NOT MEASUREMENT SENSITIVE

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MILITARY HANDBOOK

DESIGN TO COST

AMSC N/A

FSC MISC

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FOREWORD

1. This military handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Missile Command, ATTN: AMSMI-RD-SE-TD-ST, Redstone Arsenal, AL 35898-5270, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) at the end of this document or by letter.

3. This document supplements the material contained in MIL-STD-337, Design to Cost, and provides basic information on design to cost techniques and procedures that may be used by requiring organization when imposing that standard and its related data item descriptions and by performing organizations when complying with that standard and its related data item descriptions.

CONTENTS

CONTENTS

CONTENTS

CONTENTS

1. INTRODUCTION

1.1 General. Affordable and cost effective weapon systems are achieved by optimally balancing cost, performance, schedule, and supportability goals. By highlighting acquisition and operations and support (O&S) cost goals during the design process, the program manager can expect a design configuration that meets stated cost goals while fulfilling performance, supportability, and schedule requirements. Design to Cost (DTC) is one of many management tools used to achieve these results. It has been used by the Department of Defense since 1971 and by private industry long before that.

The success of any cost control effort depends primarily on management's support. The Government and contractor program managers (PMs) should control cost in the same way other design parameters are controlled (i.e., with a high visibility management system based on in-depth analytical procedures that identify and describe the relevant cost elements). Organization at all levels must treat cost as a fundamental responsibility to be addressed on a continuing basis during research, development, test, evaluation, production and deployment. This emphasis involves early establishment of realistic cost goals in all development phases followed by an integrated effort to achieve them.

1.2 Overview. This handbook provides information and guidance for application of the DTC policies contained in Department of Defense Directive (DODD) 4245.3, "Design to Cost." The mechanisms for forecasting future costs during the design process and keeping weapon system costs within budget constraints depends upon how well DTC is implemented. This handbook outlines DTC concepts and guidelines which have been successful in the past.

DTC must be tailored to the individual program, based on specific objectives and an acquisition strategy. With this in mind, this handbook outlines: 1) how DTC targets/goals are implemented, incorporated into contracts and used, 2) how the progress/status of DTC is monitored, 3) how adverse deviations from DTC targets/goals trigger cost reduction actions, 4) when incentive payments should be employed, 5) how life cycle cost (LCC) and DTC goals interact, and 6) how DTC task and organization responsibilities are interrelated.

It should be noted that this document is a Government Program Management Guide and is not to be incorporated as a contract requirement.

1.3 Concept. The concept of DTC is basically a simple one. Cost is established as a design parameter in the same sense and for the same purpose as performance parameters (such as speed, range, and effectiveness). The word cost, when used alone in this handbook and in DODD 4245.3 implies any element of cost that is contained in any of the seven standardized definitions of cost in Department of Defense Instruction (DODI) 5000.33, "Uniform Budget/Cost Terms and Definitions" namely: development cost, flyaway cost, weapon system cost, procurement cost, program acquisition cost, ownership cost, unit production costs (UPC), operations and support costs, and life cycle cost. Since DODI 5000.33 covers complete system costs over all the phases of development, production and deployment, the Government (customer) is obligated to define the level and extent of costs to be included in the DTC activity within a specific contract.

Invoking DTC program requirements in a contract adds to the contract cost and so must be carefully evaluated for reasonableness against the anticipated return (payback).

Consideration must be given to avoiding formal DTC incentive fees in competitive situations where the inherent pressures stimulate cost/performance initiatives by the offerers as necessary features of winning the contract. Examples are when a single contractor is selected for a Fixed Price Incentive Fee (FPIF), Cost Plus Incentive Fee (CPIF), or Cost Plus Award Fee (CPAF) contract. Full Scale Development (FSD) contracts with production options are usually Firm Fixed Price (FFP), based on the unit production cost, or when an FSD contract is awarded to two contractors working in parallel to produce the same system (the contractor who develops the system with the least expensive Life Cycle Cost will be awarded the larger portion of follow-on production buys).

Early in the design process, emphasis must be placed on defining an affordable system capable of countering an identified threat. Cost/schedule/performance/supportability tradeoffs play a major role in these early development phases. As cost and performance objectives become firm goals, emphasis shifts to the rigorous application of cost control techniques to achieve a system with required performance which can be acquired, operated, supported, and disposed of within budget and schedule constraints.

Every system has many parameters which must be considered in the system's design; cost is only one of them. There are several optimum combinations possible, depending on the desired value and relative importance of each parameter. At the outset of an acquisition, the optimal combination may not be identified; however, certain limits/constraints can be identified. Initially, current Department of Defense (DOD) policies on baselining and cost capping provide limits that can be addressed.

For any threat, given a desired level of technology and mission scenario, there are certain minimum essential performance and schedule requirements that must be achieved for the system to be responsive. These requirements, in conjunction with supportability and affordability limits, will determine the cost constraints. Although cost effective solutions may exist above the affordability limit, they are of interest only if the affordability limits can be raised.

Whenever feasible, DTC goals are to be established for the significant design controllable, cost driving elements of weapon systems. The plan is to manage intensively the important few, and not the trivial many. Acquisition strategies must then be structured to achieve these goals. Contractual DTC incentives should be considered and used when they will encourage the contractor to do a better job. Contractual DTC targets should also be consistent with overall system DTC goals. A DTC acquisition strategy should be tailored to achieve predetermined DTC goals; they must be precise and consistent with contractual structure. In addition a DTC goal/target tracking and feedback system, plus an active participation between the Government and contractor engineers and managers are all necessary ingredients for a successful DTC program.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto cited in the solicitation (see 6.2).

STANDARDS

MILITARY

MIL-STD-337	Design to Cost
MIL-STD-499	Engineering Management
MIL-STD-881	Work Breakdown Structures for Defense Materiel Items
MIL-STD-1388-1	Logistic Support Analysis

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are avalable from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DOD Federal Acquisition Regulation Supplement (DFARS), Part 215	Contracting by Negotiations
DFARS, Part 215.9	Contracting by Negotiation/Profit
DFARS, Part 216.1	Types of Contracts/Selecting Contract Types
DOD Directive 4245.3	Design to Cost
DOD Directive 5000.1	Major and Non-Major Defense Programs Acquisition
DOD Instruction 5000.2	Defense Acquisition Program Procedures
Federal Acquisition Regulations (FAR), Part 3.501	Improper Business Practices
FAR, Part 15	Contracting by Negotiations
FAR, Part 16.4	Incentive Contracts

(Copies of DOD Directive 4245.3, DOD Directive 5000.1, and DOD Instruction 5000.2 are available from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099. Copies of the Federal Acquisition Regulation and DOD Federal Acquisition Regulation Supplement are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-0001.)

3. DEFINITIONS

3.1 Acronyms used in this handbook.

a. BAFO.....Best And Final Offer
b. BES.....Budget Estimating System
c. CAD.....Computer-Aided Design
d. CAM.....Computer-Aided Manufacturing
e. CDEM/VAL..Concept Demonstration/Validation
f. CDR.....Critical Design Review
g. CDRL.....Contract Data Requirements List
h. CER.....Cost Estimating Relationship
i. CES.....Cost Element Structure
j. CFE.....Contractor Furnished Equipment
k. CPAF.....Cost Plus Award Fee
l. CPFF.....Cost Plus Fixed Fee
m. CPIF.....Cost Plus Incentive Fee
n. CWBS.....Contract Work Breakdown Structure
o. DAE.....Defense Acquisition Executive
p. DCP.....Decision Coordinating Paper
q. DFARS.....DOD FAR Supplement
r. DID.....Data Item Description
s. DLSIE.....Defense Logistics Studies Information Exchange
t. DOD.....Department of Defense
u. DODD.....DOD Directive
v. DODI.....DOD Instruction
w. DTC.....Design to Cost
x. ECP.....Engineering Change Proposal
y. FAR.....Federal Acquisition Regulation
z. FFP.....Firm Fixed Price
aa. FPIF.....Fixed Price Incentive Fee
ab. FSD.....Full Scale Development
ac. GFE.....Government Furnished Equipment
ad. GFI.....Government Furnished Information
ae. GFP.....Government Furnished Products
af. ILS.....Integrated Logistics Support
ag. ILSP.....Integrated Logistics Support Plan
ah. JMSNS.....Justification for Major System New Start
ai. LCC.....Life Cycle Cost
aj. LSA.....Logistics Support Analysis
ak. MEA.....Maintenance Engineering Analysis
al. MIS.....Management Information System
am. MM/FH.....Maintenance Manhours/Flying Hours
an. MNS.....Mission Needs Statement
ao. MTBF.....Mean Time Between Failures
ap. MTTR.....Mean Time To Repair
aq. NDI.....Non-Developmental Item
ar. O&M.....Operation and Maintenance
as. O&S.....Operation and Support
at. P^3I.....Pre-Planned Product Improvement Program
au. PDR.....Preliminary Design Review

av. PEO.....Program Executive Officer
aw. PEP.....Producibility, Engineering, and Planning
ax. PIP.....Product Improvement Programs
ay. PM.....Program Manager
az. PME.....Prime Mission Equipment
ba. POM.....Program Office Memorandum
bb. PPBES.....Program Planning and Budgeting Execution System
bc. PSR.....Program Status Review
bd. RAM.....Reliability, Availability, and Maintainability
be. R&D.....Research and Development
bf. R&M.....Reliability and Maintainability
bg. SAE.....Service Acquisition Executive
bh. SCP.....System Concept Paper
bi. SSI.....System Support Improvement
bj. VAMOSC....Visibility and Management of Operations and Support Costs
bk. VE.....Value Engineering
bl. VECP.....Value Engineering Change Proposal
bm. VHSICs....Very High Speed Integrated Circuits
bn. WBS.....Work Breakdown Structure

3.2 Acquisition streamlining. Any action that results in more efficient and effective use of resources to develop, produce, and deploy quality defense systems and products. This includes ensuring that only cost-effective requirements are included, at the most appropriate time, in system and equipment solicitations and contracts (DODD 5000.43).

3.3 Affordability. Affordability is a function of cost, priority, and availability of fiscal and manpower resources, and is to be considered at every milestone, and during the Planning, Programming, and Budgeting Execution System (PPBES) process. The order of magnitude of resources the DOD component is willing to commit, and the relative priority of the program to satisfy the need identified in the Mission Needs Statement (MNS), formerly the Justification for Major System New Start (JMSNS), will be reconciled with overall capabilities, priorities, and resources in the PPBES. System planning shall be based on adequate funding of program cost. A program shall normally not proceed into concept exploration/definition or concept demonstration/validation (CDEM/VAL) unless sufficient resources are, or can be, programmed for those phases. Approval to proceed into full-scale development or into full rate production shall be dependent on the DOD component's ability to demonstrate that resources are available or can be re-programmed to complete development, to produce efficiently, and to operate and support the deployed system effectively and efficiently. Funding availability shall be confirmed by the DOD component before proceeding into full rate production and deployment. To avoid creating program instability, funding changes shall not be introduced without assessment and consideration of the impact of these changes on the overall acquisition strategy. Specific facets of affordability to be reviewed at milestone decision points are set forth in DODD 5000.1 and DODI 5000.2.

3.4 Baselining. A program baseline is a formal agreement between a program manager (PM) and a program executive officer (PEO), Service Acquisition Executive (SAE), or the defense acquisition executive (DAE) that briefly summarizes factors critical to the success of a program, such as functional specifications, cost, and schedule objectives and requirements, against which the program will subsequently be evaluated (DODD 5000.45).

3.5 Contractor work breakdown structure (CWBS). The complete Work Breakdown Structure (WBS) covering a particular contractor procurement. The CWBS is a breakdown and identification, for a particular procurement, of all the acquisition tasks required during the development and production of a system or equipment. The CWBS closely follows the guidelines of MIL-STD-881 and DODI 5000.33 in identifying the hardware, services, and data required by a particular program or project throughout its planned life cycle. Many of the elements of the CWBS can be found in the cost element structure (CES), and are closely related to the WBS of the major equipment.

3.6 Cost. In this document cost is defined as the Life Cycle Cost (LCC) or a portion thereof; see DODI 5000.33 for a more explicit definition.

3.7 Cost avoidance. Selecting the most cost effective design choice based on timely and concise cost information.

3.8 Cost element structure (CES). A breakdown of life cycle cost elements that can be summarized under the major cost categories of research and development, production (or investment), and deployment (operation and support). Each major cost category is further broken down into a hierarchy of lower level cost elements following the guidelines of MIL-STD-881 and DODI 5000.33.

3.9 Cost estimating relationship (CER). A mathematical expression relating cost as the dependent variable, to one or more independent cost-driving variables. The expression may be represented by any of several functions (e.g., linear, power, exponential, hyperbolic). These cost-driving variables usually represent characteristics of system/product performance, physical features, effectiveness factors, or even other cost elements.

3.10 Cost drivers. Those elements of a cost equation which significantly impact the total system's life cycle cost. Historically, these are 20% of a system's cost elements that contain 80% of the total system's life cycle costs.

3.11 Cost reduction. A formal activity employed to rectify a cost target or sub-target breach. A cost reduction effort has a specific quantitative target.

3.12 Cost risk. A qualitative assessment of the chances of failing to achieve a design which is (a) affordable to procure, operate, and support; and (b) acceptable in terms of performance, readiness, supportability, and schedule. Cost risk is directly proportional to technical risk and estimating uncertainty.

3.13 Design to cost (DTC). An acquisition management cost control technique established to achieve defense system designs that meet stated cost requirements. Cost is a design requirement addressed on a continuing basis as part of a system's development process. The technique embodies early establishment of realistic but rigorous cost objectives, goals, or targets and a determined effort to achieve them.

3.14 DTC action plan. This plan identifies the specific effort necessary to control cost and to return the projected cost to an acceptable level when a cost target has been breached.

3.15 DTC goal. The DTC goal is a specific cost number (in constant base year dollars), or other operation and support (O&S) parameters based respectively upon a specified production quantity and rate or operation and maintenance (O&M) scenario established early during system development as management objectives and parameters for subsequent phases of the acquisition cycle.

3.16 DTC objectives. Tentative values or ranges subject to revision and tradeoff until firm DTC goals are established.

3.17 DTC program plan. This plan is a document which provides the integrated program plan for the time-phased activities required to accomplish a specific set of DTC tasks. It is a dynamic document subject to revision and change as the system evolves.

3.18 DTC targets. Cost numbers, approved by the procuring activity, which the contractor translates into design requirements for the purpose of controlling production, logistics, operating, and support costs. These contractor-controllable targets are derived from DTC goals. Targets are comprised of smaller, identifiable tasks or areas of responsibilities that serve as requisites for contractors or other Government activities.

3.19 Integrated logistics support (ILS). A disciplined, unified, and iterative approach to the management and technical activities necessary to (a) integrate support considerations into system and equipment design; (b) develop support requirements that are related consistently to readiness objectives, to design, and to each other; (c) acquire the required support; and (d) provide the required support during the operational phase at minimum cost (DODD 5000.39).

3.20 Integrated logistics support plan (ILSP). A document which provides a comprehensive and detailed plan for implementing concepts, techniques, and policies necessary to achieve the ILS objectives of assuring the effective and economical support of a system or equipment for its life cycle. The program manager shall develop an ILS plan by Milestone I and keep it current throughout acquisition. The ILS plan shall integrate logistics aspects of the program. Positive controls shall be established to integrate schedules and to interdependencies among ILS elements, design activities, and deployment plans. The ILS plan shall document readiness and support objectives, achievements to

be demonstrated, operating concepts, deployment requirements (including transportability), support concepts, plans, ILS element requirements, schedule, funding requirements, and responsibilities for ILS activity planned for each program phase. For joint service programs, the ILS plan shall address the support requirements of all participating DoD Components. The program manager shall furnish contractors with appropriate Government data such as baseline operating scenario and maintenance concepts, systems readiness objectives, and support costs on current systems to use as a basis for contractor ILS planning and analysis. The program manager shall maintain current ILS management information (including detailed schedule, resource requirement and funding, logistics support analysis (LSA) documentation, and status of progress toward support related thresholds) to support ILS planning and management decisions (DODD 5000.39).

3.21 Investment costs. Costs usually associated with the acquisition of equipment and real property. Includes the cost of non-recurring services, non-recurring O&M costs, startup costs, and other one-time investment costs.

3.22 Learning/experience or improvement curve. A system for establishing costs that reflect the learning/experience/improvement impact on quantity and production rate.

3.23 Life cycle cost (LCC). The total cost to the Government for a system over its full life. Includes the cost of development, procurement, operation, support, and disposal (DODI 5000.33). For LCC tradeoff and tracking purposes, the contractor should consider only those elements of LCC which can be influenced by the contractor's design process, i.e., those that are under his control.

3.24 LCC goals. Approved Life Cycle Cost values expressed either in dollars or in some other measurable factor; includes all costs associated with the system such as: research and development, production, deployment and disposal costs.

3.25 LCC management. LCC management is that part of the acquisition management effort that coordinates and integrates all LCC analysis, cost tracking, and cost control disciplines and activities associated with acquisition planning and execution. The objectives of LCC management are to minimize total life cost and to keep costs within established affordability constraints. An important function of LCC management is to give decision-makers visibility into the cost ramifications of decision alternatives and tradeoffs.

3.26 Logistics support analysis (LSA). The selective application of scientific and engineering processes: (a) causing support considerations to influence design; (b) defining support requirements that are related optimally to design and to each other; (c) acquiring the required support; and (d) providing the required support during the operational phase at minimum cost (DODD 5000.39).

3.27 Operation and support (O&S) cost. O&S cost is defined as the sum of all costs related to operations and support (including data training, maintenance and personnel support) of the weapon system after it is accepted into the operational inventory. O&S cost buildup begins when the first production equipment enters the force structure (either as operating unit equipment or combat crew training equipment) and continues throughout the service life.

3.28 O&S DTC parameters. Approved values for selected O&S elements expressed either in dollars or by other measurable factors, such as number of maintenance personnel, spares, fuel and other resource consumption, mean-time-between-failure (MTBF), maintenance manhours per flying hour (MM/FH), mean-time-to-repair (MTTR), and so on.

3.29 Ownership costs. Ownership costs encompass cost elements within the O&S cost category exclusively. O&S costs include costs associated with operating, modifying, maintaining, supplying, disposing, and supporting a weapon support system in the DOD inventory. Also included are costs for skill training, personnel movement, spares replenishment, repair parts, costs associated with O&M, military personnel, procurement, and military construction. Other appropriations and funds (stock fund) are used to operate and support DOD weapon support systems.

3.30 Pre-planned product improvement (P^3I). P^3I is a systematic and orderly acquisition strategy beginning at the system's concept exploration/definition phase to facilitate evolutionary, cost-effective upgrading of a system throughout the life cycle to enhance readiness, availability, and capability. This allows for development and fielding of a new system while state-of-the-art improvements to that system are being planned for phased integration.

3.31 Producibility. The aggregate of characteristics which when applied to equipment design and production planning, leads to the most effective and economic means of fabrication, assembly, inspection, test, installation, checkout, and acceptance. Ensures a smooth transition from development through production to deployment.

3.32 Unit production cost (UPC) goal. A cost established prior to the development of an item to guide design and to control program costs. It is the cost to the Government to acquire a production item based on a stated level of production and production rate. It is established early in the development to ensure from the start that engineers design and develop an item that will not cost more than the service can afford to pay for the item. The average unit production cost is that estimated unit cost to produce at a predetermined rate and quantity.

3.33 Value engineering (VE). Value engineering is the formal technique designed to eliminate, without impairing essential functions or characteristics, anything that unnecessarily increases acquisition, operation, or support costs. Contractors and Government share in the savings resulting from the VE effort. VE should complement, and not duplicate, DTC efforts.

3.34 Value engineering change proposal (VECP). A VECP is the formal means for implementing value engineering changes in ongoing contracts. (See FAR Part 48.)

3.35 Work breakdown structure (WBS). A WBS is a product-oriented family tree composed of hardware, services, and data which result from engineering efforts during the development and production of a system, and completely defines the project/program (MIL-STD-881). The WBS displays and defines the product(s) to be developed or produced and relates elements of work to be accomplished to each other and to the end product.

3.36 Zero cost growth alternative. Plan of action identifying the specific changes or alternatives necessary to reduce the forecasted costs of the required inventory to approved DMC goals and targets.

4. GOVERNMENT

4.1 General. Design To Cost goals are values for selected LCC elements that are to be attained. For major systems they are included initially as the objectives of the System Concept Paper (SCP) and later as goals as part of the acquisition planning in the Decision Coordinating Paper (DCP). Goals established for non-major systems, subsystems and components are similarly documented in appropriate service documents. Design to cost goals differ from DTC targets in that the term "target" is used to imply a contractual goal, containing only elements under the contractor's control.

It is also essential that the goals represent the LCC estimates which support the DCP and can be tracked to the budget estimations/submissions. If a re-examination of requirements, concepts and/or designs reveals that the goals are not achievable, then they should be formally revised. Generally goals expressed in constant base year dollars are preferred and, where appropriate, accompanied by then year dollar estimates, since then year dollar estimates are required for budget estimates/submissions and comparisons. The best goal is one that is measurable, controllable, and is a major cost element of the overall system.

4.2 Evolution of goals. During the concept exploration/definition and demonstration/validation phases, the PM concentrates on meeting preliminary system performance, reliability, and cost requirements. These preliminary objectives are typically submitted for command approval. During this period the PM must identify and summarize the cost elements that make up the approved and recommended program DTC objectives. The thrust and direction must be continually aimed at determining the optimal system design prior to entering FSD.

At commencement of FSD the proposed system should be fully defined and firm DTC goals (e.g. average unit production cost and O&S goals) should be established. The allocated DTC goals should be acceptable to both the PM and the contractor. The Government and contractor PMs will provide the joint leadership and coordination to achieve them. The overall DTC goals are then allocated, and each subgoal now becomes part of the cost baseline relative to each LCC element of the program. Both industry and government program management attention now shifts toward control of these goals during subsequent design and development phases of the program. Mechanisms and tools available to achieve estimated cost goals include warranties, standardization, automation, Very High Speed Integrated Circuits (VHSICs), robotics, computer aided design (CAD), computer aided manufacturing (CAM), value engineering, organization, and productivity/quality improvement.

4.2.1 Policy. DODD 4245.3 requires the establishment of one or more acquisition DTC goals for all major programs. Often these goals are stated as an average unit production cost. It should be recognized that instances will occur where flyaway cost may be used, but in most cases this is not the most appropriate goal, since flyaway costs include factors beyond the contractor's control. It may be better to use other goals such as major component costs, UPCs, or O&S costs.

A program may have more than one DTC goal. DODD 4245.3 also states that it is DOD policy to establish credible O&S DTC goals, where O&S costs are a significant factor. Such goals should be based on O&S costs that are design dependent, predictable, verifiable, and subject to DOD direction concerning metrication.

4.2.2 Approval. For major systems the DAE recommends approval of cost goals to the Secretary of Defense for final approval. These goals are developed and presented as part of the DCP. For major programs, changes to DTC goals are subject to approval by the Secretary of Defense or his designee. These changes must be the result of changes in direction based on performance, technology and concept changes that offer further system optimization through system tradeoffs. Unless changes are officially approved, the cost goals will be used as a basis for assessing the contractor's success in achieving them. A goal will not be changed as a result of changes in quantity, schedule, production rate or inflation; learning curves and inflation indices should accommodate these types of changes.

This policy also applies to non-major systems, subsystems and equipment. Since these goals are established by lower levels of management, the approval authority establishing the goals and responsible for approving any subsequent changes must be at least a level higher than the PM.

4.3 Integration. The implementation of DTC requires participation by personnel trained in writing effective DTC contract technical requirements, rapidly analyzing baselines, assessing trends, identifying critical areas and providing evaluation for DTC plans/reports. However, the investment and formal training for personnel and funds should be commensurate with the anticipated program cost benefits. Design to cost should be integrated into the existing organization and program management structure and procedures. A Government DTC program manager serves as the communications link between the contractor and the Government design and management activities and assures consistency and accuracy of cost inputs to the DTC process. The DTC process relies on personnel and information systems, although program management and system engineering enhancement may be required, in accordance with MIL-STD-499.

4.4 Management.

4.4.1 Acquisition strategy. Early planning and implementation is the key to the ultimately successful application of the DTC process. Careful planning for DTC must be coordinated during the concept exploration/definition phase with adequate cost data development. The extent of DTC coverage planned for each area must be tailored to the type and size of the system procurement, and to the phase of the program. Contracts for the DTC effort should be consistent with the technical and identified risks associated with the overall program in that phase.

It is DOD Policy to apply DTC principles and concepts to all major and designated non-major system acquisitions as defined in DODD 5000.1, DODI 5000.2, and DODD 4245.3. Additional direction is provided for applying these principles and procedures to other defense acquisitions in the service implementing documents.

4.4.1.1 Request for Proposal (RFP). The RFP should summarize the DTC work elements to be performed by the contractor. Elements required in an RFP to facilitate the DTC process include minimum essential performance and schedule and support requirements, cost objectives (both production and O&S), military specifications and standards, tradeoff authority and priorities, and tracking requirements with essential documentation. Since the total cost (LCC) of a weapon system involves both contractor and Government inputs, the RFP requirement for cost estimates should identify the contractor's controllable costs. Identification of data sources is also very important in the O&S area where the contractor needs Government supplied system deployment data and cost factors to compute the impact of his design on logistics support and personnel resources. (Refer to Federal Acquisition Regulation (FAR) Part 15 and DoD FAR Supplement (DFARS) Part 215.

4.4.1.2 Schedules.

4.4.1.2.1 Development. Development schedules should allow time for design iterations/excursions, time required to achieve DTC and performance requirements in addition to the usual considerations such as initial operating capability, assessment of the contractor business base and support capability, and test time. Program element schedules must also include sufficient time and flexibility to support additional design activity to meet cost, performance and supportability objectives (goals) identified by previous cost analyses.

4.4.1.2.2 Administrative. One of the objectives of the DTC concept is to seek enhanced and innovative solutions that offer the potential for clear cost advantages. The normal time allowed for industry to prepare and submit development proposals is relatively short, and as a result, may detract from industry's ability to offer timely, innovative, and supportable development approaches. This problem could be alleviated through the early involvement of contractors and/or realistic scheduling. Allowing a reasonable amount of time for these activities would also help to identify cost effective solutions and alternatives. Whenever possible draft RFPs should be coordinated with industry to ensure the contractor's familiarity with the planning of DTC implementation.

4.4.1.3 Contract type. The DTC process requires that contractors be given as much flexibility as possible in their design development approach. The use of firm fixed price contracts is discouraged (except for acquisitions of less than $10 million). The most flexible type of contract is the cost reimbursement type. During the development phases, cost plus fixed fee, cost plus award fee, or cost plus incentive fee contracts can be most effective. CPAF and CPIF contracts afford an opportunity to enhance DTC-related

performance by virtue of an award or incentive fee tied to the DTC process. It has been shown that profits made on production contracts that followed FSD contracts can be linked to how closely production costs related to the DTC goals. However, firm fixed price production options tied to FSD contracts, based on the achievement of the DTC goals, is an ideal way to contract for production. Regardless of contract type, DTC remains the primary means of controlling design-related costs. (Refer to DFARS 215.9 and 216.1.)

4.4.2 Reviews. A mutually agreed upon, achievable schedule and review cycle required for tracking the status and analyzing the effectiveness of the DTC program should be an integrated part of the DTC task. Formal reports should be prepared periodically between government and contractor DTC personnel jointly. Planning milestones for these reviews will ensure that sufficient new design information is available to warrant their expense. All formal project status reviews, preliminary design reviews (PDRs), and critical design reviews (CDRs) should include an analysis of the DTC program and an assessment of its effectiveness in controlling all elements of cost. All major Program Status Review (PSR) milestones should also include an assessment of the DTC status. This may best be accomplished by "splinter" sessions between the contractor's DTC program manager and the designated Government counterpart. "Splinter" sessions are particularly useful for major programs where the integration of LCC elements and DTC goals is a complex task. Regardless of the procedures used, the contractor's inputs to the DTC process must be credible and accurately depict the analysis of and progress toward achieving the DTC goals. These reviews will provide the best opportunity for the Government to ensure the continued effectiveness of the contractor's effort. Government approved contractor recommendations should be incorporated into the contractor's DTC management plan and the status presented at the program reviews for inclusion in subsequent status reports.

5. APPLICATION

5.1 General. Contract clauses for DTC generally include credible acquisition and O&S cost goals that are consistent with the program acquisition strategy/plans, and budget constraints. They also require the contractor to identify cost drivers within LCC elements to:

(1) Establish cost as a parameter equal in importance to performance, schedule and supportability requirements.

(2) Address the future costs of production and O&S on a continuing basis throughout the design phase (concept exploration definition/demonstration, concept demonstration/validation, and full scale development). Costs must also be monitored for Production Improvement Programs (PIPs) when initiated during production and deployment.

(3) Provide prompt cost feedback to engineers and managers to enable action to avoid or remedy cost target breaches.

(4) Summarize the impact on cost/technical baselines in support of excursions and alternatives that would tend to optimize/balance the DTC goals.

DTC makes cost an objective, not the result of performance and schedule decisions. The contractor is directed to focus on element design and controlling future costs by identifying parameters that have impacted costs in earlier programs and designs. Continued communication must be established throughout the various functional disciplines to provide the necessary visibility and appropriate actions.

The Government PM should ensure that the contractor tailors his DTC plan to the specific acquisition phase being worked. The plan should be sufficiently flexible to accommodate needed changes during subsequent program phases. The contractor should also show how the current effort considers previous DTC activity and how it supports the DTC program planned for follow-on development phases, if appropriate.

The DTC plan is an integrated set of specific tasks undertaken to control production costs and those O&S costs that are influenced by the contractor's design, development, and management decisions. It should be sufficiently comprehensive to enable the Government to: (1) ascertain with a high degree of confidence that the contractor has adequately evaluated Government requirements and planned for an active and effective engineering effort to control production and ownership costs; (2) verify conformance to the DTC standard, MIL-STD-337, or other DTC contractual items; and (3) monitor the contractor's effort to ensure timely and aggressive execution of the DTC program. As a minimum, the plan should include the identification of major cost drivers and DTC goals, identification of excursions/alternatives, description of models to be used, list of trade studies to be conducted, schedule, funding constraints, and recommendations.

The Government should ensure that the contractor has provided an adequate management system which will respond to the team members' program needs. The contractor's DTC PM serves as an important link between the contractor's top management and the Government to assure consistency, accuracy, and timeliness of cost inputs to the DTC process. The contractor DTC PM and the contractor top management must jointly support DTC as it may require commitment of a dedicated but not necessarily extensive unit to support DTC. However, for corporations with prior defense contracting experience, the functions contributing to an integrated DTC effort (consisting of systems engineering, logistics, producibility, reliability, cost analysis, and so on) should already be in place. Other elements needed to control cost such as an appropriate management structure; accounting practices, policies, and procedures; and formal or informal communication links must also be established for designers and others. These elements may need to be developed if not already in existance. In instances where a limited contractor DTC capability exists, some augmentation to the contractor's cost management system will be necessary. When no DTC management structure exists at the contractor's facility, the contractor must be required to justify why organizational augmentation will not be necessary.

The contractor should identify the functional areas and points of contact responsible for providing current and timely cost data to technical and management decision makers. Some adjustment/modifications may have to be made to use currently generated information. Some additional training may also be necessary for specialized aspects of the DTC effort required for complexity integration for the program acquisition.

5.2 Goals.

5.2.1 Production. The cost elements included in the goal should be clearly identified and quantifiable. The objective is to have the program goals based on the major production cost elements of the system and should include the deliverable hardware and software elements influenced by and under the control of the contractor. Often it is best not to include Government Furnished Equipment (GFE); however Contractor Furnished Equipment (CFE) should be included since it is under the contractor's direct control. If likely to be major cost elements, non-recurring engineering/tooling and engineering changes should be tracked but not included in the goal. Contract targets should be consistent with the goals WBS (usually to the 3rd level) as defined in MIL-STD-881. They must also track the cost elements included in the program baseline. Like program goals, contract targets are usually expressed in both constant base year and then year dollars. The contract must state the conditions and provide documented support needed to provide an audit trail of unforeseen adjustments to the initial goals based on any program-dictated changes. Economic escalation and variances of actuals from projected production rates and quantities should all be considered predictable variables. Changes in these factors should lead to appropriate values in the DTC contractual targets.

In some programs it may be more practical to establish individual cost goals for subsystems or major components rather than overall system cost goals. This procedure is used for cost drivers or when different and basically unrelated quantities of subsystems are to be procured such as when a subsystem may be common to two or more programs (e.g., X number of missiles and Y number of fire control systems). In such a case, it would also be more advantageous to establish O&S cost goals at the subsystems levels, rather than at the system level.

Where a system includes GFE the system integrator may not be able to control the GFE cost. If GFE is being developed for incorporation into only one system, it may be appropriate to vest control of the DTC effort for the GFE item with the system integrator. If GFE is being developed for more than one system, DTC goals (allocated programs) for the GFE should be managed as a separate activity. Whenever off-the-shelf equipment is to be acquired, modified and integrated into a new system, the associated costs may be included in contractor target cost for computational analysis but it should be recognized that there is limited opportunity to use DTC to constrain commercial product cost.

5.2.2 Operation and support. Establishing DTC goals for O&S costs is essential to the management and control of these costs. O&S costs of major weapon systems such as ships, planes and tanks often far exceed acquisition costs. The system mission, operational requirements, and maintenance levels will determine O&S requirements. Requirements in turn will identify O&S costs, including personnel manning, logistics, consumables and initial spares.

The guidance for O&S DTC goals is principally that values be derived based on cost drivers which are design controllable. These can be compared with costs accumulated during tests that replicate operating scenarios. If contractual incentives for warranties are involved, the goals associated with these goals must be capable of being fully evaluated and analyzed during operational tests or the early phases of deployment. O&S goals are normally established for: reliability, personnel, repair, security, training, spares requirements, or other similar quantitative factors. As with production DTC goals, the O&S DTC goals should be clearly documented in the contract.

Reducing operational or maintenance personnel requirements by automating and combining tasks is one approach to limiting O&S costs. Personnel costs have become the most expensive element of the DOD budget. These cost increases are compounded by requirements in personnel skill levels and training needs. Crew size, consistent with operational criterion/scenarios, sometimes can be traded off against firmware/hardware/software sophistication to obtain the desired results. Normally, improvements in reliability and advances in maintainability reduce MTTR/MTBF, and thus reduce personnel specific skill requirements; automation also offers many opportunities to control personnel cost. These opportunities must be weighed against the cost of additional studies and hardware/software development costs, if any. Although it is commonly believed that production costs must necessarily increase in order to provide increased reliability and maintainability (R&M),

actual experience indicates otherwise. Designs which are simple, realistic, durable, and easy to maintain by the existing organizational structure, generally cost less to fabricate, assemble, test, and operate in the field. Well executed designs not only yield enhanced R&M, but usually result in lower production costs as well. When evaluating production and O&S costs, performance, and schedule, it is usually necessary to convert these elements to a common measure, usually unit cost. Cost estimating relationships may be developed to convert the design variable parameters into optimizing cost expressions. A bibliography of cost models is available through the Defense Logistics Studies Information Exchange (DLSIE). Although models may not always demonstrate a high degree of precision in reflecting or predicting costs, they will usually provide cost differentials between competing or alternate designs and excursions, and consequently are useful for DTC purposes.

5.3 Program.

5.3.1 General requirements. The Government PM should ensure that the contractor's DTC program plan includes identification of procedures for managing, tracking and documenting DTC. As a minimum the procedures should address program schedules, hardware acquisitions, coordination and time phasing of Government and contractor tasks, identification of input data essential to program management (i.e., cost drivers, trade studies and tracking/reporting), the appropriate cost elements and applicable work breakdown structures required to support documentation. The contractor's plan should be based on the planned system life cycle, funding profile, deployment scenario and schedule. The challenge of achieving the cost targets, the scope of the engineering design effort, the technical and logistic complexity, production risk, cost and man-hours estimating uncertainty, cost analysis, the degree to which a cost breach would adversely effect the program, schedule, and funding constraints must also be addressed. The assumed ground rules and requirements will be the basis for the coordinated DTC plan.

5.3.2 DTC management elements. The Government PM should ensure that key elements of the contractor's DTC program include:

(1) Procedures for optimizing cost, performance, supportability and schedule.

(2) Methods for allocating DTC contract targets into subgoals for assignment to individual design group leaders.

(3) Methods of providing production and O&S cost estimates and their impact on each other for preliminary designs to the designers. Timing is critical. Feedback procedures should provide timely cost estimates to give engineers the time to select the optimal choice from available alternatives.

(4) Methods for periodically developing and updating research and development (R&D), production and O&S estimates as the design evolves.

(5) Methods for controlling production, O&S and subcontractor costs and tracking them.

(6) Methods for evaluating, tracking and documenting the cost impacts of design and requirements changes.

(7) Methods for assuring that all pertinent design-controllable cost elements are considered in each trade study and in the development of the associated cost estimates.

(8) Identification of the contractor's DTC program manager who will be responsible for the management of the DTC effort.

Because the contractor needs extensive cost data development for his own accounting procedures, the contractor's management system will usually produce much of the information required for a successful DTC implementation.

5.4 Process.

5.4.1 Cost analysis. Cost analysis should be based on the appropriate LCC and/or WBS elements specified in MIL-STD-881 and as further defined by the procuring activity. The supporting rationale for each analysis should include all guidelines, assumptions, and ground rules. Data sources, design maturity, and cost estimating methodology should also be identified. The analysis should address the state-of-the-art, alternative approaches, cost data sources and the associated risk and uncertainty. If CERs are used, each cost element shall be supported by a definition of the variables and data used to derive the values selected. The analysis should include any sensitivity analysis or other techniques used to identify cost drivers. The Government PM should ensure that the contractor has described the process for applying cost data and cost factors, data sources, and whether Government or in-house data bases were used. The documented procedure in developing the cost/technical baseline shall be developed to support the process.

In some cases, the contractor's analyses may conform to one or more cost models prescribed by the customer. In this situation the contractor will only provide input data necessary to use the model plus any rationale in support of the input data. Improper use of a generic cost model or inappropriate assumptions regarding its use may yield invalid results. Therefore, precautions should be exercised by both contractor and customer to ensure valid outputs.

Any appropriate estimating methodology may be used (e.g., parametric, historical, analogies, or detailed engineering) depending on the amount and type of input data and resources available, and on the maturity of system designs (e.g., advanced development phases or full scale development).

The contractor may elect to use either in-house or Government-furnished models as long as all pertinent LCC elements and performance parameters are included and they are Government approved. Computerized models are encouraged to facilitate transfer of data between the Government and the contractor and to aid in expediting mathematical calculations and sensitivity analyses. The Government may elect to specify a required estimating methodology, standard computer models, equations or ownership factors which the contractor shall use in DTC analyses.

Costs at very low levels of indenture are not usually part of the DTC reporting process. However, all cost details used by the contractor in the management of the contract should be available to the Government upon request. The contract and data item descriptions (DIDs) will specify the WBS levels and the extent of cost details to be reported to the Government. These data should be the minimum necessary for the Government to properly monitor the DTC effort without constraining existing resources.

5.4.2 Government-supplied information. The contractor shall be responsible for obtaining required information from the Government procuring activity. The type and amount of required information depends on system design maturity, acquisition phase, scope of the Government oversight, and degree of tailoring required for the DTC efforts. The Government furnished information (GFI)/GFE/Government furnished products (GFP) may require individual monitoring as one of the cost element structures within the program.

When necessary, the contractor should be encouraged to request data relevant to the contracted weapon system from the DoD Program Office for visibility and management of operations and support costs. To the extent that the contractor's data base is insufficient for the contracted DTC effort, the contractor shall request access justification for relevant Government data regarding reliability and maintainability objectives, ILSPs and procedures, LSAs, repair level analysis, and maintenance engineering analysis (MEA). If such data is not available, the contractor may be required to develop them in accordance with existing DOD regulations.

5.4.3 Cost methodology. The cost model being used shall be based on the most current hardware and software configuration, maintenance, and support concepts, and should conform to specific contract requirements. Cost model documentation should also show how an audit trail will be maintained and validated for input data and supporting rationale (cost estimating techniques, forecasting, and analysis results).

The cost methodology should:

(1) Identify the DTC preferred alternatives used in formal trade studies (no trade studies should be duplicated; trade studies conducted by other functional areas should be used whenever possible).

(2) Provide the necessary level of detail to support daily efforts to control the costs of the emerging design.

(3) Include descriptions of analytical tools, procedures, communication channels, and data flow for trade studies for providing high quality, timely, and concise information to the cognizant Government and contractor decision makers.

(4) Identify CFE required for input to contractor cost models and the processes to be used to perform sensitivity analyses, discounting, comparisons to funding profiles, and effectiveness and readiness impacts.

(5) List points of contact for functional and cost element responsibility for management/organization structure.

(6) Provide cost modeling capability to satisfy programmatic excursions to support design - build team efforts.

5.4.4 Cost equations. Cost factors, CESs, and CERs are to be compatible with the level of detail needed at a specific point in the system acquisition cycle. Cost estimating techniques which range from the use of historical costs to detailed analyses of each cost element represent the continuum of estimating techniques from which an appropriate methodology may be selected. The type and depth of cost analysis shall be determined by the amount of detail required to support the DTC program and provide a cost effective basis for informed programmatic decisions by both the Government and the contractor for reporting, documenting, and communicating within the organization.

5.4.5 Sensitivity analysis. Sensitivity analysis should be performed by the contractor to identify design-controllable cost drivers.

5.4.6 High risk areas. The Government contract should require the contractor to identify potential problems in cost estimating or in the reliability of the cost forecasts and should include plans to reduce the risks in these areas to an acceptable level. Likely risks include: (1) schedule slippage; (2) future design changes; (3) test schedules and results; (4) production improvement (learning) curve assumptions; (5) limited historical information and cost data; (6) inadequate tailoring of requirements, specifications and standards; (7) reliability; (8) readiness; (9) off-the-shelf hardware enhancements to support military applications; (10) industry/regulatory provisions; and (11) support requirements. Through the use of learning/experience curves and base year baselines, the high risk associated with quantity or rate changes due to funding cuts can be virtually eliminated. The cost impact on schedule caused by inflation can also be eliminated by using Constant Base Year dollars for estimating.

5.4.7 Baseline. Baselines for production and O&S should be documented and adequately supported to serve as the reference from which to measure any subsequent changes. The requirements should also be sufficiently comprehensive to enable the Government to identify and determine with a high degree of confidence that: (1) the contractor's cost analyses are based on the best data available; (2) the contractor's methodology is sufficiently sensitive to the type and depth of engineering design tradeoffs expected to be encountered during the contract; (3) through independent cost analysis verification that the contractor's estimates are reasonable and correct; (4) conformance to the procedures of MIL-STD-337 has been accomplished; (5) fact-finding on efforts is accomplished; and (6) responsibility and organization levels for O&M and O&S concepts have been validated by LSAs.

The Government contract should direct the contractor to identify the top cost drivers (e.g., hardware, performance, schedules, standards, specifications, repair levels, spares, personnel, and the like) that affect

cost and discuss these issues. Unless otherwise directed by the contract, the contractor's response should include only those cost elements controlled by the contractor. Analyses shall be stated in both constant program base year dollars (using normalizing factors provided by the Government) as well as then year dollars (unless otherwise specified in the contract). The contractor should also identify the major cost drivers which account for most (usually 80%) of the forecasted cost. Management emphasis should be applied to this prioritized list of cost drivers. Candidates for trade studies should be selected from the list and the list updated as necessary.

5.4.8 Logistics support cost elements. Major ownership cost categories are heavily influenced by the contractor's design. Two of the more important elements of integrated logistic support influenced by the design of the prime mission equipment (PME) are: (1) initial investments during the production phase; and (2) the sustaining O&S costs associated with a deployed system. The Government will provide the anticipated mission scenario and deployment concept. Ownership cost elements will be developed and tracked by the contractor and will reflect the deployment scenarios.

DTC activities related to ownership costs should be consistent with guidance in MIL-STD-1388-1 and should be consistent with supportability elements. Whenever supportability can not be directly translated to specific cost goals, procedures should include surrogate goals for supportability costs. Data from LSAs, reliability and maintainability studies, and other supportability evaluations should be integrated into the process to ensure that decisions reflect all germane data and that assembled information presented by the contractor to the Government is consistent with them. The system support initiative describing how to acquire programs should be followed in order to identify material/assets readiness and compatibility matrices.

5.4.9 Trade studies. Trade studies should consider acquisition (R&D and production) and ownership costs (O&S and disposal) and deployment scenarios (e.g. maintenance levels, operator/maintenance requirements and performance). They should be conducted early in the development process to select a firm design or, in some cases, after a previously accepted design has demonstrated inadequate cost effectiveness. Usually these trade studies need use only those elements of life cycle cost and performance parameters that discriminate between the alternatives or modifications being considered. Depending upon the acquisition phase, the trade study may include qualitative and quantitative information on design, human factors, reliability and maintainability, logistics support, performance, and other design development, production and ownership factors. These trade studies are normally documented and reported by the contractor according to the Contract Data Requirements List (CDRL) vehicle used in reporting data for engineering and logistics efforts prescribed in the statement of work.

Trade studies should be performed whenever:

(1) System/equipment modifications, enhancements or procedures change or whenever alternative support concepts appear to offer performance or supportability improvements.

(2) The selected alternative may not be realistically accomplished in a cost effective manner.

(3) The relationship between cost, performance, schedule, supportability and Government requirements can be improved.

(4) It is necessary to choose a new more cost effective alternative at the system, subsystem or major component level of the WBS, based on required design changes (programmatic restraint).

(5) It is necessary to minimize cost given a fixed performance threshold and schedule.

(6) The most cost effective choice between software systems, firmware (built-in software), and computer hardware needs to be determined.

5.4.10 Software. Software development and maintenance costs have become important and critical cost elements in weapon system acquisitions. The contract should specify appropriate trade studies that consider built-in diagnostic capability, artificial intelligence, modern technology interface, external automatic test equipment, maintenance philosophy, reliability, operational flexibility, maintainability, and availability factors. The objective is to identify, track, control and, if possible, reduce rapidly growing software and development software maintenance costs. The effect of software decisions and their associated costs should be included in tradeoff analyses along with other appropriate DTC factors.

5.4.11 Tradeoffs. The contractor must be given latitude to make tradeoffs within the program in order to achieve DTC objectives. Possible tradeoffs include: (1) increases in development and/or acquisition costs that significantly reduce O&S cost; (2) improve reliability or system performance, while allowing acceptable degradations in cost; (3) changes in schedule to accommodate performance or production changes and associated cost changes. The DTC effort should permit contractor flexibility. The contractor should challenge the specified system/subsystems characteristics and recommend changes to them wherever there is a valid indication of significant LCC savings or LCC avoidance. Technologies such as acquisition streamlining and technology insertion are most appropriate in this regard. Full-scale development normally will not include major cost and performance tradeoff activity unless challenges arise which invalidate the designs derived from the concept exploration/definition and concept demonstration/validation phases.

5.4.12 DTC preferred alternative. Upon completion of a formal trade study, the contractor shall identify the preferred alternative and submit recommendations along with supporting rationale. This procedure is required to insure consideration of potential contradictions among cost targets, schedule, and performance. When the preferred alternative recommended as the low-cost option is not selected, the contractor should include the rationale of why the cost-preferred decision was not accepted.

5.4.13 Cost control. The Government PM shall ensure that the contractor executes an effective, engineering-oriented effort to control the design, development, production, modifications, enhancements, operations, maintenance and support costs. The objective of this effort is to achieve an affordable product which is acceptable in terms of performance, readiness, supportability, effectiveness and schedule. The contractor's organization should be structured to facilitate this management effort and identify appropriate skilled resources and responsibilities.

5.4.14 Cost control strategy. The contractor should develop a cost control strategy that makes cost equal in importance to performance, supportability and schedule during the design and development process. This strategy should allow for balancing projected future acquisition and ownership costs and precipitate proactive measures to meet stated cost targets. This strategy should also include an evaluation of the cost risk associated with achieving the goals and the appropriate level of management involvement required to contain the risk.

In addition, the Government should ensure that the contractor develops policies and procedures consistent with an increased awareness of cost. These procedures should include allocation of subgoals, management by objectives, DTC status discussions at program reviews, awards, and publicity. Appropriate levels of cost and performance visibility should be provided to cognizant Government and contractor engineers and managers.

5.4.15 Cost trend analyses. Cost estimates and variances from design targets should be periodically tracked and provided to individual design-build teams in a timely manner. The cost analyses should be reported and organized to identify and explain adverse trends in terms of both LCC and the individually allocated cost subtargets. A corrective action plan should also be developed for management's use in resolving identified problems. Key Government personnel should be closely linked to the contractor's DTC management team and should examine their (the Government's) requirements and procedures to assist the contractor in fighting cost growth.

5.4.16 Threshold breach. The contractor should be required to continuously analyze cost variables and forecasts, and he should take appropriate action whenever a substantial breach is forecasted. In the event of a probable threshold, target or goal breach, the contractor should formally report each critical and/or potential breach and determine what corrective action is required. For major programs (programs costing in excess of $200 million in development or 1 billion in production) a zero cost growth option should accompany the report of the potential breach. For less than major programs, the responsible review authority will decide whether a zero growth alternative is required to accompany any notice of a cost breach.

5.4.17 DTC/LCC management. The contractor should be required to prepare and submit a DTC action plan and procedures for each instance where the projected cost of the current design significantly exceeds the approved goal.

This plan should identify the specific tasks necessary to reduce the projected cost to a level equal to or below the cost goal. This cost reduction effort shall be discussed in terms of LCC, schedule, risk, and benefits. The contents shall address cost avoidance, affordability, and effectiveness reallocation procedures.

5.4.18 Cost reduction efforts. The Government PM should require the contractor to submit periodic DTC status reports summarizing the progress in carrying out the cost reduction efforts identified by the cost trend analyses, and threshold breaches. For each task, the report will discuss the background, action taken to date, actions planned, schedule, and the current assessment of the cost reduction's successful efforts relative to the DTC goals.

5.4.19 Reports and data. The contract should require the contractor to establish a means of rapid communication for reporting DTC status to responsible organization and Government personnel throughout the term of the contract. The level and detail of these reports shall be consistent with the stage (phase) of design and the responsibilities assigned to Government and contractor personnel. Reports will be submitted by the contractor according to the stated schedule, with any subsequent modification. To the maximum degree possible, the contractor should provide timely Government visibility into the DTC planning, status, and actions through the use of electronic data links consistent with the contractor's in-house management information systems (MIS). Electronic data links offer the possibility of reducing the frequency and size of reports and replacing them with on-line demands for updating data as needed. The current status should be compared with the previously reported status. These comparisons between the current estimate and previous estimate should be used to illustrate cost and schedule trends. Whenever the cost objectives/goals are changed, the contractor shall include an explanation of how the trends will be effected. The contractor should be required to provide a quantitative substantiation of the evaluation along with recommendations.

The final report should contain, with supporting rationale, the contractor's recommended cost targets/goals for the next program phase and an executive report on the overall DTC effort. Close coordination will be necessary, since these reports can involve inputs from many functional groups engaged in the DTC effort, (e.g., design engineering, systems engineering, human factors, safety, reliability, maintainability, logistics support, operations research, and cost analysis).

The contract should allow for Government access to contractor technical personnel, cost methodologies, and related data bases available to support monitoring, surveillance, validation and verification activities. The following are types of data typically required for an objective Government review of the DTC effort:

(1) The WBS to be used in production, broken down to a reasonable level of indenture (usually the 3rd level).

(2) A current estimate of production and related O&S cost for each of the lower level elements of the WBS expressed in constant base year dollars or by other measurable factors such as unit operating crew size, organized maintenance personnel, operational requirements and logistics R&M requirements.

(3) Estimates displayed by functional cost elements such as labor, material, overhead, purchased/subcontracted parts, etc.

(4) A current ranked list and assessment of the cost drivers.

(5) A cumulative summation of these detailed estimates at each level of WBS.

(6) Identification and analysis of the cost variance at each level between the current estimate and prior estimates of the DTC goal or contract target, supported by rationale.

(7) A summary of cost trends.

(8) Proposed or implemented corrective actions for over-target variances or to take advantage of under-target conditions.

(9) Reliability, availability and maintainability (RAM) reports relative to predicted and allocated cost growth. Displays should provide a measure of O&S cost progress. Where possible, a conversion to comparative cost should be shown using cost factors/models.

The maturity of the design concept must be related to the milestone at which DTC is reviewed. A significant measure of the maturity of a design is the cost weighted percentage of system components or equipment which has been completed, such as: (1) drawings; (2) hardware fabrication; (3) software development; (4) hardware tests; (5) vendor quotes; and (6) actual support element costs. This data should be available at every management review.

5.4.20 Subcontracts. Most major defense system R&D acquisitions require a prime contractor, and one or more subcontractors. Frequently subcontractors are responsible for designing a portion of the system/subsystem which is crucial to the system's performance and often constitutes a substantial part of total system cost. When there is significant subcontractor design/development effort, the prime contractor should allocate appropriate DTC targets to such subcontracts and ensure full subcontractor participation in supporting the DTC effort. The tracking and reporting of progress toward subcontract production and O&S targets, and visibility of prime contractor decisions regarding changes in subcontract DTC targets, performance, or other requirements should be included in the prime contract. Subcontractors may also have DTC incentives built into their subcontracts with the prime contractor.

6. CONTRACTS/ACQUISITION PHASES

6.1 Background. Although the objective of DTC remains constant throughout the development phases, there is a marked shift in the tasks and emphasis as the cycle progresses. Although DTC contract requirements must be tailored to the specific phase of the individual program, they should include the following, as a minimum:

(1) Establish cost as a design criterion equal in importance to performance, supportability and schedule.

(2) Provide needed flexibility in terms that will protect the interests of the Government while allowing the contractor the maximum latitude to tailor his design to meet DTC targets and affordable systems/subsystems.

(3) Define DTC targets in terms which are auditable, contractually enforceable, agreeable and meaningful to both the contractor and the Government.

(4) Define the means by which contractor progresses toward achieving DTC targets will be formally assessed, recorded and reported.

(5) Motivate the contractor to achieve DTC targets through competition, practical contractual incentives, intensive organized management, or all of the above.

In addition the contract terms and conditions should reflect the phase of development. For example the DTC contract requirements for concept exploration/definition differ from those for full scale development. General guidance for each contract phase and type is provided below.

6.2 Conceptual exploration/definition. The requirements process has a major impact on future weapon system costs. In analyzing the possible ways of countering a threat or supplying a needed capability, the cost and schedule of each of the possible alternatives must be minimized while optimizing performance and supportability. The degree of uncertainty and risk contained in cost estimates at this point in the development process is very high and the accuracy of point estimates is highly questionable. In this stage of development it might be better to express these estimates in terms of relative cost differentials between competing concepts or perhaps in terms of a range.

As the concept exploration/definition phase progresses, the objective should be to identify cost drivers and viable system alternatives. The differences in the cost of development, production, and deployment of these alternatives should be analyzed and evaluated. As an integral part of this process the O&S cost drivers and the hardware/software design characteristics having the greatest influence on costs should also be identified. Where relevant, the incremental costs associated with the various levels of performance should be determined. This approach introduces cost considerations and disciplines early in the design and development process. In addition it provides the necessary background for the establishment of realistic performance thresholds and cost ceilings at the onset of the concept demonstration/validation phase (Milestone I).

For high technology programs, in which the state-of-the-art is very dynamic, or where capability to meet the threat (mission) is more important than cost, the use of firm cost goals may be self-defeating or even impossible in concept exploration/definition and concept demonstration/validation. Rapidly advancing technology may invalidate premature decisions resulting in firm goals that have been set either too high or too low, driving decisions to something less than an optimal balance between cost, schedule, performance and supportability. In these situations, flexibility in cost objectives should be allowed to vary to reflect this pre-planned product improvement (P^3I) advancing technology and its validation at each major concept change or design iteration. When necessary, alternatives that are clearly beyond the limits of affordability can be de-emphasized in favor of more affordable ones. The cost estimates are generally not refined enough for the establishment of firm goals at this point, but instead represent objectives which may be validated during the concept demonstration/validation. An in-depth analysis of the affordability of these objectives should be completed, documented and reported prior to the conclusion of this phase.

The contracts let for this phase are typically comprised of technical studies and/or feasibility models. At this stage, often there is no formal requirement for a firm program DTC goal. However, in some cases the contractor(s) may be provided guidance as to the anticipated affordability levels and other design constraints (such as whether or not to go beyond the state of the art). Where this is done, the guidance should be in sufficient detail to be meaningful (i.e., performance and schedule objectives, planned elements of cost, the general predicted production quantities/rates and deployment concept).

One of the results of the concept exploration/definition phase should be to accumulate enough information to establish the system's DTC and technical objectives with reasonable confidence levels. This information should include general estimates of production and O&S costs, and studies or models used to date. The detail and substantiating data should be consistent with the degree of design definition. From these studies conducted jointly by Government and contractors during this concept exploration/definition phase the Government should begin to identify the relationships for performance, logistics support levels, DTC goals, and objectives to be achieved in later phases.

6.3 Concept demonstration/validation (CDEM/VAL). Preliminary life cycle cost estimates and DTC objectives are required in the System Concept Paper (SCP) at Milestone I (and at comparable points for non-major systems and subsystems). These are based on the preferred and prioritized system alternatives developed during the concept exploration/definition phase.

The application of DTC in CDEM/VAL should include the establishment of cost goals and objectives, expressed as ranges if point design estimates are not possible at this time. Alternatives should be compared with the data available at this point. Throughout the CDEM/VAL phase, proposed hardware and software design alternatives should be assessed in terms of their impacts on the DTC objectives and their ability to identify those optimum alternatives possessing an affordable mix of system cost parameters (acquisition and O&S), performance, and schedule.

The ultimate purpose of the DTC effort during the CDEM/VAL phase of a program is to provide the decision-making information required to develop and justify DTC goals as soon as possible, but not later than the beginning of FSD (Milestone II).

One result of the CDEM/VAL phase should be prototype design, fabrication, and test. In this phase, the RFP should specify DTC objectives or an affordability ceiling and the minimum acceptable performance, cost and schedule requirements. In specifying the performance and other design constraints such as O&M, inclusion of requirements that would generate significant costs but make only a marginal contribution to the required mission should be avoided. Caution should also be exercised to ensure that performance and design requirements do not adversely impact total cost in comparison to their contribution to the system's mission effectiveness. The use of an acquisition strategy addressing streamlining procedures can help minimize this potential problem.

If the contractor is asked to provide DTC estimates in response to a CDEM/VAL activity, consideration should be given to extending the RFP period to 130 days instead of the more normal 90 days. This would allow the necessary time to establish DTC estimates with some degree of accuracy. Given the required time, the cost estimates could then include a cost technical baseline, description of techniques used, ground rules, assumptions, evaluation mechanisms and selection of various designs and support concepts. In addition it would include any required program support rationale and priority. Documented data in the above categories can help to maintain consistency with follow-on estimates and, downstream, it may provide larger benefits at a modest cost along with cost avoidance alternatives.

6.4 Full scale development (FSD). The decision to enter FSD normally includes selecting a system to be developed from among the competing concepts and designs, which have various performance, cost, operating and support characteristics. Because the overall performance characteristics, attributes, basic design, O&S configuration, and unit cost goals should have been firmly established at this time, available flexibility to trade these elements for cost considerations is significantly lessened. However, even with many of the design decisions already made, cost can continue to be used as a design parameter.

Design engineering is an iterative and complex process. Design to cost is a viable control mechanism intended to identify areas in which design changes (enhancements) can effect significant cost savings or avoidances. As the design matures, the DTC effort is directed toward providing visibility into those areas of risk where cost growth threatens the achievement of DTC goals. A large number of cost constraining techniques exist, such as standardization, value engineering, producibility engineering and planning (PEP), could-cost, should-cost, non-developmental items (NDIs), robotics, new technology insertion, VHSICs, and PIPs which when applied would limit cost growth resulting from design engineering changes or added requirements. These techniques can reduce costs without sacrificing required system performance, supportability and schedule. DTC also involves tracking the progress and effect of these changes on future budgets. The Program Objective Memorandum (POM) and Budget Estimate and Submission (BES) cycles for the PPBES provide the vehicle for supporting rationale and while producibility must be considered even in the concept exploration/definition and CDEM/VAL phases, it

is a key ingredient of FSD. Producibility and maintainability engineering of a design, together with logistics support analysis, are basic and necessary aspects of the FSD DTC effort. They serve to ensure continuing cost limiting activities during the early stages of the weapon system life cycle. Cost avoidance/reductions do not happen; they are made to happen! Rigorous cost avoidance/reduction activities are needed to make forecasted experience/improvement curve rates a reality.

By the time the program begins FSD, a firm design configuration (approved by the Government at CDRs) and the system performance requirements should have been established. The system design is largely "frozen" except for relatively minor Engineering Change Proposals (ECPs) formally submitted for Government approval. When two or more parallel FSD contracts are a feasible acquisition strategy, source selection should consider the selection of the best design in terms of LCC, system performance, schedule and/or supportability parameters. During CDEM/VAL the acquisition strategy of most systems requires the testing of prototypes; therefore, there will normally be a test data base upon which to affirm the evaluation of system cost including O&S (supportability) cost as well as performance and schedule. The actual cost incurred in prototype fabrication may provide indications which will be useful, but not fully conclusive, estimates for production costs. At the close of the CDEM/VAL phase the contractor(s) should be required to provide refined estimates of production, O&S cost, methodology, DTC plans, assumptions, data and source information for use in the FSD contract (source selection requirements).

When there is only one FSD contractor, selection of the best design in terms of LCC, system performance, schedule and/or supportability parameters should still be emphasized, but the contract requirements will normally be more explicit. The system design parameters, configuration and performance requirements normally have been established and are included. However, as with CDEM/VAL, unessential and overly detailed technical requirements must be avoided. Acquisition streamlining or value engineering may be used to purge contract documents of requirements that add to cost but contribute little to the military mission.

The FSD contract must include DTC targets, or provisions for establishing them as soon as possible, an identification of the relevant cost elements, the associated assumptions, and ground rules. The contract should also include the requirements for the tracking, reporting and reviewing the status of progress made and documentation prepared toward achieving these targets. Provisions requiring the prime contractor to allocate targets to the major subcontractor(s) and requiring that the prime contractor be responsible for managing them through the organization responsible for their status should also be included. In addition P^3I and system support improvement (SSI) should be included as an integral part of the original DTC effort. If this is impractical, then separate goals for the improved product should be developed.

6.5 Full rate production and initial deployment. At times a DTC award or incentive fee for a development DTC target is paid to the development contractor for actual cost performance being performed two to three years into

production or even after the system is fielded. This is especially true for O&S cost targets where fielding is required to determine MTBF and MTTR. Unit production targets and O&S cost must be established in accordance with an agreed set of cost elements and progress (experience/learning) curves to prevent improper assignment of production related cost elements. Identification of appropriate cost elements acquired from the contractor's cost accounting system, applying specified progress curves and escalation factors, must be used to translate the DTC targets into actual costs that can be tracked and measured.

The production contract deliverables which are not a part of the production elements identified in the FSD DTC effort should be excluded from the DTC tracking and evaluation. The production contract should provide the data necessary to track the actual costs associated with the DTC elements that make up DTC goals. This cost tracking should start immediately after the production contract is awarded and the cost data should be reported initially within the first 90-120 days, and at least quarterly thereafter. DTC tracking should cease two to three years into production when it has been determined that the FSD DTC target has been achieved or cannot be achieved. Contractual clauses must be incorporated in the FSD contract to deal with problems resulting from awarding of production contracts to someone other than the FSD contractor. If this is not carefully done, it may not be possible to either reward or penalize the development contractor for DTC efforts if production is awarded to another contractor.

DODD 4245.3 requires that production and O&S cost be rigorously controlled through the establishment of DTC goals. A number of factors such as changes in engineering design, mission threat, funding, supportability, schedule, GFE and performance requirements may increase costs during production. There are a number of techniques available to counter such changes. These include intensive and organized management (both Government and contractor), contract incentive clauses, reliability improvement warranties, and cost reduction oriented pre-planned product improvement programs. Funding set-asides to finance such efforts must be made early in system development if these opportunities are to be properly exploited. Cost increases resulting from quantity, schedule, inflation and/or learning/experience changes can be accommodated by learning curves and escalation/de-escalation factors.

7. INCENTIVES

7.1 General. The primary intent of an incentive is to motivate the contractor to undertake those efforts necessary to acquire a product that can be produced and supported at or below the DTC targets that the Government and FSD contractor have previously agreed upon. The nature of the incentive arrangement and the size of the incentive should be commensurate with the savings anticipated in the production effort. If the acquisition strategy is to rely primarily upon concurrent development competition to achieve the DTC targets, then the use of additional DTC incentives will normally be unwarranted. If concurrent development competition does not exist, then the contract should be intensively managed by the Government or contain some type of incentive to properly motivate the contractor to achieve DTC targets.

Competition in the industry is probably the single most compelling incentive. It may provide an all or nothing incentive environment; i.e. the winning contractor receives all or the largest portion of the follow-on Government production contract. In a sense, even the sole source contractor is competitively motivated when failure to meet DTC objectives may jeopardize program continuation and follow-on production contracts, but the contractor should be made aware of these penalties.

Award fees and/or incentive fees can be effective in motivating the contractor to achieve or better DTC targets if applied properly. Award fees are earned through subjective Government evaluation of the contractor's performance in meeting or bettering agreed targets and are added to existing fees. However, unless a waiver is obtained, these R&D contract award fees are limited by Federal Acquisition Regulation (FAR) to 12% plus a 3% base fee for a total fee of 15% of the development contract price. Incentive fees are earned through objective evaluation of performance and planned payment equations. They may either modify existing fees or be an independent additional fee. These too, however, are limited to 15% of the development contract fee. The incentive fee structure requires that some sort of cost limiting mechanism be imposed. (Refer to FAR 16.4.)

Value Engineering Change Proposals (VECPs) provide another incentive mechanism which can be used during the latter stages of development and throughout production. VECPs require that a change to the contract be implemented and they must save the Government money. The contractor jointly shares in these efforts. Care must be taken to ensure that VECPs and DTC efforts complement, but do not duplicate each other.

Warranties and guarantees can be used to provide incentives to the contractor to design and produce a system that meets specified reliability and maintainability targets. These targets may also be incentivized with award or incentive fees to be paid at some future date. Typically however, award fees for O&S achievement are earned through test or simulation results while warranties and guarantees are met through service performance.

7.2 Competition. Competition is a very effective, proven tool for achieving DTC goals. It has perhaps the greatest flexibility of all the incentives. To be effective, flexibility requires careful consideration of RFP requirements, source selection criteria, and subsequent evaluation of contractor proposals. Some of the source selection criteria which lead to an

effective DTC program include the contractor's DTC management organization and plan; cost estimating, accounting, and validating methods; allocating and identifying cost drivers; cost management visibility and reporting mechanisms; procedures for identifying and conducting trade studies and cost containment, and the like.

DTC contract incentives are not likely to be effective when competition is maintained. Company survival (i.e., future contract awards) may be the most effective spur for DTC goal achievement. If the temptation of large future contracts is great enough, the competing contractors may try to "buy in" by bidding below actual cost on the early development contracts, hoping to recover in later years (refer to FAR 3.501). Thus, all DTC claims should be evaluated closely. The DTC incentives with all assumptions must be matrixed for other source selections to balance priority and rating for the best and final offer (BAFO). Whenever possible the contractor should be required to sign up to a Firm Fixed Price (FFP) production contract option during full scale development; this option should be based on the unit production costs and associated LCC.

7.3 Award fees. In most programs, the design generated in FSD will not always be the same one that reaches production nor will the early prototype configuration be the same as the FSD configuration. This design evolution complicates the Government's task of determining the amount of the award fee. Adequate audit trails of Government mandated and other contract changes is vital for determining an equitable award fee. Supporting documentation in performance progress is essential.

An award fee should be included as part of the FSD contract and should be based upon the achievement of the DTC targets negotiated therein. Award fee payments made in production should be based upon the contractor's actual performance in achieving the FSD DTC targets. Actual unit production costs should be compared to the negotiated unit production costs and the determination of the amount of the award fee payments should be tied to at least the first two to three years of production. An award fee gives the Government latitude to make payments according to the results achieved. Similarly, the flexibility of an award fee arrangement is particularly useful for O&S cost incentives. Awards for O&S achievements should be paid only after system demonstration that O&S objectives have been achieved.

Generally, each contract containing provisions for achieving DTC targets can also contain provisions for the payment of an award fee related to the DTC targets in addition to any other structured incentive; however, the sum of the contract fees cannot exceed 15% of the development contract cost without a waiver. The amount of the award fee must be large enough to keep the attention of the contractor's top level management on the achievement of the DTC targets. A range from 3% to 12% of the engineering development contract is encouraged, with 12% the predominant figure for larger programs. The thrust of the award fee provision is to motivate the competing contractor into maintaining a dedicated effort to design a system which will cost the Government no more than the DTC targets stated in the contract.

Where it is deemed advantageous to use an award fee to encourage a developer to achieve the DTC targets, the amount of fee, progress milestones, range of incentive, and level of performance must be determined in advance and incorporated into the development contract. This strategy must be communicated to competition within the industry.

7.4 Payments. Award fees for DTC are generally based on contract terms that provide for payment upon the completion of established milestones. The award fee payments are based upon the degree to which the performance requirements for that milestone were fulfilled and upon the Government's subjective evaluation of how well the contractor has performed in designing the system within the DTC targets at that point. The Government may, under an award fee contract, award partial fee sums to the contractor if the contractor has not fully achieved the objectives of the contract. The Government may also award no fee (except for the mandatory 3%), if the contractor has achieved some objectives while performing at unacceptable levels under other key elements of the contract.

Payments of award fees, or portions thereof, held for poor contractor DTC performance may not be carried forward to the next award fee milestone. But this will depend upon whether the Government desires the contractor to periodically achieve DTC targets at the milestones established or at the end of the design effort for the contract. The most significant portion of the award fee should be reserved for actual demonstration of the achievement of production and O&S targets. A production contract signed at or below the DTC targets is a strong indicator of a successful DTC program; however, only if subsequent cost growth (due to design changes) is constrained and documented can the entire DTC activity in the program be deemed a success.

Award fees must be included in the contract so that increments of the award fee may be paid based on documented rationale and evaluation. The schedules where the award fee is to be paid should be consistent with the tracking programmatic milestones. These targets should be spaced so that measurable design, development or qualification goals (such as CDRs or the completion of a series of development tests) have occurred during the interim. The award fee progress payments can be paid at the milestones and graduated in value as discussed previously.

7.5 Incentive fees. Incentive fees contained in cost plus incentive fee or fixed price incentive fee type contracts are specific contractual entitlements to be authorized to the contractor upon achievement of the previously specified target alone based upon concise objective evaluation of the goal achievement. When incentive fees are used the FAR also limits the amount that can be paid to a total fee of 15%. All incentive payments and evaluation procedures must be carefully explained in the terms of the contract. Mutual communication and understanding of these incentive fees are prime motivations for contractors to meet DTC targets. The limits on incentive fees are not exclusive of award fees; both fees together must not exceed 15% in R&D, or 10% in production.

In instances where a substantial incentive fee may be paid by the Government, the basis of an estimate or projection of DTC performance should be developed in accordance with a mutually agreed upon methodology and formuli. The agreement should provide for such things as application of progress (learning/experience) curves, the effects of soft tooling, hard tooling, labor mix changes, overhead, business base projections, adjustments for inflation, economic escalation, and any other significant factors. The P^3I and state-of-the-art technology exploitation are prime considerations.

7.6 Multiple incentives. When multiple incentives are included in a contract, the DTC incentive should be separate and distinct from the others, and it should be large enough to not be overshadowed by other incentives. It is best to limit the number and complexity of incentives so as not to dilute their intended effect by minimizing their size and consequently their impact. To minimize contractor "gaming", making an incentive so large that it would be more advantageous for the contractor to achieve it at the expense of lower incentives should be avoided. It is recommended that both UPC goals and O&S goals be incentivized but not independently (for example, specific UPC goals should be evaluated with their associated O&S goals). The incentive for achieving DTC targets must be compatible with the related essential performance and other goals. Since DTC targets can often be represented as a function of such factors as R&M, one must be careful not to reward or penalize the contractor twice for the same benefit. The requirements allocation matrix developed to support the multiple incentives program within the contract should present an optimally balanced approach.

8. REQUEST FOR PROPOSAL CONSIDERATIONS

8.1 General. The following areas should be addressed in response to RFP's.

8.1.1 Design balance. Design proposal and method for achieving the design should consider the best balance among performance, cost elements, economic production rates, supportability, and schedule.

8.1.2 Cost data bases/models. Available cost data bases and models should be recommended and included in the RFP.

8.1.3 Flexible requirements. Requirements should be structured to encourage technological innovations, ingenuity and inventiveness; non-essential detailed specifications and technical requirements should be excluded; and activities should be limited to mission essential requirements.

8.1.4 Risk. Areas considered to be high risk or that have a major effect on cost should be identified, and avoided whenever possible.

8.1.5 Ranking. Parameters should be ranked for the purpose of accommodating tradeoffs.

8.1.6 Trade studies. Areas of consideration for trade studies and limitations associated with the trade studies should be identified. Trade studies shall be conducted on the top ten cost drivers and their alternatives.

8.1.7 Compatibility. Compatibility is required between system, equipment, and when appropriate, facilities.

8.1.8 Latitude. Latitude should be influenced by the degree of risk, performance requirements and schedule.

8.1.9 DTC requirement factors. DTC requirements should be based upon quantities, rates, time periods involved, DTC award/incentive fee requirements, and the deployment concept.

9. SOURCE SELECTION CRITERIA

9.1 General. The following areas are vital source selection criteria.

9.1.1 Best value. Proposal(s) which offer the best potential combination of performance, supportability, and LCC, and meet a given schedule are considered the best value.

9.1.2 Cost management approach. The management approach for making cost equal in importance to performance, supportability, and schedule must be considered.

9.1.3 Credibility. Credibility of and the procedures for, estimates of LCC (R&D, Production, O&S costs and pre-planned product improvement), including methodology used to generate the estimates, groundrules, and assumptions, the data used, and sources must be considered.

9.1.4 Detail. The scope and depth of data required to support claims made in the proposal, and the phase of acquisition must be evaluated.

9.1.5 Goal adjustment. Rationale for changing goals due to directed changes must be valid.

10. DTC CONTRACT ELEMENTS

10.1 General. The following items are DTC contract elements.

10.1.1 Management plan. Describe the DTC management and implementation plan.

10.1.2 Targets. List DTC targets/objectives.

10.1.3 Cost drivers. List top cost drivers.

10.1.4 Trade studies. List potential DTC trade studies. List other trade studies under contract and conducted previously.

10.1.5 Cost elements/factors. Describe cost elements as well as inflation factors, production planning, and deployment concept.

10.1.6 Tracking/reporting. List requirements for tracking and reporting progress status relative to the DTC targets.

10.1.7 Data requirement. Describe data required to verify DTC goal achievement.

10.1.8 Reviews. Describe planned reviews of these cost goals.

10.1.9 Minimum requirements. Identify minimum essential performance and compatibility for mission accomplishment.

10.1.10 Action plan. Describe the action plan when DTC thresholds are being breached.

11. DTC PROGRAM PLAN ELEMENTS

11.1 DTC plan. The information generated by the contractor's DTC program planning effort shall be summarized in the form of a DTC Plan and submitted in accordance with applicable contract requirements such as the Contract Data Requirements List, DD Form 1423. The DTC Plan shall be sufficiently comprehensive to enable the procuring activity to: (1) ascertain with a high degree of confidence that the contractor has adequately evaluated and planned for an active engineering cost control effort; and (2) monitor the contractual effort to ensure timely and effective execution of the DTC program. This plan shall also provide for an action plan which will be submitted whenever a potential breach of a cost threshold is imminent.

11.2 Cost control strategy. This section of the plan shall discuss the contractor's approach for making cost equal in importance to performance, supportability, and schedule requirements. This section will also discuss the contractor's plan for balancing the projected future costs of production, operations and support, and for taking active measures to meet or better the cost targets. This includes identifying the degree of risk involved in meeting the cost targets and the appropriate level of cost control activity to contain this risk. Additionally, this section includes: (1) the contractor's approach for instilling cost discipline in decision making personnel (e.g., allocation of cost subtargets, management by objectives, awards, publicity, etc.); (2) providing appropriate level of cost visibility and cost status feedback to the cognizant managers and designers; (3) establishing procedures for "make or buy" decisions, (4) controlling vendors and subcontractors; (5) establishing ground rules for adjusting targets (e.g. to account for such things as estimating errors, engineering change proposals, specification changes, etc.) and (6) the rationale showing how cost targets were established and the methodology used to control cost and balance production, operations and support costs. Further, this section of the plan shall provide a list of all required trade studies, (which will be updated annually) showing how they relate to the major cost drivers and include a discussion of any major cost drivers which will not be addressed in sufficient depth during the formal tradeoff process. Also, this section shall discuss plans for timely Government visibility into the contractor's DTC program via an electronic link or other equally expedient method.

11.3 Organization. Organization for the DTC function does not imply new organizational entities. For many companies with prior military contracting experience, the functions contributing to an integrated DTC effort are already in place (e.g., systems engineering, logistics, production planning, reliability, cost analysis and estimating, etc.). This section of the plan shall discuss the contractor's organization for executing the cost control strategy in an effective and efficient manner. It will also include the management structure, contractor decision and approval authority, policies and procedures, and functional relationships for making cost a key decision and design parameter. Additionally, this includes discussion of the functional responsibilities, analytical techniques, and data processing capability for providing current, concise, and timely cost feedback to the organization's decision-makers. Organizational elements which are uniquely DTC-related must be justified. If value engineering is contributing to cost reductions, how it relates to the DTC effort must be shown.

11.4 Milestones. This section of the plan shall provide a schedule for the status and effectiveness of the DTC program. Formal DTC reviews shall be held periodically between the procuring activity and contractor DTC personnel. Care should be taken in spacing these reviews to ensure that enough new design information is available to warrant the expense of preparing and attending these reviews. Additionally, all formal project status reviews, preliminary design reviews, and critical design reviews shall include a review of the DTC Program and an assessment of its effectiveness in controlling cost. These reviews provide the best opportunity for the Government to ensure the continued effectiveness of the contractor's engineering cost control effort.

11.5 DTC tradeoff studies. This section of the plan shall discuss the selection and identification of any DTC tradeoffs which are necessary to address major cost drivers not covered in other formal engineering tradeoff studies. The schedule, level of efforts, and means and depth of detail of reporting results for these studies shall be discussed. This section shall be updated as new tradeoff studies are developed and as the results of the trade studies are completed. A rewrite of the plan is not necessary for these updates; the use of change pages is encouraged.

11.6 Cost methodology. This section of the plan shall discuss the procedures for identifying the DTC-recommended alternative resulting from formal tradeoff studies, and for providing the necessary level of cost visibility to support day-to-day efforts to avoid and control cost in the emerging design. A flowchart shall illustrate the analytical tools, procedures, and data flow which were used to determine the DTC recommendations for formal tradeoff studies (e.g., system effectiveness, readiness, LCC, discounting, comparison to programmed acquisition funding profiles, and the like). Another chart shall illustrate data flow, analytical tools, and communication channels for providing high quality, timely, and concise cost information to the cognizant decision-making and design personnel. A table shall identify Government-furnished data required for input to contractor cost models. For multi-service procurements the Government-furnished data requirements shall be identified for each participating DOD Component. The discussion of the cost methodology shall include the approach used for analyzing each relevant life cycle phase (e.g., development, production, and deployment [O&S]) and how these phases fit together in the total cost approach. Cost modeling shall be based on the most current hardware and software configuration, retrofit planning, and support concept. Cost model documentation procedures shall be discussed showing how an audit trail will be maintained for input data and supporting rationale, cost estimating techniques, estimates, and analysis results.

11.7 DTC baseline. The cost methodology used by the contractor to support the DTC program shall be documented to show the initial and/or baseline estimates for specific cost targets and LCC. The DTC baseline shall be sufficiently comprehensive to enable the procuring activity to ascertain with a high degree of confidence that: (1) the contractor has performed cost analysis of a high technical quality based on the best available data; (2) the contractor's cost methodology is sufficiently sensitive to the type and depth of engineering design tradeoffs expected to be encountered during the contract; and (3) through independent cost analysis, that the contractor's numbers are reasonable and correct.

11.8 Cost target estimates. This section of the plan shall, if cost targets have not yet been established, present the contractor's proposed cost targets with the cost estimates and rationale to support them. If the cost targets have been established, the contractor shall present the initial estimates and supporting rationale. In either case, the contractor shall identify the major cost drivers (i.e., for production and logistics [O&S]) and show how they relate to the cost targets. A table shall show the allocated cost subtargets and the corresponding responsible contractor point of contact. If the development contract includes production options, the relationship of these production prices to the predicted production cost targets and related elements (e.g., learning/experience curves, lot size, production rates, inflation, escalation, and the like) shall be discussed in depth.

11.9 Baseline LCC estimate. This section of the plan shall present the contractor's initial or baseline LCC estimate.

11.10 Supporting rationale. This section of the plan shall address supporting rationale for the DTC and LCC baseline and shall include all guidelines, assumptions, and ground rules. Data sources and cost prediction methodology shall be described in terms of applicability to the stage of design maturity and the state-of-the-art technology. Alternate approaches or sources considered for the analysis or used for cross-checking purposes, and the associated risk or uncertainty shall also be described. Cost estimating expressions for each cost element shall be included with a definition of variables and a substantiation of corresponding values. For proprietary techniques where the contractor will not divulge the cost estimating expressions or for cases where the procuring activity has prescribed a cost model, only the input data necessary to reproduce the analysis plus the supporting rationale will be included. For cost drivers, the sensitivity analysis or other techniques used to identify them shall be summarized.

11.11 DTC action plan. This part of the plan applies after cost targets have been established. The contractor shall prepare and submit a DTC Action Plan for each instance where the projected cost of the current design exceeds a cost threshold. This plan shall identify the specific effort necessary to control costs and to get the projected cost back to an acceptable level. This cost reduction effort snall be discussed in terms of the cost for implementation, and costs to schedule, risk, benefits, alternatives and recommendations.

12. DTC STATUS REPORT ELEMENTS

12.1 DTC status report. In accordance with applicable contract requirements such as the Contract Data Requirements List, the contractor shall periodically (usually quarterly) report progress in meeting or bettering the cost targets or, if targets have not yet been established, report the status of the present estimates compared to the baseline estimates. Electronic mail or other equally expedient method should be considered as a timely means of submitting the DTC Status Report for programs where the risk of meeting cost targets is high. The final periodic report shall contain, with supporting rationale, the contractors' proposed cost targets for the next phase.

12.2 LCC and cost target tracking. This section of the report shall compare the current status versus target costs, and current status versus the previously reported costs. For LCC this comparison shall be the current LCC estimate versus the baseline LCC estimate and previous LCC estimate to illustrate LCC trends. For cost targets this comparison shall be in terms of total targets and any allocated subtargets. Whenever the individual cost targets or the baseline LCC estimate is changed, an explanation and a quantitative substantiation for the change shall be included.

12.3 Cost trend analysis. This section of the report shall evaluate the tracking information to identify adverse trends in terms of LCC, cost targets, and the individual allocated cost subtargets. Identified problem areas shall be analyzed for remedial action. When implemented these remedial actions become cost initiatives.

12.4 Cost initiatives. This section of the report shall summarize progress in carrying out the cost initiatives identified by the cost trend analysis for controlling cost. For each initiative discuss the background, action taken to date, action planned, and the current assessment of successful completion. Periodic progress on efforts to rectify a cost threshold breach as identified in a DTC Action Plan, shall be reported in this section.

12.5 Tradeoff activity. This section shall summarize formal tradeoff study activity (including any DTC tradeoff studies) and any significant informal tradeoff activity occurring or completed since the previous reporting period. A table shall identify all tradeoff studies, completed, underway, and planned. When the DTC recommended alternative identified from formal trade studies or the low cost affordable option derived from informal tradeoffs is not selected, an explanation of why the cost-preferred alternative was not adopted shall be included in the report.

APPENDIX

DTC RELATED REFERENCES

The following is a listing of other documents that are related to design to cost and may be of assistance in implementing this handbook.

1. Regulations, directives, and instructions.

AFR 800-11	DTC/LCC Management Plan
DFARS, Part 27	Acquisition Planning
DFARS, Part 234	Major System Acquisition
DODI 5000.33	Uniform Budget/Cost Terms and Definitions
DODD 5000.39	Acquisition and Management of Integrated Logistic Support for Systems and Equipment
DODD 5000.40	Reliability and Maintainability
DODD 5000.43	Acquisition Streamlining
DODD 5000.45	Baselining of Selected Major Systems
DODD 7000.3	Selected Acquisition Reports
DODI 7041.3	Economic Analysis and Program Evaluation for Resource Management
DODI 7220.31	Unit Cost Reports
DODI 7220.32	Defense Acquisition Executive Summary
Federal Acquisition Regulation (FAR), Part 7	Acquisition Planning

2. Standards.

MIL-STD-965	Parts Control Program
MIL-STD-1388-2	DOD Requirements for a Logistic Support Analysis Record

3. Manuals, handbooks, and guides.

Acquisition Strategy Guide, July 1984, Defense Systems Management College, Fort Belvoir, Virginia.

AMC Guide - Design To Cost, AMC-P 70-19, July 1987, Army Materiel Command, Alexandria, Virginia.

Cost Realism Handbook, May 1985, Navy Office of Acquisition Research, Washington, D.C.

Department of Defense Manufacturing Management Handbook for Program Managers, July 1984, Defense Systems Management College, Fort Belvoir, Virginia.

DOD and NASA Guide - Incentive Contracting Guide, October 1969, Department of Defense/National Aeronautics and Space Administration, Washington, D.C.

Integrated Logistics Support Guide, May 1986, Defense Systems Management College, Fort Belvoir, Virginia.

Risk Assessment Techniques, July 1983, Defense Systems Management College, Fort Belvoir, Virginia.

System Engineering, October 1983, Defense Systems Management College, Fort Belvoir, Virginia.

Value Engineering, DODD 4245.8-H, March 1986, Department of Defense, Washington, D.C.

CONCLUDING MATERIAL

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Army - MI
Navy - AS
Air Force - 11

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MIL-HDBK-766	Design to Cost

3a. NAME OF SUBMITTING ORGANIZATION

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

4. TYPE OF ORGANIZATION *(Mark one)*

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

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional

b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional

c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional

8. DATE OF SUBMISSION *(YYMMDD)*

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

DD FORM 1426, 82 MAR   PREVIOUS EDITION IS OBSOLETE.