. logistics cost data guides (e.g. AD A084170)
b. cost and planning manuals (e.g. DCA Circular 600-60-1)
c. Navy Fleet Maintenance Support Office reports
d. Aviation Supply Office commercial repair contract data
e. Ships Parts Control Center data
f. Naval Air Rework Facility repair and replacement cost file
g. VAMOSC data (see paragraph 5.7.2.3)
h. Navy training plans
i. billet cost models (OP 112C)
j. LCC factors and data (OP 112C)
k. logistics data (e.g. AIR-4111)

Advance planning information and senario data is usually available from these documents even early in the R&D phase:

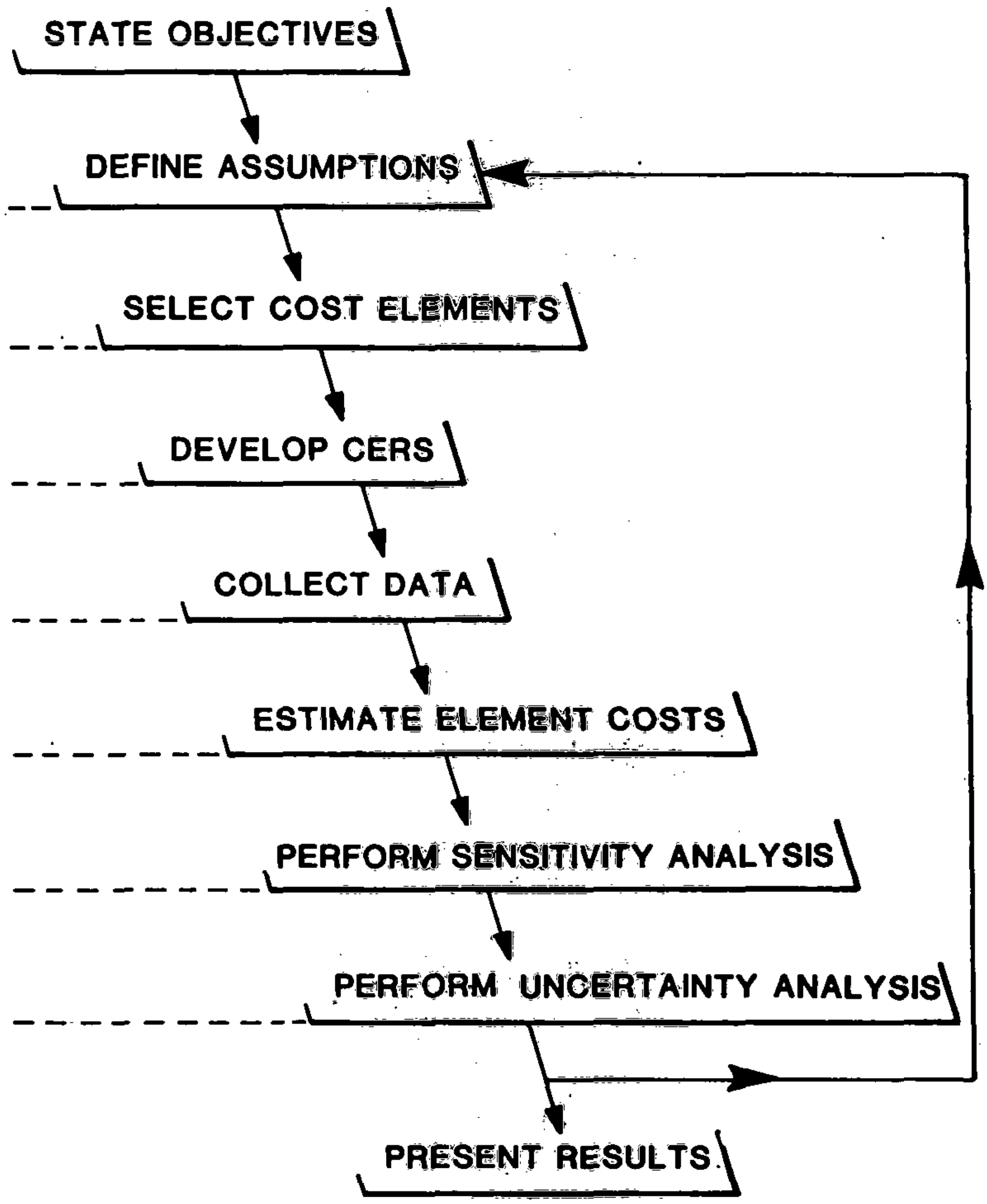
l. equipment planning document for manpower, personnel, and training
m. decision coordinating paper (DCP)
n. justification for major system new starts (JMSNS)
o. integrated program summary
p. acquisition strategy
q. ˉ (see DoD Instruction 7000.3)

5.9.2 Hardware data. During the production & hardware stage (from demonstration & validation or full scale development through deployment) the contractor develops product performance data in a WBS format (see MIL-STD-881). This information would include indentured item costs and logistic information which should be documented in the logistic support analysis record (LSAR) performed in accordance with MIL-STD-1388. LCC related data may be found in the following sources:

a. LORA (in accordance with MIL-STD-1390)
b. ILSP
c. reliability test
d. maintainability test
e. LSAR (in accordance with MIL-STD-1388)
f. CPR (see DoD Instruction 7000.10)
g. CCDR
h. validation test
i. development test and evaluation
j. operational test and evaluation
k. certification for service use
l. production acceptance test and evaluation
m. bid sheets
n. overhead and labor rate projections (Bureau of Labor Statistics)
o. contract price data
p. source selection reviews

5.10 Analysis procedures. Figure 5 shows the typical actions taken in performing an LCC analysis. Although presented as a serial process, these actions in practice overlap and interrelate. These are general procedures for performing a baseline LCC analysis. Special cases, such as collecting and estimating costs for an analogous product or performing tradeoff studies, may omit some of the steps illustrated. LCC planning, as discussed in paragraph 5.2.1, will determine the basic framework of the LCC effort, including the major alternatives to consider and the amount of resources available to perform the work. The analyst's first step is to use the LCC planning information to produce a set of objectives by considering such factors as the number of alternatives to be addressed, data inadequacies, schedule and manpower limitations, degree of accuracy required, degree of documentation and justification required, and the unknowns involved in how to model some aspects of the problem. To efficiently and effectively state LCC objectives, the analyst depends on experience gained through conducting similar investigations as well as knowledge of the military environment and operational procedures.

5.10.1 Definition and execution. The analyst should select an approach appropriate to the the LCC objectives. The analyst should consider the intended use of the results and to what degree they require treatment of uncertainty. The given assumptions should be made explicit and evaluated for their criticality, for



NOTE: It is important that these steps be documented

FIGURE 5. LCC analysis procedures

their effect on the uncertainty of the results, and to ensure consistency with other assumptions to be made by the analyst. Major assumptions usually concern the length of the usage period, the quantity and timing of systems or equipment deployed, the operational concept, and the support concept. For equipment these assumptions are usually predetermined by system level planning. The selection of cost elements is discussed in paragraph 5.4. Table I lists some of the techniques available to the analyst as aids in treating the data collected and in estimating costs. The level of effort, the available analytical resources, and the importance of the analysis determine the extent of usage of these analysis techniques.

TABLE I. Associated analysis techniques and aids.

life cycle cost-benefit analysis	regression analysis
cost estimating relationships	decision-risk analysis
cost estimating	sensitivity analysis
modeling	statistical inference
operations research	Monte Carlo method
parametric cost analysis	Delphi technique
discounting	logistic support analysis
present value analysis	level of repair analysis
engineering cost estimating	critical path method

Data collection is an important part of the procedure and is generally the most time consuming. A simplified example of data collection follows:

Example: LCC data is required for an O&S cost profile of an operational avionics equipment, the AN/ARN-84 Tacan set for the A-6 weapon system, which is similar to a new equipment design, the AN/ARN-().

Step 1. Refer to the NAVAIR 01-85AD8 Work Unit Code Manual and find the unique code for the AN/ARN-84 which is "713CO".

Step 2. Refer to the Navy Maintenance Support Office aviation reports. Under the code "713CO" the analyst will find:

- equipment unit cost
- repair/discard procedure
- total flight hours
- total maintenance actions
- organizational level repair actions
- mean flight hours before failure
- unscheduled maintenance manhours
- manhours per maintenance action

Step 3. Collect an adequate sample of VAMOSC data for the subject equipment on the A-6 weapon system. The following information can be obtained for the AN/ARN-84:

organizational level labor rate
intermediate level labor rate
total cost of maintenance for the reporting period
organizational level repair cost
intermediate level repair cost
depot level maintenance repair cost
material cost
mean flight hours before failure
manhours per maintenance action
depot labor rate
Naval Air Rework Facility
commercial repair cost

Step 4. Refer to the Aircraft Program Data File. This source provides the initial year of deployment, the total number of A-6 aircraft deployed per year, and the number of land based and sea based squadrons.

Step 5. Refer to the Navy Training Plan covering the AN/ARN-84 for the number and skill levels of the operators and maintenance personnel.

Step 6. Refer to the AN/ARN-84 ILSP. This gives information on:

maintenance plan
level of repair
equipment shipping weight and size
areas of deployment
inventory control point
equipment configuration
logistic support manager
procedures for transporation to and from repair points
available documentation
name and location of manufacturers
software, spares, and quantities
consumables required

The amount of data collected above serves as an illustration of the extent and depth of LCC information currently available to the analyst.

5.10.2 Evaluation. The purpose of this part of the analysis is to ensure that there is sufficient basis for judging the reliability of the LCC analysis results. At this point the cost elements and their constituent parameters can be seen in the context of the total LCC, and the effect of individual uncertainties on the total LCC can be addressed. Sensitivity analysis is a useful technique in separating those uncertainties associated with major cost drivers from the uncertainties which have little effect on the results, i.e. where reasonable variations would not change the ranking of alternatives. Having thus identified the areas of concern, the analyst should apply uncertainty analysis techniques to the necessary depth (see paragraph 5.8.2). Among the analytical tools available to the analyst, the most frequently used are "a fortiori", contingency, statistical uncertainty, and decision-risk analysis. In addition to the uncertainties associated with design requirements and cost estimating methods, the analyst should not omit considerations of uncertainty in such areas as production rates, deployment schedules, operating rates, support concepts, and political and economic factors which may affect the acquisition.

5.10.3 Results. The results of a LCC analysis are unique to the specific situation or question which the analysis was meant to address. Therefore, care should be taken not to use these numbers out of context. The analytical results (which are normally numeric cost values in tabular form) should be viewed as information for the managerial decision process, not as an end in themselves. Whether the results are used for futher studies (such as cost-effectiveness analysis) or for management decisions (such as selecting a source for procurement), the contextual sensitivity of the numbers should be recognized. Since LCC analyses can become complex in terms of the detail in the cost element structure and in the size of the data base, there can be many ways to classify the results. This handbook gives examples of some of the many ways results can be displayed. In addition to the previous examples (shown in figures 2, 3, and 4), the following examples (see figures 6, 7, 8, 9, and 10) illustrate the variety of LCC output reports which can be useful to the LCC management effort in classifying and tracking important aspects of the acquisition. LCC results should be tailored for the end-user, i.e. they should be summarized or expanded depending on who is viewing them and for what purpose. Format and documentation of the results are parts of the analysis which are discussed in the following two paragraphs.

5.10.4 Format. Requirements for LCC analysis are numerous and depend on the characteristics of a particular acquisition (see paragraph 4.3). Some of the more important ones arise in connection with acquisition review boards, LRGs, SARs, ASUs, and budget backup data. Some (like CAIG) have formal specifications, others may have informal ones. Some require time-phased cost, some require cost by appropriation, some require prior year (sunk) cost, some require total LCC and others only partial. Therefore, it is not practical to recommend one standard format to meet all requirements. Normally, format and documentation requirements are given in the instructions (e.g. DoD Instruction 5000.2) establishing the program reviews. The analyst should use the resources and guidance of the appropriate office of the cognizant Systems Command in answering questions of format and documentation.

5.10.5 Documentation. Properly documented LCC estimates can be understood, verified, and independently reproduced. At various stages in the acquisition process, certain cost elements are more important than others. They should be given special attention in regard to documentation. It is particularly important that the source of each estimate be reported. When estimating is done by newly-developed statistical (parametric) equations, the underlying data base should be documented, variables carefully defined, statistical measures reported, and other analytical procedures discussed. If statistical equations were taken from the cost analysis literature, the sources should be cited. When the estimate is done by analogy, percentages, or cost factors, the underlying rationale should be explained. Other estimation approaches should be documented at an equivalent level of thoroughness. Figure 11 is a simplified example of analysis documentation. For more information on format and documentation refer to DoD Directive 5000.4 and DoD Instruction 5000.2.

5.11 Analysis review. Section 4 of this handbook discusses LCC from the point of view of the acquisition manager, emphasizing how tradeoff studies and LCC management techniques (in the context of benefit and effectiveness considerations)

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ANNUAL COST BY FUNDING TYPE

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

<- - - - - - - - FUNDING TYPE - - - - - - - ->

YEAR	RDT&EN	SCN	MCON	O&MN	MPN	OPN	TOTAL
FY80	5,098	0	0	0	0	0	5,098
FY81	16,076	0	0	0	0	0	16,074
FY82	58,115	0	11,580	5,211	0	0	74,906
FY83	0	3,826	64,672	146	0	3,042	71,686
FY84	0	111,927	67,348	3,955	7,578	6,450	197,258
FY85	0	115,077	9,380	7,224	8,331	5,819	145,831
FY86	0	119,717	0	10,890	9,295	5,198	145,099
FY87	0	124,196	0	14,603	10,396	5,271	154,465
FY88	0	0	0	15,645	10,904	3,959	30,508
FY89	0	0	0	16,432	10,638	4,117	31,187
FY90	0	0	0	17,351	11,167	4,281	32,800
FY91	0	0	0	18,246	11,720	4,454	34,420
FY92	0	0	0	15,795	12,316	3,050	31,162
FY93	0	0	0	22,499	12,930	3,173	38,602
FY94	0	0	0	23,624	13,577	3,299	40,500
FY95	0	0	0	24,805	14,256	3,975	43,036
FY96	0	0	0	30,078	14,967	3,974	49,019
FY97	0	0	0	24,383	15,738	4,133	44,234
FY98	0	0	0	25,599	16,502	4,298	46,399
FY99	0	0	0	26,875	17,325	3,834	48,034
FY00	0	0	0	28,222	18,193	3,988	50,404
FY01	0	0	0	29,630	19,101	4,147	52,879
FY02	0	0	0	31,119	20,061	4,314	55,494
FY03	0	0	0	32,260	21,060	4,485	57,805
FY04	0	0	0	32,533	22,112	4,665	59,310
FY05	0	0	0	25,102	21,445	2,772	49,319
FY06	0	0	0	16,795	21,297	1,730	39,821
FY07	0	0	0	8,992	20,434	1,200	30,626
TOTAL	79,288	474,743	152,980	508,013	361,331	99,630	1,675,985

FIGURE 6. Sample LCC management funding report

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SUMMARY

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

COG. OFFICE	R & D (COST ELEMENT)	INVESTMENT (COST ELEMENT)	O&S (COST ELEMENT)	DISPOSAL (COST ELEMENT)	COG. OFFICE TOTAL
PROG MGR	6,883	13,998	0	0	20,881
% COGNIZANT OFFICE TOTAL	33.0	67.0	0.0	0.0	100.0
% OF COST ELEMENT TOTAL	7.2	2.2	0.0	0.0	1.2
NAVALSTA	0	0	42,519	0	42,519
% COGNIZANT OFFICE TOTAL	0.0	0.0	100.0	0.0	100.0
% OF COST ELEMENT TOTAL	0.0	0.0	4.5	0.0	2.5
CONTRACT	77,507	591,579	37,008	0	706,093
% COGNIZANT OFFICE TOTAL	11.0	83.8	5.2	0.0	100.0
% OF COST ELEMENT TOTAL	80.7	93.1	3.9	0.0	42.1
NESSEC	11,580	15,328	237,321	0	264,229
% COGNIZANT OFFICE TOTAL	4.4	5.8	89.8	0.0	100.0
% OF COST ELEMENT TOTAL	12.1	2.4	25.1	0.0	15.8
CNET	109	2,484	18,177	0	20,771
% COGNIZANT OFFICE TOTAL	0.5	12.0	87.5	0.0	100.0
% OF COST ELEMENT TOTAL	0.1	0.4	1.9	0.0	1.2
SPCC	0	0	64,056	0	64,056
% COGNIZANT OFFICE TOTAL	0.0	0.0	100.0	0.0	100.0
% OF COST ELEMENT TOTAL	0.0	0.0	6.8	0.0	3.8
TYPE-CMD	0	11,496	412,051	0	423,547
% COGNIZANT OFFICE TOTAL	0.0	2.7	97.3	0.0	100.0
% OF COST ELEMENT TOTAL	0.0	1.8	43.6	0.0	25.3
NAVSUP	0	243	11,260	0	11,503
% COGNIZANT OFFICE TOTAL	0.0	2.1	97.9	0.0	100.0
% OF COST ELEMENT TOTAL	0.0	0.0	1.2	0.0	0.7
NAVFAC	0	0	454	0	454
% COGNIZANT OFFICE TOTAL	0.0	0.0	100.0	0.0	100.0
% OF COST ELEMENT TOTAL	0.0	0.0	0.0	0.0	0.0
RM(LOG)	0	0	121,931	0	121,931
% COGNIZANT OFFICE TOTAL	0.0	0.0	100.0	0.0	100.0
% OF COST ELEMENT TOTAL	0.0	0.0	12.9	0.0	7.3
COST ELEMENT TOTAL	96,079	635,129	944,777	0	1,675,985
% OF LIFE CYCLE COST	5.7	37.9	56.4	0.0	100.0

FIGURE 7. Sample LCC management summary report

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ANNUAL COST BY COGNIZANT OFFICE

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

< - COGNIZANT OFFICE - >

YEAR	PROG MGR	NAVALSTA	CONTRACT	NESSEC	CNET	SPCC	TYPE-CMD	NAVSUP	NAVFAC	PM(LOG)	TOTAL
FY80	978	0	4,120	0	0	0	0	0	0	0	5,098
FY81	5,358	0	10,716	0	0	0	0	0	0	0	16,074
FY82	546	0	62,670	11,580	109	0	0	0	0	0	74,906
FY83	1,457	0	61,132	4,864	585	0	3,648	0	0	0	71,686
FY84	3,949	868	172,981	5,577	737	608	9,928	333	10	2,266	197,258
FY85	4,205	998	117,909	6,080	985	1,265	11,791	174	11	2,594	145,831
FY86	2,954	1,133	124,097	1,023	1,084	1,777	9,740	295	11	2,984	145,099
FY87	1,533	1,292	100,271	1,369	601	2,396	11,957	354	12	4,679	154,465
FY88	0	1,357	6,396	1,488	631	2,490	12,556	372	12	5,209	30,508
FY89	0	1,425	6,7[illegible]	1,557	663	2,590	13,187	391	13	4,642	31,187
FY90	0	1,496	3[illegible]	5,072	781	2,693	13,843	410	14	4,858	32,880
FY91	0	1,571	[illegible]	8,940	821	2,802	14,539	431	14	5,087	34,428
FY92	0	1,650	[illegible]	8,851	862	1,332	12,439	453	15	5,326	31,162
FY93	0	1,732	24[illegible]	15,208	905	1,386	13,059	475	16	5,575	38,602
FY94	0	1,819	258	15,968	958	1,441	13,711	499	17	5,837	40,500
FY95	0	1,910	271	16,766	998	1,498	14,397	524	17	6,654	43,036
FY96	0	1,937	284	18,205	1,047	3,409	18,554	550	18	5,014	49,019
FY97	0	2,034	298	11,915	1,100	3,545	19,485	578	19	5,260	44,234
FY98	0	2,135	313	12,509	1,155	3,687	20,457	606	20	5,516	46,399
FY99	0	2,242	329	13,132	1,212	3,834	21,477	637	21	5,150	48,034
FY00	0	2,354	345	13,791	1,273	3,988	22,553	669	22	5,408	50,404
FY01	0	2,472	363	14,479	1,337	4,147	23,678	702	23	5,678	52,879
FY02	0	2,596	381	15,[illegible]	1,404	4,314	24,868	737	25	5,963	55,494
FY03	0	2,725	400	15,[illegible]	1,864	4,485	26,107	774	26	6,260	57,805
FY04	0	2,302	420	16,[illegible]1	474	4,665	27,410	677	27	6,573	59,310
FY05	0	2,205	441	13,228	71	2,772	24,379	482	28	5,736	49,319
FY06	0	1,437	429	9,392	0	1,730	21,647	261	30	4,894	39,821
FY07	0	827	216	6,318	0	1,200	18,136	137	31	4,767	30,626
TOTAL	20,881	42,819	786,093	264,229	20,771	64,056	423,547	11,803	484	121,931	1,675,985

FIGURE 8. Sample LCC management report for total cost responsibility

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ANNUAL COST BY COST CATEGORY :PM(LOG)

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

< - - - - - - - - - - - - - COST CATEGORY - - - - - - - - - - - - - >

YEAR	INDIRECT O&S COSTS	PROGRAM MANAGEMENT	TESTING	PRIME EQUIPMENT	TRAINING	SUPPLY SUPPORT	TECHNICAL DATA	SUPPORT EQUIPMENT	OPERATION	MAINTEN-ANCE	TOTAL
FY80	0	0	0	0	0	0	0	0	0	0	0
FY81	0	0	0	0	0	0	0	0	0	0	0
FY82	0	0	0	0	0	0	0	0	0	0	0
FY83	0	0	0	0	0	0	0	0	0	0	0
FY84	0	0	0	0	0	0	77	638	0	1,552	2,266
FY85	0	0	0	0	0	0	161	670	0	1,764	2,594
FY86	0	0	0	0	0	0	281	703	0	2,000	2,984
FY87	0	0	0	1,369	0	0	369	738	0	2,202	4,679
FY88	0	0	0	1,423	0	0	388	775	310	2,313	5,209
FY89	0	0	0	1,480	0	0	407	0	326	2,429	4,642
FY90	0	0	0	1,539	0	0	427	0	342	2,550	4,858
FY91	0	0	0	1,601	0	0	449	0	359	2,678	5,087
FY92	0	0	0	1,665	0	0	471	0	377	2,812	5,326
FY93	0	0	0	1,732	0	0	495	0	396	2,952	5,575
FY94	0	0	0	1,801	0	0	520	0	416	3,100	5,837
FY95	0	0	0	1,873	0	0	546	0	980	3,255	6,654
FY96	0	0	0	0	0	0	573	0	1,023	3,418	5,014
FY97	0	0	0	0	0	0	602	0	1,069	3,589	5,260
FY98	0	0	0	0	0	0	632	0	1,116	3,768	5,516
FY99	0	0	0	0	0	0	663	0	531	3,956	5,150
FY00	0	0	0	0	0	0	696	0	557	4,154	5,408
FY01	0	0	0	0	0	0	731	0	585	4,361	5,678
FY02	0	0	0	0	0	0	768	0	614	4,581	5,963
FY03	0	0	0	0	0	0	806	0	645	4,809	6,260
FY04	0	0	0	0	0	0	846	0	677	5,049	6,573
FY05	0	0	0	0	0	0	711	0	0	5,025	5,736
FY06	0	0	0	0	0	0	0	0	0	4,894	4,894
FY07	0	0	0	0	0	0	0	0	0	4,767	4,767
TOTAL	0	0	0	14,483	0	0	11,621	3,525	10,324	81,978	121,931

FIGURE 9. Sample LCC management report for tracking responsibility in detail

DATE 8/25/83 NAVMAT LCC FLEX METHODOLOGY: MIL-HDBK-259(NAVY) EXAMPLE OF A WEAPON SYSTEM LCC

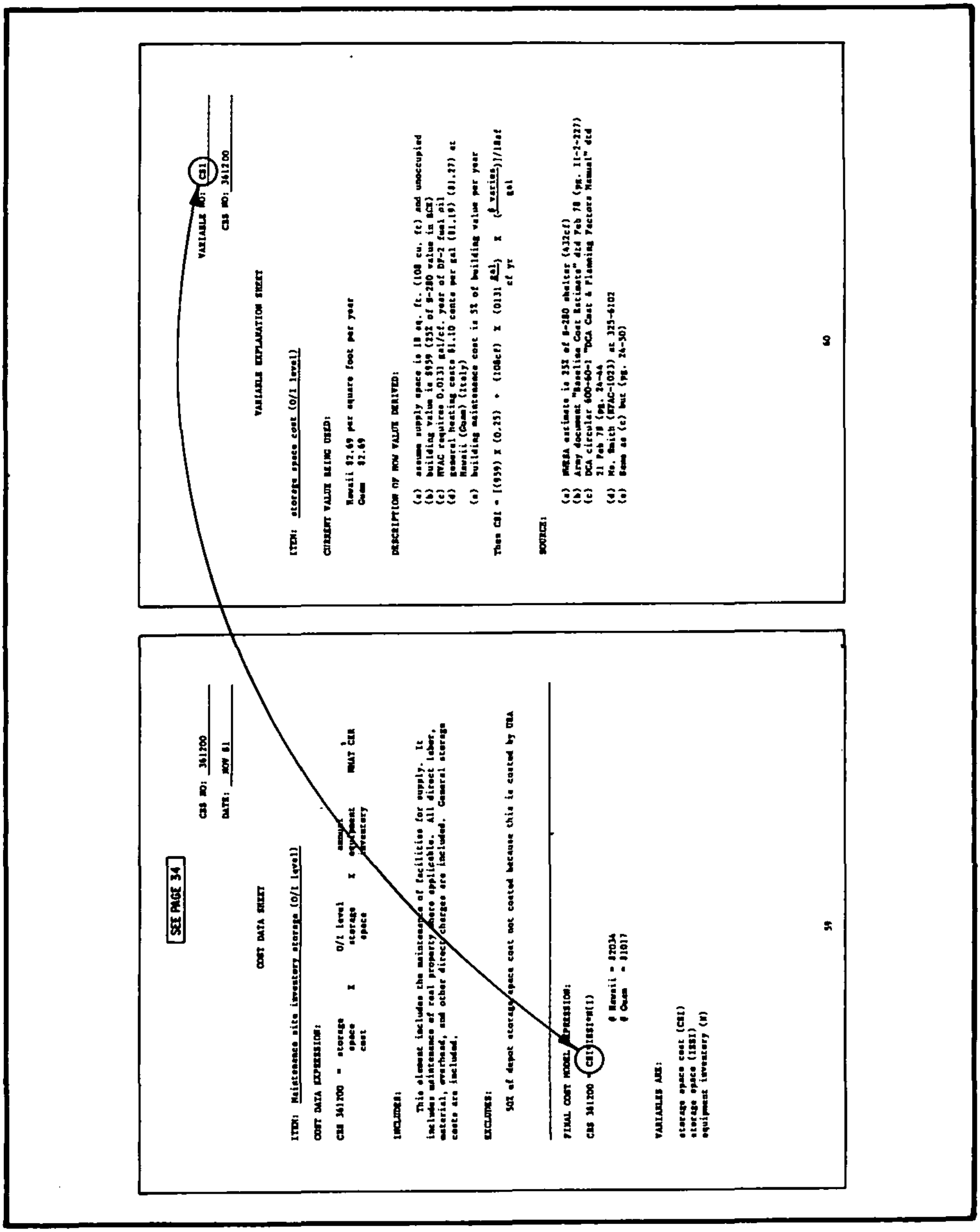
ANNUAL COST BY COST CATEGORY

$$$ COSTS IN THOUSAND DOLLARS $$$ *****BASE YEAR=FY80 ,INFLATED DOLLARS*****

- - - - - - - - - - - - - - - - COST CATEGORY - - - - - - - - - - - - - - - -

YEAR	INDIRECT O&S COSTS	PROGRAM MANAGEMENT	TESTING	PRIME EQUIPMENT	TRAINING	SUPPLY SUPPORT	TECHNICAL DATA	SUPPORT EQUIPMENT	OPERATION	MAINTEN-ANCE	TOTAL
FY80	0	978	0	4,120	0	0	0	0	0	0	5,098
FY81	0	7,480	0	6,366	0	0	106	2,122	0	0	16,074
FY82	0	21,390	8,490	1,639	22,516	0	546	8,744	11,580	0	74,906
FY83	0	57,505	0	88	1,755	1,170	316	2,340	3,648	4,864	71,686
FY84	868	59,816	0	106,579	1,954	3,619	405	5,506	9,418	9,094	197,258
FY85	998	1,455	0	110,782	905	2,957	502	5,730	11,118	11,384	145,831
FY86	1,133	1,513	0	115,249	1,084	3,651	637	4,651	8,775	8,406	145,099
FY87	1,292	137	0	121,156	601	4,393	397	4,845	10,526	11,117	154,465
FY88	1,357	0	0	1,469	631	2,862	388	775	11,364	11,661	30,508
FY89	1,425	0	0	1,527	663	2,981	407	0	11,935	12,248	31,187
FY90	1,496	0	0	1,588	781	3,104	427	0	12,529	12,874	32,800
FY91	1,571	0	0	1,652	821	3,233	449	0	13,159	13,543	34,428
FY92	1,650	0	0	1,718	862	1,785	471	0	11,846	13,629	31,162
FY93	1,732	0	0	1,787	905	1,861	495	0	11,596	20,225	38,602
FY94	1,819	0	0	1,859	950	1,940	520	0	12,176	21,236	40,580
FY95	1,910	0	0	1,933	998	2,022	546	0	13,328	22,259	43,036
FY96	1,937	0	0	0	1,047	3,959	573	0	17,346	24,157	49,019
FY97	2,034	0	0	0	1,100	4,123	602	0	18,211	18,165	44,234
FY98	2,135	0	0	0	1,155	4,294	632	0	19,113	19,070	46,399
FY99	2,242	0	0	0	1,212	4,471	663	0	19,424	20,021	48,034
FY00	2,354	0	0	0	1,273	4,657	696	0	20,398	21,025	50,404
FY01	2,472	0	0	0	1,337	4,849	731	0	21,416	22,074	52,079
FY02	2,596	0	0	0	1,404	5,051	768	0	22,492	23,183	55,494
FY03	2,725	0	0	0	1,064	5,259	806	0	23,612	24,338	57,805
FY04	2,302	0	0	0	474	5,343	846	0	24,791	25,553	59,310
FY05	2,205	0	0	0	71	3,234	711	0	22,124	20,974	49,319
FY06	1,437	0	0	0	0	1,991	0	0	19,698	16,695	39,821
FY07	827	0	0	0	0	1,337	0	0	17,117	11,345	30,626
TOTAL	42,519	150,275	8,490	479,513	45,564	84,146	13,642	34,714	397,939	419,181	1,675,985

FIGURE 10. Sample LCC management report for tracking special categories



SEE PAGE 34

CBS NO: 361200

DATE: NOV 81

COST DATA SHEET

ITEM: Maintenance site inventory storage (O/I level)

COST DATA EXPRESSION:

CBS 361200 = storage space cost X O/I level storage space X annual equipment inventory WHAT CER

INCLUDES:

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

EXCLUDES:

50% of depot storage space cost not costed because this is costed by USA

FINAL COST MODEL EXPRESSION:

CBS 361200 = CSI*ISSI*N(I)

$ Hawaii = $2034
$ Guam = $1017

VARIABLES ARE:

storage space cost (CSI)
storage space (ISSI)
equipment inventory (N)

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VARIABLE NO: CSI

CBS NO: 361200

VARIABLE EXPLANATION SHEET

ITEM: storage space cost (O/I level)

CURRENT VALUE BEING USED:

Hawaii $2.69 per square foot per year
Guam $2.69

DESCRIPTION OF HOW VALUE DERIVED:

(a) assume supply space is 18 sq. ft. (108 cu. fc) and unoccupied
(b) building value is $959 (25% of S-280 value in ACX)
(c) HVAC requires 0.0131 gal/cf. year of DF-2 fuel oil
(d) general heating costs $1.10 cents per gal ($1.19) ($1.27) at Hawaii (Guam) (Italy)
(e) building maintenance cost is 5% of building value per year

Then CSI = [(959) X (0.25) + (108cf) X (0131 gal/cf yr) X ($ varies/gal)]/18sf

SOURCE:

(a) NWESA estimate is 25% of S-280 shelter (432cf)
(b) Army document "Baseline Cost Estimate" dtd Feb 78 (pg. II-2-227)
(c) DCA circular 600-60-1 "DCA Cost & Planning Factors Manual" dtd 21 Feb 78 (pg. 24-44
(d) Ms. Smith (NFAC-1023) at 325-6102
(e) Same as (c) but (pg. 24-30)

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FIGURE 11. Example of analysis documentation

can be a powerful tool in controlling and possibly reducing the total cost of a product. Section 5 addresses the implementation of LCC from the point of view of the LCC analyst, providing basic guidance on some of the procedures and techniques which are important to understanding the fundamentals of LCC analysis as conducted within the acquisition management office. A third point of view is that of the reviewer, i.e. the LCC analyst whose function as an outsider is to check for objectivity and validity in the acquisition's LCC process. A brief discussion of some of the more common traps and pitfalls which can cause difficulties for the reviewer would help the LCC analyst avoid such situations and improve the integrity of the analytical work. Areas where problems could arise are:

a. Validity of the acquisition office's assumptions and soundness of their cost element structure. Information generated within an acquisition office might be biased to present a more favorable picture of the acquisition. It is sometimes difficult for the analyst to get unbiased information from the contractor or fror 'he analyst's own acquisition office.

b. Commonality and pecularity considerati with respect to learning curve assumptions, i.e. how the subject prod is similar to and different from analogous systems or equipment.

c. Contractor accounting procedures and de .nitions of recurring and non-recurring cost might vary to mask inves'ment costs.

d. Evaluation and applicability of cost overruns on similar acquisitions should be considered.

e. Instability of joint service acquisitions should be recognized, i.e. if one participant cancels or changes quantities, the unit cost of the product changes.

f. Quantity and schedule changes might happen -- the analyst should address these uncertainties.

g. Acquisition office's use of management reserve, advance procurement funding, and engineering change orders to budget for uncertainty may be hidden or explicit.

h. Need to make simplifying assumptions because of time or resource constraints on the LCC effort.

i. Lack of uniformity in categorizing har' rocurement support costs. Definitions might be used ina, ...iv to the acquisition office's advantage. The analyst shoul take care that procurement support cost is properly included.

j. When development and production procede concurrently, risk and uncertainty increase.

k. OSD inflation rates might have an unrealistic effect on the LCC estimate. If then-year (inflated) dollars are required, the analyst should address the realism of the mandated inflation rates and consider applying sensitivity analysis.

l. Inappropriate cost element structure, i.e. sometimes key parts are left out or, conversly, too much detail is included.

m. Inadequate description of the life cycle, especially of the latter phases.

n. Inappropriate use of relative and absolute costing approaches. Relative costs are appropriate for comparisons but not for budget or projection usage.

o. Use of obsolete data in high technology areas, e.g. digital products and software.

p. Too much emphasis on cost vice other resource demands, e.g. focusing on manpower cost when the real problem is exceeding the supply of certain skill levels.

q. Inadequate attention to those aspects of a problem which are controllable, e.g. comparing alternative logistic support options when, for some reason other than cost, a logistic support senario has already been dictated.

r. Lack of conformity in LCC methodologies among different contractors and vendors participating in the same acquisition.

5.12 Summary. This handbook assumes some prior knowledge and understanding of the many disciplines associated with the acquisition, operation, and support of systems and equipment, e.g. acquisition management, logistic support, procurement, budgeting, economic analysis, and computer programming. Since LCC is a broad subject, a successful management effort would make the fullest use of outside resources to augment in-house capability. Information available to the acquisition manager and the LCC analyst includes material such as manuals, guides, handbooks, and computer models (e.g. LCC-1, LCC-2, LCC-3, DCA Circular 600-60-1, DoD 4100.33H, NAVMAT P5242, NAVMAT P9494, AD 728481, AD 901477L, and AD A115622). The manager and the analyst can profit from the experience of other acquisitions by adapting their models, techniques, lessons learned, and data collecting methods to fit the present situation. Case studies are available which describe the implementation of LCC in acquisition management (e.g. AD A114767 "Report on the Navy Life Cycle Cost Model for the SEA NYMPH Project" which describes the design, development, and application of the NAVMAT LCC methodology to a large military electronic equipment acquisition). There are also dedicated cost analysts and estimating staffs in NAVMAT, NAVAIR, NAVELEX, and NAVSEA which can provide professional assistance on LCC matters. Cost terminology, cost analysis, cost estimating methods, relevant and defensible cost data sources, and computer models can be a problem separately and together, and they constitute a dynamic, changing environment which requires knowledgable and experienced cost analysts to assist the acquisition manager. The manager should know these staffs are available and should develop a sense of when to call on their assistance. Finally, it should be stressed that there are important points which need fuller development and more detailed study before the analyst has sufficient knowledge to conduct a thorough LCC investigation. Among these are: application of learning curves; treatment of disposal cost and salvage value; unequal lives and residual value; sunk cost and imputed value; audit and control procedures for LCC estimating; conduct and management of LCC tradeoffs; understanding and use of reliability and maintainability information; inflation and the effect of expanded and compressed schedules; support and test equipment considerations; risk and uncertainty analysis and models; legal implications of cost and safety tradeoffs; and discounting. Reference to advanced treatment of LCC is recommended. Several excellent textbooks on LCC are available commercially as well as detailed guidance prepared by the other services (these are in addition to the documents listed in section 2). Short training courses in LCC are commonly and widely offered by local universities, continuing education programs, private industry, and various government organizations. With formal training so readily available those interested in life cycle costing are encouraged to take advantage of it.

Custodian:
Navy - AS

Review activities
Navy - AS, OS, SH, EC, SA, YD

Preparing activity
Navy - AS

(Project MISC-NDOB)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-HDBK-259 (NAVY)	LIFE CYCLE COST IN NAVY ACQUISITIONS

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)*: ______

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a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

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