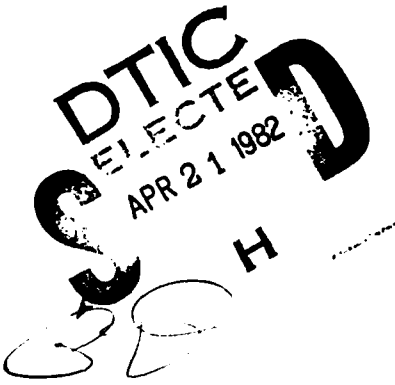
AD-A113 684 LOGISTICS MANAGEMENT INST WASHINGTON DC F/G 14/1
THE FRAMEWORK FOR LIFE CYCLE COST MANAGEMENT.(U)
JAN 82 R P WHITE MDA903-81-C-0166
UNCLASSIFIED LMI-RE103 NL

(10)

THE FRAMEWORK FOR LIFE CYCLE COST MANAGEMENT

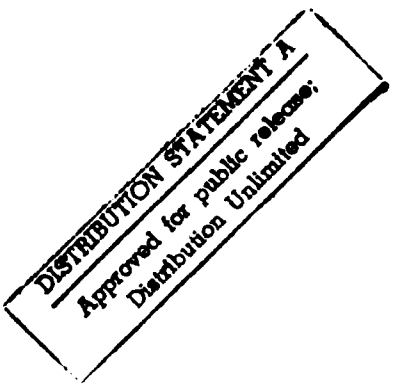
January 1982

Richard P. White



Prepared pursuant to Department of Defense Contract No. MDA903-81-C-0166 (Task RE103). Views or conclusions contained in this document should not be interpreted as representing official opinion or policy of the Department of Defense.

LOGISTICS MANAGEMENT INSTITUTE
4701 Sangamore Road
P.O. 9489
Washington, D.C. 20016



THE FRAMEWORK FOR LIFE CYCLE COST MANAGEMENT

EXECUTIVE SUMMARY

Over the past quarter century, the Department of Defense has introduced many management concepts and contracting techniques in the interest of low life cycle cost. Examples are:

- design to cost
- life cycle costing
- value engineering
- reliability improvement warranties
- affordability
- integrated logistics support
- standardization
- configuration management

Some of these are designed to aid in managing acquisition costs, some in managing operation and support costs, and some in balancing the components of life cycle cost.

Can such a diverse set of concepts and techniques, developed independently over a 25-year period and implemented through directives and instructions of a variety of organizations, be used in a systematic way to achieve low life cycle cost?

The answer is yes. They complement and reinforce each other in promoting:

- balance among the principal acquisition objectives of performance, schedule, cost, and supportability; and
- attention to operation and support needs and costs early in the acquisition cycle.

Can an integrating framework be devised within which the concepts and techniques can work together in the interest of low life cycle cost?

Again, the answer is yes. In fact, the framework already exists. It is the phased process for acquiring new weapon systems.

Although the process is undergoing change as a consequence of the Deputy Secretary's program to improve acquisition, it will continue to consist of a series of phases leading from development to production and subsequent delivery of a new weapon system. The phases are separated by review and decision milestones intended to assure that all prerequisites for the next phase have been satisifed.

Each management concept or contracting technique is an aid to at least one milestone decision by the military department or the Defense System Acquisition Review Council (DSARC). Each is used in establishing plans, providing estimates, or making trade-off decisions. Thus the framework for system acquisition -- the phased acquisition process -- also is the integrating framework for life cycle cost management.

TABLE OF CONTENTS

1. THE COST OF ACQUISITION

INTRODUCTION

Newspaper articles, GAO reports, selected acquisition reports to Congress, and internal Department of Defense memoranda each tell, from very different perspectives, of the high cost of defense. It is disturbing that this is happening today, after more than two decades during which DoD has installed new procedures for acquiring major systems and introduced imaginative programs to slow the upward spiral of costs.

Even if the impression of high costs going higher were only partially correct, it is sobering to realize that the cost of acquiring a new weapon, the cost most often cited, is only part of the total life cycle cost of one. The cost of operating and supporting a weapon over its useful life may equal or exceed the money spent to acquire it, and those operation and support (O&S) costs also need to be controlled.[1]

A number of new contracting techniques and management concepts have been introduced to help control life cycle costs. Contractual innovations include life cycle costing (LCC), reliability improvement warranties (RIW), and value engineering (VE) programs and incentives. Design to cost (DTC) and affordability are two of the newer management concepts.

---

[1]We have chosen to address the attempts to achieve lowest life cycle cost in terms of the development, production, and use of major weapon systems, in part because of the large dollars committed to these purposes, but also because the existing programs that deal both directly and indirectly with total costs of ownership were designed for use in the acquisition of major systems. The contract techniques (LCC, VE incentives, RIW) can be used on other than system acquisitions without concerns for the trappings of program management that exist to help control the uncertainties of design, development, and production of a new system.

The question, in regard to these and other concepts and techniques having to do with management and control of costs, is whether they all work together in the interest of low life cycle cost, or whether they compete with each other and only serve to confuse the weapon system acquisition process.

Our objective has been to develop an integrating framework for compatible employment of the management concepts and contracting techniques in the interest of low life cycle cost. We conclude that the framework already exists in the phased acquisition process, the reviews by the military departments, and the key decision milestones of the Defense System Acquisition Review Council (DSARC). The factors essential to life cycle cost management can be fitted into that framework.

In this first chapter we examine the nature and sources of the costs of acquiring and operating military equipment, the elements that shape the costs, and the role of the contract. In Chapter 2 we describe and analyze the current factors that are intended to influence and restrain the costs of acquiring and operating major systems. Chapter 3 presents the essence of the second chapter in a framework for managing the costs of the total program, from conception through development and production to operational use -- in other words, for managing life cycle costs. Chapter 4 sets forth conclusions. The Appendix is a detailed analysis of DoD regulations, directives, and instructions covering factors that influence life cycle cost.

COSTS

Cost of contract performance is and has been a key target of DoD's procurement policy and practice. Contract cost analysis, contract price analysis, contract cost principles, cost accounting standards, profit policy, contract types, contract negotiation techniques, certified cost or pricing

data, and indirect cost monitoring are among the tools used to assess and influence contract costs.

The cost of contract performance is defined as the price DoD must pay to acquire a product or service, and statutes and regulations talk both price and the cost of ownership. Public Law 10 U.S.C. 2305(c) stipulates for formally advertised procurements that "Award shall be made...to the responsible bidder whose bid...will be most advantageous to the United States, price and other factors considered." Similarly, Defense Acquisition Regulation (DAR) 3-801.1 states that the policy for procurements by negotiation is "to procure supplies and services...at fair and reasonable prices calculated to result in lowest ultimate overall cost to the Government." "Other factors" and "lowest ultimate overall cost" have been interpreted to mean that projected costs of ownership, in addition to contract price, are to be considered in selecting one contractor from among those competing for an award.

This effectively broadens the area of responsibility for costs beyond the contracting function to include such functions as program planning, designing, supply management, maintenance engineering and management, quality assurance, testing, personnel, and transportation. DAR 3-801.3 points out that timely actions and decisions in other functional areas will affect the price that must be paid on any given contract, but it does not address the major role that many of these others play in determining the level of ultimate overall cost to DoD.

In any event, contracting officers rarely have taken the path provided by law and regulation. Price and other factors and overall costs are not used often, perhaps because contracting officers have not sought, or have had difficulty getting the outside help needed to make and justify selection on any basis other than low bid or low offer.

The DoD Life Cycle Costing Procurement Guide (Interim) issued in 1970 sought to provide a way to justify award on the basis of total ownership costs. It defined LCC as "an acquisition or procurement technique which considers operating, maintenance, and other costs of ownership as well as acquisition price, in the award of contracts for hardware and related support."[2] It said the objective of LCC "is to insure that the hardware procured will result in the lowest overall ownership cost to the Government during the life of the hardware."

In the period immediately following the development of the LCC technique, its use was targeted for competitive procurements of less than complete weapon systems. The GAO reported in 1973 that it had identified 64 LCC awards made by DoD during the first seven years of testing the concept.[3] Most of these had been awarded during fiscal years 1970 and 1971. Thus it is obvious that it still was not easy to use "price and other factors" in selecting one contractor for award.

However, awareness of the significance of life cycle cost also existed outside the contracting process. Planners and logisticians with concerns for operating and support costs and availability of systems and equipments had developed concepts such as reliability and maintainability and worked to push logistic planning forward to the front end of the major system acquisition process.

Cost Estimates

Estimated costs are an adjunct to the decision process in both competitive and noncompetitive procurements, at all stages in the useful life

---

[2]The Swedish Air Force, on the other hand, considers LCC to be a maintenance responsibility and assigns responsibility to the plans division of the maintenance organization.

[3]"Ways to Make Greater Use of the Life Cycle Costing Acquisition Technique in DoD," B-178214, May 21, 1973.

of a product from the first contracts for design and development through the last buy of the production item and consideration of the last proposal to modify the items in the operational inventory. There is not necessarily universal agreement as to what activities and events are to be covered by the estimates, but the use of evaluated estimates in making decisions is an accepted practice.

It is expected that estimated costs, those of the Government as well as those of competing companies, will be used in planning acquisitions and in selecting a winner or winners in competitive acquisitions. The Government also is expected to use estimates during the iterative design, development, and test process. There are many different cost estimates, made at different times for the same and for different purposes. The first estimates, early in the design stage, obviously are blue sky; the design is not fixed, uncertainties are great, performance characteristics are evolving, the maintenance and supply concepts are not yet firm, and new data are being generated constantly. However, as things start to take shape, the estimates of what it is likely to cost become more precise, still subject to significant error but better than earlier ones.

At some point, early in this process, estimating just the likely cost is not enough. All decisions must factor in the cost of alternative actions in order to reach an intelligent balance between product availability and performance characteristics and the cost of attaining those objectives. To borrow a phrase from DoD history, the overall and overriding goal still is to get "the most bang for the buck."

Life Cycle Cost Determinants

Life cycle costs are the result of many different decisions and actions in the design, development, production, operation, and support of a

system, subsystem, or component. The decisions and actions in turn are the objects of the specific functions addressed in the directives and instructions reviewed in the next chapter.

Life cycle cost factors in the design, development, and production phases include the product design, the availability and adequacy of funds, test requirements, production rate and quantities, and, obviously, the costs incurred by the contractors in doing the work.

The design is a function of the perceived threat and the need that shapes the system solutions which are explored before picking the one or ones to take into full-scale development and production. Design decisions are influenced by the life cycle cost considerations of affordability, design to cost (DTC), reliability and maintainability (R&M), quality assurance, standardization, specifications, standards, configuration management, parts control, and value engineering.

Funding, at the time needed and in sufficient amounts, is essential to the orderly and stable performance of design, development, and test, to the planning and analysis for future logistic support, and for economic and efficient production.

Test requirements are functions of the technological uncertainties of the design, the interaction of the subsystems and components, and the maturity and demonstrated quality of the parts. Because test programs can cost considerable amounts of time and money, they must compete for both with engineering and production requirements within the constraints of finite funding and fixed initial operational capability (IOC) dates. The costs include both the cost of the testing procedures and the cost of necessary redesign, rework, and retest. Life cycle cost considerations are explicit in the requirements of directives dealing with R&M and test and evaluation (T&E).

Production rates and quantities are functions of the perceived threat and availability of funds, and the relative stability of these factors has a profound effect on acquisition cost. For example, quantity and schedule changes accounted for about one-third of the 129 percent growth in the cost of 47 programs reported in the Selected Acquisition Reports (SARs) as of 31 December 1980.

Contract costs are a function of all the foregoing factors, design, funding, T&E, and production rates and quantities. They also are a function of lead times, fixed costs of the contractors, efficiency and economy of their operations, and effects of inflation. The techniques employed in cost and price analyses, contract negotiations, and contract management are intended to help keep the contract cost portion of total life cycle cost at a reasonable level.

Life cycle cost factors in operation and support of deployed systems and equipments are functions of manning, training, maintenance, spares, and the frequency, manner, and length of use. These factors in turn require early planning, as stipulated in directives on integrated logistics support, quality, reliability, maintainability, survivability, supportability, standardization, and other logistic efforts.

THE ROLE OF THE CONTRACT

The report submitted to the Deputy Secretary of Defense on 30 March 1981 at the conclusion of a 30-day assessment of the defense acquisition system, included a statement that brings into question the role of the contract in life cycle cost management.

The statement was that although more attention was being paid to "support" in DoD solicitations, performance and schedule were still seen by contractors to be DoD's principal objectives. The recommended solution was to

identify ways to motivate contractors to attain R&M goals. This would include the approach used to evaluate proposals as well as specific awards, incentives, and guarantees. One suggestion, a specific award for improving R&M, addressed an obvious key to lowered life cycle cost, but it would be a questionable way to attain that goal.

The theory of contract incentives has been challenged in studies for the past 15-20 years, almost from the start of the drive in 1962 to increase DoD use of incentive contracts. Despite absence of support from studies, contractual incentives still are proposed as solutions for many acquisition problems. The following paragraphs are intended to put the contract in perspective and to pose questions that seem to warrant definitive answers.

Contract is a term used to describe an agreement, enforceable by law, between two or more competent parties, to do or not to do something not prohibited by law, for a legal consideration. Thus, in the context of DoD's acquisitions, the contract is the agreement between a contractor and DoD as to what the contractor will do, when he will do it, and what DoD will pay the contractor for doing it. The amount paid will be related, depending on the terms of the contract, to either the estimated or the actual costs of doing the agreed-upon work.

The contract often is looked upon as the means for motivating a contractor to achieve goals that otherwise might not be reached. Examples are the various forms of incentives whereby a contractor may be promised additional profits for bettering target objectives of cost, product performance, or delivery. Other examples are RIWs, VE incentives, and LCC. These incentive concepts are outgrowths of a basic procurement principle expressed in DAR that profit is the basic motive of business enterprise, a motive that should be harnessed to stimulate more effective and economical contract performance.

That appraisal of business motivation rests on the assumption that contractors are profit maximizers and will opt for alternatives that promise increased profits. This view may be valid, although the continued upward surge of program costs, despite widespread use of incentive contracts, would seem to make it suspect. The fact of escalating costs raises two distinct possibilities. One is that a contract might not be a proper mechanism for controlling program costs. This possibility grows out of the fact that although a contract covers specified tasks to be performed within a stated time for a given price, any one contract covers significantly less than the total program and contract cost objectives may be attained by actions that prejudice program cost goals.

The second possibility is that the fault lies with the particular types of contracts used and with widely held views as to what a contract is and what it can accomplish. A standard incentive contract, a precise arrangement with predetermined targets and formulas, may not be suited to contracting for development of new weapon systems using new technologies or unproved combinations of new and old technologies. The uncertainties of that environment may demand a different approach.

Further, if a contract is the expression of an agreement between two parties as to what will and will not be done, can the standard contract also be a suitable tool for managing the effort required to produce the agreed-upon result? From the point of view of both a contractor and the buying activity, the answer might be no. The contractor needs to use its own information systems and organizations to manage the efforts, and these are not and should not be contract requirements, at least in specific detail. The contract addresses what is to be done and when, but how is left to the contractor and it is the how that requires managing.

The program manager and the functional specialists in the program office need to work with their counterparts in the contractor's organization, and the contractual arrangement should facilitate the open exchange of information as to problems and objectives.

The following is a general description of the acquisition process. At the time the Mission Element Need Statement (MENS) is approved, planning and engineering have produced general ideas of a system or systems that might correct the mission area deficiency. A good deal of conceptual work needs to be done to test the initial ideas, and policy dictates that the acquisition activity contract with several (more than one) contractors to explore alternatives and seek innovative, cost-effective solutions. The program office and supporting activities monitor those explorations and evaluate the results. Subsequent contracts, each tailored to the particular contractor's system concept, are awarded to demonstrate and validate the most promising concepts. Many functions, including logistic planning and reliability, maintainability, and quality engineering are accomplished and cost, performance, and supportability estimates are developed. As development progresses, so do activities in the different functional areas and, from time to time, contracts are awarded to move the competing programs along toward selection for production and deployment.

Thus, many or most of the plans, actions, and decisions of DoD participants precede or otherwise take place outside the contracts and contracts and contract modifications are a consequence of these actions and decisions. It follows that these actions and decisions determine the ultimate life cycle cost of a major system, particularly because operation and support costs after the system is deployed account for such a significant part of the total life cycle cost of that major system.

The March 1981 report assessing DoD's acquisition system also restated the principle that an arms-length relationship with its contractors did not equate to an adversarial relationship. It said that weapons acquisition should be managed on a participating basis with the contractor a full constructive team member.

Award Fees

The DAR authorizes the use of a cost-plus-award-fee (CPAF) contract in certain situations. While the DAR conditions for use may be unnecessarily restrictive and the emphasis on the motivational strength of the award fee misplaced, we suggest that the true potential of the CPAF contract has not been realized.

The CPAF is a cost-reimbursement type contract with special fee provisions. Allowable costs of contract performance are reimbursed, the contractor is paid a fixed fee and given the chance to earn additional fee through the quality of its performance in relation to stated criteria. The amounts of additional fee awarded are determined by the Government's evaluation of performance against those criteria.

The award fee contract can be viewed not as a motivational device but rather as a management tool which helps Government managers focus on solutions to problems that impede achievement of program objectives. It does this by establishing criteria (or objectives) and providing for periodic evaluation of performance against them. The criteria can be changed from time to time to reflect changing circumstances. The mechanism serves as the framework for exchanges between the program office and the contractor which facilitate managerial decisionmaking and effective operational control. The award fee arrangement is a strategy for implementing a "joint management" model of program management and system acquisition. Its strength is not the additional

fee that may be awarded for attainment of objectives but its flexibility in adjusting to changed circumstances and the fact that it forces communication between contractor and program office.

Analysis

A 1980 study for the Air Force concluded that the award fee contract was a preferred alternative to the more traditional and less flexible cost-plus-a-fixed fee, cost-plus-incentive fee, or fixed-price incentive contract types most often used for system and subsystem acquisitions.[4]

Whenever substantial uncertainty exists, a method of management is needed that is both adaptable to this uncertainty and helpful in reducing it. Structures for managing contract-based acquisition must necessarily be inter-organizational in design in any environment where the Government satisfies its acquisition needs chiefly by contracting with private firms in a quasi- or non-market situation. Methods of managing the acquisition process must, therefore, explicitly recognize the Government's need to participate actively in that process.[5]

Further, mixed-sector quasi-market acquisition under uncertainty, with its cooperative requisites, cannot be conducted in an ordinary arms-length manner, as if between buyers and sellers in a classic free market. The Government must participate in the acquisition process. The award fee approach facilitates achievement of program goals by its shared-management requirements, and by its avoidance of the interposition of contractual or other barriers between Government and contractor managers. This is called a "managerialist" rather than a "contractualist" approach to acquisition which casts

---

[4]Hunt, Raymond G., PhD., Use of the Award Fee in Air Force System and Subsystem Acquisition, Final Report (Abridged) to Air Force Business Management Research Center, April 1980.

[5]Ibid, p. 5.

the contract in the role of servant to managerial ends instead of the other way around.[6]

Success in acquiring products with low overall cost of ownership would seem to depend on the ability of both Government and company managers to work together in handling the uncertain business of new product development. In essence this would be a matter of following through after award to make sure the original decisions -- based on estimates, conjectures, and judgments -- hold up. If events prove the results of some of those decisions to be less than optimum, the managers must be able and willing to make changes.

However, the relationship between many Government and company managers has grown adversarial rather than open and cooperative. The contract terms often become the focus and the Government position seems to be one of enforcing the contract requirements, ignoring the constant need to reevaluate earlier decisions and consider alternatives when unanticipated technical and business problems arise, as they inevitably do in the uncertain process of new product development. In this regard, acquisition under uncertainty is, by definition, a dynamic affair -- problems emerge in both anticipated and unanticipated shapes. This environment does not sustain the usefulness of standard operating procedures very often or very long, nor is it subject to control by the most carefully planned contractual nostrums.

[6] Ibid, p. 7.

Blank

2. SYSTEM ACQUISITION AND LIFE CYCLE COST

SYSTEM ACQUISITION POLICIES AND PROCEDURES

Policies and procedures for acquiring major systems are set forth in the March 1980 issuances of DoD Directive (DoDD) 5000.1, Major System Acquisitions, and DoD Instruction (DoDI) 5000.2, Major System Acquisition Procedures.

DoDD 5000.1 establishes objectives that include developing and tailoring an acquisition strategy, minimizing the time it takes to introduce a system into operational use, achieving cost-effective balance between acquisition and ownership costs and system effectiveness, and integrating support, manpower, and related concerns into the acquisition process. Responsibility for management of acquisition programs, except for decisions retained by the Secretary of Defense, is decentralized to DoD components. Policies related to affordability, acquisition time, standardization and interoperability, and logistic supportability are set forth.

DoDI 5000.2 assigns responsibilities to the Defense Systems Acquisition Review Council (DSARC), the Defense Acquisition Executive (DAE), and others. The Under Secretary of Defense for Research and Engineering (USDRE) is responsible for policy and review of all research, engineering development, technology, test and evaluation, contracting, and production of systems covered by the directive. The Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) (ASD(MRA&L)) is responsible for policy on logistic, energy, environment, safety, and manpower planning for new systems. The Assistant Secretary of Defense (Comptroller) coordinates, together with USDRE and the Assistant Secretary of Defense (Program Analysis and Evaluation)[1]

[1]Now Director, Program Analysis and Evaluation.

(ASD(PA&E)), the interface of the acquisition process with the program planning and budgeting system. The ASD(PA&E) evaluates cost-effectiveness studies prepared in support of milestone decisions for major system acquisitions.

The head of each DoD component manages each major system acquisition assigned by the Secretary of Defense and establishes lines of authority, responsibility, and accountability. In turn, the component head ensures that program managers are assigned, with approved charters, as soon as feasible and establishes career incentives to attract, retain, motivate, and reward program managers. The program manager acquires and fields, in accordance with instructions from line authority, a cost-effective solution to the approved mission need that can be acquired, operated, and supported within the resources projected in the Secretary of Defense Decision Memorandum (SDDM).

DoDI 5000.2 provides four decision milestones for the acquisition process and specifies the documentation requirements. The Mission Element Need Statement (MENS) is the basic document for the Milestone 0 decision. It defines a specific deficiency within a mission area and the general magnitude of resources the component is willing to invest to correct the deficiency.

The Decision Coordinating Paper (DCP) provides the primary documentation for the DSARC in making milestone recommendations to the Secretary of Defense. Annex C to the DCP is to list the life cycle cost of alternative systems in both constant and current dollars. The totals are to be broken into the estimates for development, production, and operating and support costs. The SDDM documents the milestone decision including approved goals and thresholds for cost, schedule, performance, and supportability.

Activities of the OSD Cost Analysis Improvement Group (CAIG), the principal advisory body to the DSARC on matters related to cost, are set forth in

DoDD 5000.4, October 30, 1980. The CAIG reviews and evaluates independent and program office cost estimates prepared for presentation at each DSARC. It establishes criteria and procedures for preparation and presentation of cost estimates. It compares estimates of alternatives with design to cost goals and DCP cost thresholds. The independent cost estimate provides a projection of all elements of life cycle cost, and presentations to the DSARC include time-phased life cycle cost estimates of each alternative under consideration. These life cycle cost estimates are compared to the latest Five Year Defense Plans (FYDPs).

DoDI 5000.2 has specific instructions and guidance for the program manager, including:

1. From the outset the program manager shall consider the effectiveness of the proposed weapon system in its intended threat environment.

2. Acquisition strategy is the conceptual basis of the overall plan the program manager follows in executing the program.

3. A work breakdown structure and a configuration management plan shall be developed for each program.

4. A life cycle cost estimate shall be prepared at Milestone I and updated for each subsequent milestone. Milestone I cost, schedule, performance, and supportability goals shall not inhibit the program manager in trading off among those elements in developing the most cost-effective solution to the mission need. Firm design to cost goals shall be established at Milestone II for the system or systems selected for full-scale development. Program accomplishments shall be evaluated against cost, schedule, and supportability goals with the same rigor as the evaluation of technical performance.

5. Threshold values shall be established for cost, schedule, performance, and supportability at Milestones I, II, and III and the program manager must report actual or estimated threshold breaches immediately to each line official and the DAE.

6. Affordability considerations shall be a factor in determining the selection of alternative concepts at Milestone I. Favorable decisions at Milestones II and III will not be made unless the system's projected life cycle costs are within the amounts specified in the latest FYDP/EPA or unless compensating changes are made to other items in the defense program.

7. Standardization shall be applied to reduce cost of production and operational support and accelerate timely operational readiness.

8. Costs of production shall be considered from the early phases of the program and affordability must be considered in production planning.

9. Manpower and personnel factors shall be considerations and constraints in system design.

10. Goals and thresholds shall be proposed at Milestone II for reliability and maintainability parameters directly related to operational readiness, mission success, survivability, maintenance manpower cost, and logistic support cost.

11. Integrated logistic support plans and programs shall be structured to meet peacetime readiness and wartime employment system readiness objectives beginning early in the system development process.

Analysis

The phased major system acquisition process provides for four key decisions by the Secretary of Defense. At each of the four milestones, an affirmative decision means that the need is valid and the work has progressed so that the risks of increasing the level of activity and the size of the commitment are within acceptable levels. The April 30 decision by the Deputy Secretary of Defense to reduce the four Secretary of Defense decisions to two does not appear to invalidate the phased acquisition system. The new system, when implemented, will provide for service review and, presumably, decision to initiate a program, the present Milestone 0 decision. The new Secretary of Defense decision called "requirements validation" would come earlier than the present Milestone I decision to which it corresponds, the decision to proceed to demonstration and validation. The new Secretary of Defense decision called "full-scale development and production" would come a little later than the corresponding Milestone II decision to approve full-scale development. The production go-ahead decision, Milestone III, would be replaced by service review and, presumably, approval. Thus, it appears that four phases will be retained, even though the timing of and responsibility for decisions will change.

The program manager is at the center of the acquisition process and responsible for coordinating activities for the Government and communicating its desires and requirements to the contractors. Despite the positive terms of the directives, the program manager may not always have the authority needed to perform at the expected level of effectiveness.

It also is a matter of concern that the program manager may not be strongly motivated to authorize current expenditures to benefit later operating and support costs, particularly when present needs could claim all available funds.

LIFE CYCLE COST MANAGEMENT TECHNIQUES, CONCEPTS, AND PROGRAMS

Within the processes delineated by DoDD 5000.1 and DoDI 5000.2, specific actions are taken which influence, both directly and indirectly, the total cost of owning and operating military systems and equipments. These are identified and analyzed in the remainder of this chapter.

Affordability

The long history of growth in weapon system acquisition and support costs, with attendant uneconomic acquisition rates, delayed deployments, and reduced readiness, led DoD to consider the affordability of individual weapon systems. The affordability problem was described as "there are simply more programs ready to enter the production phase at any given time than there are production funds available to fund them."[1]

Affordability, introduced in the 1980 edition of DoDD 5000.1, is defined as the ability to provide adequate resources to acquire and operate a proposed weapon system in an efficient and effective manner. Affordability is to be considered at every milestone in the system acquisition process. It is

[1]Defense Science Board, Report of the Acquisition Task Force, March 15, 1978.

a function of cost, priorities, and availability of fiscal and manpower resources. As such, affordability is principally a determination of the Program Planning and Budgeting System (PPBS) process.

DoDI 5000.2 sets forth procedures for consideration of affordability. Before approval is given to initiate a weapon system program, the DoD component must describe the magnitude of the resources it is prepared to commit to acquire a system to satisfy its need. As the development of the weapon system proceeds, the DoD component must identify the system's projected life cycle cost in the FYDP/EPA. If the total life cycle cost for all systems being acquired exceed the forecast availability of funds, the DoD component must identify the programs that will be cancelled or adjusted to remain within funding constraints.

Application of affordability procedures is primarily the responsibility of the individual DoD component. The affordability discipline requires that the total cost of ownership of every weapon system be included in the financial planning for the life cycle of those systems. This must be demonstrated at each milestone in the phased development process to the official who can authorize the program to proceed to the next phase. This may be the Secretary of Defense, the service secretary, or other designated official of the DoD component, depending on the dollar value of the program.

Analysis. Affordability analysis is a management concept to assure that authorizations to proceed with weapon system acquisition programs are consistent with DoD's budget and other financial plans. It relies on no contract clauses. The total impact of this concept has yet to be felt, but, if it is to work, some programs must be cancelled. Knowledgeable parties agree that the cost of completing existing programs far outstrips the most optimistic prediction of funds that will be available for such purposes. The

validity of the affordability concept hinges directly on the willingness of the DoD component to identify and cancel programs so that the remaining programs will be stable and affordable.

Life Cycle Cost

Life cycle cost is a term that means the total cost of a system over its full life and includes the costs of development, procurement, operations, support, and disposal. It frequently is stated as an admonition to decision-makers, as in "consider the life cycle cost of alternatives." The implication is that all other things being equal, the alternative promising the lowest life cycle cost should be selected. It also is stated as a principal goal of many functions in the acquisition process, as in "do your job in such a way as to result in the lowest ultimate lifetime cost to the Government."

Life cycle costing (LCC) , on the other hand, is a technique that requires evaluation of future operating, maintenance, and other costs of ownership as well as acquisition price in awarding contracts for hardware and related support and in making decisions as to alternative courses of action. The objective of LCC is to ensure that the hardware acquired will result in the lowest overall ownership cost to the Government during the life of the hardware.

DAR 1-335 states that proper consideration must be given, in development or acquisition decisions, to those systems or equipments that will result in the lowest life cycle cost to the Government. It refers readers looking for guidance on LCC to three documents published in the early 1970s. Life cycle cost estimates are among CAIG's responsibilities in support of the DSARC process. That group, together with cost analysis groups in DoD components, has advanced DoD's cost estimating capabilities. Many other

directives refer to life cycle or ownership costs, but we found no acquisition directive or instruction devoted completely to the subject.

Analysis. Competitive awards on the basis of lowest ultimate life cycle cost, with contract provisions for measuring and rewarding achievement of projected life cycle cost, are rare at the major system level and only marginally prevalent for other kinds of acquisitions. Life cycle cost estimates are required in major system acquisitions and used in determining affordability and the relative total cost of alternative system concepts. However, particularly in the early phases of system development before full-scale development and initial production, O&S cost projections are too uncertain to justify selection of one alternative on the basis of total life cycle cost.

Life cycle cost, while a commonly used term, is not clearly defined nor are its potential uses fully treated in acquisition regulations and directives. Most of what is written about use of life cycle cost estimates focuses on the development of cost models. Existing guidance on contract application of LCC is contained in old publications, long out of print. While the close identification of life cycle cost estimates with CAIG and the DSARC process is desirable, it may impede the effective application of life cycle cost considerations in other, nonsystem acquisitions.

Procurement Planning

Procurement planning, DAR 1-2100, is a process for coordinating and integrating the acquisition of defense materiel. Its purpose is to obtain a quality product in a timely manner and at a reasonable cost. It sets milestones to be met in achieving a program's goals over its procurement life cycle. It is to be keyed to the FYDP and the DCP or Program Objective Memorandum, as applicable.

Planning starts with the initiation of the documentation to obtain program approval. The program manager has overall responsibility for planning and the contracting officer prepares and maintains the plan. The plan is to discuss

- program risk (technical, cost, and schedule)
- integrated logistic support
- application of design to cost
- application of life cycle cost
- reliability and maintainability
- test and evaluation approach

It also is to include a milestone chart identifying critical decision points and time factors.

Analysis. The planning, if done as envisioned in DAR, would seem to make a vital contribution to life cycle cost management. However, the recommendations for improving acquisition approved by the Deputy Secretary of Defense on April 30, 1981, include several that suggest that planning performance still does not measure up to the DAR standard. One possible reason might be that the DAR is not the best medium for stating the requirement, even though its title is "Procurement Planning."

Design to Cost (DTC)

DTC is a management concept. It is a logical adaptation of commercial business practice in developing a new product and justified by the fact that program costs can be driven upward by unfettered latitude in setting performance characteristics and schedules and in selecting technologies. Cost goals are established during system development and the goals are to be attained by tradeoffs among operational capability, performance, cost, and schedule. The objectives of DTC are: to establish cost as a parameter equal

in importance with technical requirements and schedules throughout the design, development, production, and operation of weapon systems, subsystems, and components; and to establish cost elements as management goals for acquisition managers and contractors to achieve the best balance between life cycle cost, acceptable performance, and schedule.

DoDD 5000.28, Design to Cost, May 23, 1975, is under review and will be changed. As of now, it includes the following policies:

1. Cost is a design parameter during a system's design and development phase and a cost discipline to be used throughout the acquisition and operation of a system.

2. Life cycle cost objectives for each acquisition are separated into cost elements within development, production, operation, and support. As system definition continues, the cost elements are firmed into cost goals to which the system is designed and its costs controlled.

3. Cost requirements and achievement of cost goals will be evaluated during design and development with the same rigor as technical requirements and the achievement of performance goals. Tradeoffs must be continually examined to ensure the system developed will have the lowest life cycle cost consistent with schedule and performance requirements.

4. Cost goals "designed to" in development will continue to be used in subsequent phases; production cost will be controlled to the production goals and initial outfitting, personnel, spares, rework, etc., will be controlled against operation and support cost goals.

5. Although the initial goal uses a production cost element, the objective during design and development will include the control of future operating and support cost. Measurable surrogates such as numbers of operating and support personnel and R&M factors will be the goals for major O&S cost factors.

6. Programs conducted in accordance with the DTC concept are reviewed periodically on a life cycle cost basis.

7. Progress in implementing and attaining DTC goals is reviewed at each major program milestone and DCP review.

DAR 1-338 explains that cost, under the DTC concept, is a design parameter during design and development and a management discipline during the

acquisition and operation of the system or equipment. It reinforces the primacy of DoDD 5000.28 in DTC matters and recognizes that DTC considerations are essential parts of procurement planning and should be developed at the inception of the program. It says that when used, the required cost, technical, and schedule requirements should be tailored to each program in order to facilitate product development at the lowest life cycle cost consistent with mandatory schedule and performance requirements.

Responsibility for implementing the design to cost concept is assigned to DoD components having authority and responsibility for the acquisition of defense weapon systems, subsystems, and components. The design to cost goal is to be established if possible before Milestone I, program initiation, but in any event, before Milestone II, full-scale development. Both DSARC and the CAIG have DTC roles. DSARC is to review a component's DTC goals and recommend appropriate action to the Secretary of Defense, who sets the official program DTC goal.

Analysis. In practice, there have been questions about which cost to design to, unit production cost or life cycle cost. Most early efforts settled on unit production cost. Reasons include difficulties in estimating and measuring operating and support costs after deployment, difficulties compounded by the fact that the producer has little control over what happens after delivery. Development of surrogates for O&S costs may lead to greater application of design to life cycle cost. The principal value of the design to cost concept is in its potential for forcing consideration of the cost implications of design and engineering decisions made in developing a new system. The proper use of DTC injects a needed discipline into acquisition; this also is the principal argument for its use. However, the argument that it provides positive incentives to the contractor to design for low production

and life cycle costs must be viewed with skepticism; Government concerns for costs are better conveyed through cost-effective performance requirements and design specifications and standards.

Reliability and Maintainability (R&M)

Reliability and maintainability are separate engineering disciplines combined into programs to:

1. Increase operational readiness and mission success of fielded items.
2. Reduce demand for maintenance and logistic support of components.
3. Field items that can be operated and maintained with skills and training expected to be available in DoD.
4. Provide specific types of R&M data essential to acquisition, operation, and support management.
5. Ensure that each increment of cost and schedule investment in R&M contributes significantly to the above objectives.

DoDD 5000.40, Reliability and Maintainability, July 8, 1980, establishes policies and responsibilities to achieve these objectives. It defines reliability as the duration of probability of failure-free performance under stated conditions. Mission reliability is the ability of an item to perform its required functions for the duration of a specified mission profile. Maintainability is the ability of an item to be retained in or restored to specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair.

DoD components are required to establish programs that tailor R&M engineering and accounting tasks for maximum efficiency. Reliability engineering is to focus on the prevention, detection, and correction of design deficiencies, weak parts, and workmanship defects. Maintainability engineering is to reduce maintenance and repair time, number of tasks required for

each maintenance action, and the need for special tools and test equipment. Program plans are to stress early investment in R&M engineering to avoid subsequent costs and schedule delays.

R&M accounting is to provide information for acquisition, operations, and support management, including properly defined inputs for estimates of operational effectiveness and ownership cost. Cost and schedule investment to obtain management data (such as R&M demonstrations) are to be clearly visible and carefully controlled.

R&M are continuing, never-ending imperatives critical to operational readiness, mission success, maintenance manpower inputs, and logistic support cost. DoD components are expected to define fundamentals of design, manufacture, and management which result in reliable and maintainable items. The fundamentals are to be used to select and tailor R&M engineering tasks and tests. In turn, the tasks and tests are to be contractual requirements, enforced by program managers and acquiring activities.

USDRE, ASD(MRA&L), the Director, Defense Test and Evaluation, the CAIG, service secretaries, directors of defense agencies, and program managers and acquiring activities all have R&M responsibilities. R&M achievements and plans are to be addressed at each major milestone decision or equivalent point in the acquisition process, from mission area analysis through production and deployment. The acquiring agency also must follow up on in-service evaluations to ensure that R&M goals reaffirmed in the production decision are achieved in service. While R&M of equipment also are matters of concern, the principal emphasis is on major systems and subsystems.

Analysis. System commands in the services are developing a concept called product assurance that combines reliability and quality engineering

disciplines. The focus is on producing designs that will meet desired operational life (i.e., are reliable) and developing manufacturing standards that will enable the contractor to build to print, avoiding defects in workmanship. DoD's engineers are expected to develop the reliability specifications and standards and the contractor's to design to those requirements. To the extent requisite reliability and quality can be built into a product's specifications, the job can be done right the first time, reducing reliance on measurements such as mean time between failure and reducing the incidence of redesign and retrofit.

Quality Assurance

DoD components are required, by DoDD 4155.1, Quality Program, August 10, 1978, to develop and manage a quality program to assure mission and operational effectiveness and user satisfaction and assure that all services provided and products designed, developed, purchased, produced, operated, and maintained conform to specified requirements. DoD components also are to assure that all of the above are cost-effective.

Quality requirements are specified, measured, and assessed at each step of the major system acquisition and support process. The program manager is responsible and accountable for the quality, reliability, and maintainability of the system. Quality characteristics are to be specified and designed into the system, the characteristics are to be quantified whenever possible, critical application items are to be identified and controlled, quality and technical requirements are to be achieved, test and evaluation is to be performed, and design reviews and independent assessments are to be made before each milestone is completed and actions taken on discovered deficiencies.

Responsibility for quality program policies is assigned to USDRE. ASD(MRA&L) is responsible for assuring that DoD components have logistic

support plans that provide for quality programs and for coordinating with USDRE in developing the programs. Ultimate responsibility for compliance with the quality program requirements resides with DoD components. The quality program requirements for major system acquisition and deployment span the total life of the system, from determination of need through each phase in the DSARC process to deployment and ultimately to disposal.

DAR Section XIV provides policies and procedures for procurement quality assurance to assure that supplies and services conform to quality and quantity set forth in the contract. Its focus is on contract terms and conditions and applicable specifications, and its concern is concentrated on the inspection function. Nevertheless, it states that a contractor may control quality in ways that include: manufacturing processes; drawings, specifications, and engineering changes; testing and examination; and reliability and maintainability assessment.

Analysis. The directive links quality, reliability, and maintainability and supports this linkage with test and evaluation and design reviews. In contrast, the inspection and acceptance role for quality assurance stressed in DAR coverage is an essential part of the acquisition process but contributes little to life cycle cost management.

Test and Evaluation (T&E)

The DoD policy for T&E in the acquisition of weapon systems is stated in DoD Directive 5000.3, Test and Evaluation, December 26, 1979. T&E begins as early as possible and is conducted throughout the acquisition process to assess and reduce risks and estimate the operational effectiveness and suitability of the system. Evaluation criteria, test objectives, and critical issues are established before tests begin and successful accomplishment of T&E objectives is demonstrated before each decision to continue the acquisition process.

Long lead times and high costs require assurance that weapon systems, when produced, will function as planned. It is too late, after delivery, to worry about logistic supportability, maintainability, operational effectiveness, operational suitability, reliability (both failure-free performance and the ability to perform the mission), and survivability, all of which need to be tested and evaluated.

The Director, Defense Test and Evaluation, has overall responsibility for test and evaluation matters within the Department of Defense. A Test and Evaluation Master Plan (TEMP) is required for each major system and for selected other systems. Development T&E is normally accomplished or managed by the materiel development agency of the service involved. Operational T&E is normally the responsibility of a major field agency, neither the developer nor the user of the weapon system. The total plan also must deal with production acceptance T&E.

Test and evaluation is a vital part of weapon system acquisition, throughout the entire process. This program is managed by DoD personnel; it is not a contract operation. (Contractor quality control is a separate topic.) Development T&E before Milestone I helps assure selection of the appropriate concept. Development T&E before Milestone II helps assure the selection of the appropriate technical approach. By Milestone III there should be adequate development T&E to assure that all significant design problems have been identified and that solutions are in hand. By Milestone III there also should have been adequate operational T&E (using reasonable representatives of production items) to provide a valid estimate of the system's operational effectiveness and suitability.

Analysis. While not linked organizationally with product assurance, T&E are parts of the preliminary engineering activity needed to assure the

developing system will perform as required. Nevertheless, T&E, together with reliability, maintainability and quality engineering activities, are likely to be underfunded or deferred when program funds are tight.

Standardization and Related Programs

DoDD 4120.3, Defense Standardization and Specification Program, February 10, 1979, updates established policies to improve the operational readiness of DoD components and assure the cost-effective mission performance of systems and equipment by fostering the efficient use of resources and optimum reuse of the products of engineering efforts.

The degree and effectiveness of standardization efforts are addressed in DSARC and (S)SARC milestone reviews. Existing items and engineering practices and documents prepared under this program are used in the program initiation and demonstration/validation phases only to the extent that they satisfy program needs and their use will not compromise program objectives. They are used in full-scale engineering development and production/deployment phases wherever cost-effective. A parts control program is used to reduce the costs and logistic burden.

USDRE is responsible for the Defense standardization and specification program (DSSP) policy, administration, and guidance. The secretaries of the military departments and directors of defense agencies are to provide resources to assure effective implementation of DSSP policies and each is to designate an office responsible for DSSP.

The objective of DoDI 4120.19, DoD Parts Control System, June 11, 1981, is to conserve resources and to reduce life cycle cost by reducing the varieties of component parts and promoting the use of parts of known performance during the design, development, production, or modification of equipments and weapon systems. The USDR&E is responsible for operation of an

integrated parts control system in DoD. The military departments are to apply the program to system and equipment design and require use of the parts control program in appropriate contracts.

Related to this is the effort to use nongovernment specifications and standards in the manufacture of military materiel, as set forth in DoDI 4120.20, Development and Use of Non-Government Specifications and Standards, December 28, 1976.

DoDD 4120.21, Application of Specifications, Standards, and Related Documents in the Acquisition Process, November 3, 1980, is intended to ensure the cost-effective application of specifications, standards, and related documents in system and equipment acquisition programs. It defines "application" as the process of reviewing and selecting from available specifications, standards, and related documents those that have application to particular materiel acquisitions and contractually invoking them wholly, or in part, at the most advantageous time in the acquisition cycle.

In acquisitions, the emphasis is on achieving mission-oriented requirements and performance capability within stated cost goals by selectively applying and tailoring the provisions of each appropriate nonproduct document. (A nonproduct document is one that establishes and defines requirements for management, design processes, procedures, practices, methods, and data applicable to a broad range of products. Specifications, standards, and related documents are those that establish and define requirements for purchased material, processes, procedures, practices, methods, and data. Such documents encompass all military, federal, and nongovernment specifications and standards.)

USDRE is responsible for developing and implementing the policies governing the application of specifications, standards, and related documents

in DoD system and equipment acquisition programs. Heads of DoD components are to comply with the provisions of this directive, develop contract provisions to encourage offerors and contractors to submit cost-effective application and tailoring inputs, and, at the time of DSARC review, require program managers to document the degree of tailoring accomplished. Provisions of this directive are to be applied at the earliest possible time, but application not essential to the requirements of the specific acquisition phase is to be avoided.

DoDD 5010.19, Configuration Management, May 1, 1979. Configuration management is an engineering management procedure that includes configuration identification (baseline characteristics), control, status accounting, and audit. It is intended to ensure operational efficiency and control cost. The degree of management applied is tailored to the complexity, size, quantity, intended use, mission criticality, and life cycle phase of the item. Management of interface baseline characteristics is applied to specified developmental items before approval for full-scale development, Milestone II. USDRE is responsible for the overall management policy. After deployment, ASD(MRA&L) ensures effective implementation during operational logistics functions. The head of each DoD component assigns specific items and categories of items to technical organization, office, or individual for management during each life cycle phase. The DoD Configuration Management Committee provides necessary support in the conduct of the program.

Analysis. The test of these directives and instructions, all of which seem logical and necessary, comes in their implementation. If carried out with good judgment, the effect on life cycle costs should be salutary. One impediment to effective implementation is the unfocused assignment of responsibility for each of these programs.

Value Engineering (VE)

VE is a sequential process for systematically analyzing high cost functional requirements of DoD systems, equipment, facilities, procedures, operations, maintenance, and material to achieve the essential functions at the lowest total cost of effective ownership, consistent with performance, reliability, quality, maintainability, and safety requirements.

DoD's VE program is set forth in DoDD 5010.8, DoD Value Engineering Program, 12 May 1976. It covers both internal and contractor VE efforts. The policy is to ensure that VE supports the continuous review of systems and equipment against "design to" objectives for acquisition and ownership costs, particularly during engineering development. Support includes training personnel to apply VE principles as a normal part of their duties, use of VE clauses, and selective use of VE task teams, internally and by contractors. VE is intended to be a primary mechanism for cost reduction during production and logistic support phases of the life of systems and equipment. DAR Section 1, Part 17 covers the contractual aspects.

Responsibility for VE is assigned to DoD components and through them to commands. Responsibility is exercised through VE focal points at various organizational levels and includes responsibility for VE training, manpower, funding, and both internal and contractor projects. In addition to other responsibilities, components are to ensure that contractor and DoD personnel are encouraged to submit VE proposals and to evaluate and process submitted proposals.

DAR coverage concentrates on the cost reduction aspect of the VE change proposal (VECP) and the incentive payment to the contractor for cost savings resulting from an accepted VECP. While the inference is that such changes result from the application of the VE discipline, that link is not

stated; any change proposal leading to cost reduction can be processed as a VECP.

DAR 1-1700 sets forth two basic approaches to VE. One is a voluntary VE incentive program which is implemented by clauses establishing the extent to which the contractor and DoD will share in the savings generated by accepted VECPs. The incentive clauses are to be used in every supply or service contract of $100,000 or more, but certain exceptions, including contracts for R&D other than full-scale engineering development, are authorized. Under the voluntary approach, the contractor is to be paid for the costs of developing and submitting accepted VECPs. The other approach is a mandatory program in which DoD requires and pays for a specific VE program effort. This becomes a priced line item in the contract schedule.

Analysis. The 1976 directive requires that DoD components establish VE focal points at headquarters and each level of command engaged in acquisition, construction, and support activities. The use of VE during engineering development to support the continuous review of systems and equipment against design to objectives for acquisition and ownership costs is potentially valuable in managing life cycle cost, but the present emphasis is on the contractual mechanism of the VECP, a more specific application. There is reason for concern, too, over the level of VECP activity.

DoD activity in adopted VECPs fluctuated in the 10 fiscal years 1971 through 1980 from a high of 930 in fiscal 1971 to a low of 496 in fiscal 1978.[2] There appears to be a significant drop in the numbers of VECPs adopted

[2]Source of these and following VECP data is AF/RDG Mini-Book, January 1981, prepared by the Directorate of Contracting and Acquisition Policy, Deputy Chief of Staff/Research Development and Acquisition, Headquarters, United States Air Force.

in the latter half of the 10-year period. Savings ranged from a high of $107 million in fiscal 1980 to a low of $41 million in fiscal 1975 but there seems to be little relationship between the number of VECPs and the value of savings resulting therefrom.

Some measure of the significance of the VECP activity can be gained by comparison with the total number of change orders processed in the six fiscal years, 1975 through 1980. The 9,404 change orders in 1975 increased to 13,164 in 1980, and the VECPs dropped from 826 to 550 in those same years. A further indication of the significance can be gained by comparison with the number of definitive contracts over $100,000 awarded, which total approximates the number of contracts with VE incentive or program clauses. In 1975, 31,080 contracts over $100,000 were awarded. In 1980, the total had increased to 54,814.[3] However, the total of active contracts at any one time would be greater than the number of definitive contracts awarded in a fiscal year; there is some carryover from one year to the next.

Integrated Logistics Support (ILS)

ILS is a unified and iterative approach by management and technical activities to cause support considerations to influence requirements and design, define support requirements that are optimally related to the design and to each other, acquire the required support, and provide the required support during the operational phase at minimum cost. ILS elements are: the maintenance plan; manpower and personnel; supply support, including initial provisioning; support and test equipment; training and training devices; technical data; computer resources support; packaging, handling, storage, and transportation; and facilities.

[3]Source of the data in this paragraph is the annual report, DoD Prime Contract Awards, Size Distribution, prepared by DIOR, Washington Headquarters Services.

Policies and responsibilities for ILS are set forth in DoDD 5000.39, Acquisition and Management of Integrated Logistic Support for Systems and Equipment, January 17, 1980. (This 1980 publication replaced DoDD 4100.35, October 1, 1970.)

Logistic support analysis, an adjunct of ILS, is used to evaluate alternative support concepts, to perform tradeoffs between system design and ILS elements, and to perform tradeoffs among ILS elements in order to meet system readiness objectives at minimum cost.

Each acquisition program is required to have an ILS program that begins at Milestone 0. The ILS program is structured to meet program system readiness objectives (i.e., peacetime readiness and wartime employment) within established cost, schedule, performance, and logistic (including manpower) constraints. The policy calls for realistic program goals for system readiness, support resources, and support-related design parameters.

The ILS program is a response to the reality that both time and money are needed to develop adequate logistics support for a new system. Failure to include logistics planning in the acquisition process could result in the acquisition of systems which cannot be kept operable.

The program manager is responsible for ILS. The ASD(MRA&L) issues policies and guidance on ILS, reviews readiness objectives for realism, reviews ILS plans and resources for adequacy, and reviews programs for manpower and other logistic resources for consistency with objectives and compatibility with test and evaluation results and early field experience.

Integrated logistic support is designed to be an integral part of the acquisition process and as such, its principal application is in the acquisition of major systems. It is a program management function.

Analysis. ILS seems to provide the means for giving direction to all logistic concerns early in a program and a prime tool for life cycle cost management. Like other basic directives, DoDD 5000.39 identifies four factors, or what might be called objectives in acquisition. It speaks of cost, schedule, and performance "constraints" and recognizes a fourth one, "manpower, and other logistic constraints." DoDD 5000.1 addresses cost, schedule, performance, and supportability "design requirements." DoDI 5000.2 cites the same four factors, but describes them as "goals and thresholds" rather than requirements. DoDD 5000.28 also cites four factors, operational capability, performance, cost, and schedule, but does not characterize them further. These may not be significant differences, but had they been written at the same time, the nomenclature might have been identical. In any event, agreement on terms might enhance understanding and performance.

Reliability Improvement Warranties (RIW)

A warranty is a promise by a seller to a buyer regarding the nature, usefulness, or condition of the item or service furnished. Generally, warranties apply for a stated period of time after acceptance, and they delineate the rights and obligations of the buyer and seller in the event the goods or services are defective. A RIW is a contractual technique by which a contractor agrees to repair or replace all equipment that fails during a specified or measured period of use. The technique is described in "RIW Guidelines," an attachment to a joint ASD(I&L) and DDR&E memorandum dated 13 August 1974. The intent of RIW is to motivate the contractor to design and produce equipment that will have a low failure rate and be economical to repair when it does fail, thereby reducing the life cycle cost of the equipment to the Government.

The applicability of RIWs is limited to procurements that can be on a fixed-price basis with multi-year funding for warranty services. There must be sufficient time provided for the contractor to identify and analyze failures in order to permit reliability and maintainability improvements. Also, the equipment must either be readily transportable (for return to the contractor's plant) or susceptible to field service by the contractor. Therefore, the decision to use a RIW must be a joint determination of the program or product manager and the contracting officer.

Analysis. There has been fairly substantial use of RIWs in DoD procurements with generally good results, although there are indications the results could have been attained for less cost by better design engineering, product assurance efforts, testing, or other manifestations of more direct program management. The technique, used when the product exhibits unsatisfactory reliability in use, has been characterized, correctly if somewhat cynically, as "prepaid maintenance."

Blank

3. THE FRAMEWORK FOR LIFE CYCLE COST MANAGEMENT

INTRODUCTION

DoD life cycle cost management activities focus on the phased process for managing major system acquisitions. Major systems are characterized by large investments of time and resources in the uncertain periods of development, production, and deployment and in the operation and support of systems after deployment.

Uncertainties trace to the technical risks of the research, development, and test of new weapons; to the difficulties of and changes in threat assessments; to the vagaries of annual authorization and appropriation of funds; and to the vacillations in planning and funding for operation and support of systems fielded and to be fielded. The relatively long time to develop and field a new system contributes to the uncertainties of predicting the threat and estimating the costs of producing, operating, and supporting the system.

The relatively long time from identifying the mission need to disposing of the obsolete system (10 or more years to develop plus five, 10, or more years of operational life) runs counter to the immediacy of the annual budget cycle and the relatively short duration of both normal military tours and congressional and presidential terms. These factors, taken together, reinforce the tendency to make decisions based on short-term considerations. Many participants are pushed by time to achieve something significant in their tours and terms and, if it is necessary to choose between satisfying a current or future need, to decide in favor of the current one.

These short-term considerations work against the concern for life cycle cost that has been growing within DoD over the past two decades as the department has struggled with the responsibilities of acquiring increasingly complex and costly systems and equipment. DoD directives have raised ownership costs and supportability to the level of product performance and schedule as objectives in major system acquisitions.

The levels of life cycle, or ownership, costs are determined by the amount and timing of funding, performance characteristics, designs, specifications, reliability and maintainability (R&M), producibility, quantities, production and delivery rates and schedules, changes in program and design, types and extent of testing, and general economic conditions.

Early and timely funding give a program necessary stability, and stable quantities that permit economic production rates keep production costs down. Proper specifications and standards, together with capable reliability engineering contribute to doing the job right the first time. Good quality designed into a product reduces the amount of testing needed and testing can be costly. When testing is needed, it can hold total costs down if done early and in a realistic environment. Contract modifications may increase contract costs but may either add to or reduce production and operating and support (O&S) costs.

Under current rules, each DoD official who has responsibility for the acquisition process is expected to make every effort to minimize the time to introduce each new system into operational use; to achieve the most cost-effective balance between acquisition and ownership costs and system effectiveness; and to integrate support, manpower, and related concerns into the acquisition process. Similarly, the objectives of defense R&M activities are

to reduce demand for (and thereby the cost of) maintenance and logistic support and to field items that can be operated and maintained with skills and training expected to be available.

The program manager is charged with acquiring and fielding a cost-effective solution to the approved mission need that can be acquired, operated, and supported within the resources projected for the program. The program manager follows an overall plan based, conceptually, on an acquisition strategy that reflects the management concepts to be used in directing and controlling all elements of the acquisition. The strategy encompasses the whole acquisition process.

The validity of a program manager's decisions, and of those above who must approve milestone decisions, depends in part on the quality of cost, schedule, performance, and supportability estimates. There is considerable uncertainty early in the process and bands of uncertainty are identified for point estimates. The broad bands present early are expected to narrow as the program matures and uncertainties diminish.

Milestone decisions are based on review of details of single programs and reflect the readiness of the system to move to the next phase. The program must compete for funds with others in the planning, programming, and budgeting system (PPBS). Thus, affordability, the ability to provide adequate resources to acquire and operate a system, is principally a PPBS determination. A request or proposal to move into the next acquisition phase must include the assurance that sufficient resources are or can be made available to carry the program through that phase.

THE FRAMEWORK

While there often are gaps between policy objectives and the realities of day-to-day operations, two existing directives provide the means for bridging

this gap in the major system acquisition process. Policies and procedures for the acquisition of major systems, DoDD 5000.1 and DODI 5000.2, provide the framework for managing the total cost of ownership. We have used the requirements of these documents as the framework, even though the Deputy Secretary of Defense approved, on April 30, 1981, a change from four to two Secretary of Defense decisions and directed appropriate revision of these documents. One of the two decision points would be called "requirements validation," a combination of the present Milestones 0 and I. This would be the decision to initiate the major program and include approval of threat, weapon concept, and risks and goals for schedule, readiness, and affordability. A specific not-to-exceed dollar funding threshold would be established to carry the program through concept validation and early full-scale development activity up to the second decision point, "full-scale development and production." The goals to be achieved by, and the timing of the second Secretary of Defense decision, would be set at the first decision point.

We would not expect a reduction from four to two Secretary of Defense decisions to alter the framework to any significant degree. The decision points are reference points for orienting the timing of ongoing planning and management decisions and do not dictate what is to be done. It is progress in advancing the design and development that now determines a program's readiness to advance into the next major phase in the process. This is not changed by a reduction in the number of milestones.

The framework is augmented with policies and procedures addressing key elements of the process, elements that directly influence the total life cycle cost of a system. These are the concepts of affordability and design to cost; the disciplines of reliability, maintainability, quality, and value engineering (VE); the test and evaluation (T&E) programs; the planning disciplines of

acquisition strategy, procurement, integrated logistic support (ILS) (and logistic support analysis (LSA)) and the contracting techniques of LCC, VE incentives, and reliability improvement warranties (RIWs). The standardization and specifications program, directions in using specifications, standards, and other documents, and the activities of parts control and configuration management, support the engineering disciplines in their roles in system design and development.

The framework is the phased acquisition process keyed to four decision milestones. The activities preceding and following the decision points all contribute to the successful development of the system by integrating the four objectives that must be satisfied in acquiring and fielding a major system, and by providing the conceptual basis for considering the effect of proposed actions on performance, schedule, cost, and supportability. The phased process, broken by four milestone decisions, is depicted in Table 3-1.

TABLE 3-1. THE PHASED ACQUISITION PROCESS

DECISION LEADING TO NEXT PHASE	PHASED ACTIVITIES LEADING TO NEXT DECISION
	Analyzing Mission Area Deficiencies
Milestone 0	Exploring Alternative Concepts
Milestone I	Demonstrating and Validating Alternative System Solutions
Milestone II	Developing One or More Alternative Systems on a Full-Scale
Milestone III	Producing and Deploying the Selected System
	Operating and Supporting the System

Table 3-2 reproduces the framework and shows when, in the process, each of the listed concepts or programs may be or are invoked. The solid deltas

TABLE 3-2. THE FRAMEWORK FOR LIFE CYCLE COST CONTAINMENT

ACTIVITY	MISSION AREA ANALYSIS	MILESTONE 0 CONCEPT EXPLORATION	MILESTONE I DEMONSTRATION & VALIDATION	MILESTONE II FULL-SCALE DEVELOPMENT	MILESTONE III PRODUCTION & DEPLOYMENT
AFFORDABILITY	Δ	▲	▲	▲	▲
LIFE CYCLE-- COST ESTIMATE			▲	▲	▲
COSTING			Δ	Δ	Δ
DESIGN TO COST		Δ	▲	▲	▲
VALUE ENGINEERING				▲	▲
VE INCENTIVES				▲	▲
RIW					▲
ACQUISITION STRAT.		▲	▲	▲	▲
PROC. PLANNING	▲	▲	▲	▲	▲
PROGRAM MANAGEMENT		▲	▲	▲	▲
PROD. PLANNING	Δ	Δ	▲	▲	▲
ILS/LSA	Δ	▲	▲	▲	▲
R&M	▲	▲	▲	▲	▲
QUALITY PROGRAM		▲	▲	▲	▲
STANDARDIZATION & SPECIFICATIONS PROG.		▲	▲	▲	▲
PARTS CONTROL		Δ	Δ	Δ	Δ
CONFIGURATION MGMT.				▲	▲
TEST & EVALUATION		Δ	Δ	▲	▲
MANPOWER & TRNG.		▲	▲	▲	▲
SPECS. & STANDARDS		▲	▲	▲	▲

LEGEND: ▲ = Mandatory Event
Δ = Discretionary Event

mark mandatory events, ones required by regulation or directive. The other deltas are discretionary events, ones where participants are to start thinking about future actions or collecting data to help later actions, or, in appropriate circumstances, take action. For example, LCC may, but is not required to be employed in soliciting proposals leading to contracts in the demonstration and validation, full-scale development, and production and deployment phases. While a parts control system is required, its implementation is to be discretionary, case-by-case, when determined to be cost-effective. As a further example, preliminary estimates and reconciliations during mission area analysis will predict the order of magnitude of resources that might be required to correct a mission deficiency, but the affordability concept is not implemented until Milestone 0 and following decision points.

The table indicates that while most activities begin at or immediately following Milestone 0 and end with production and deployment after Milestone III, certain planning and R&M activities begin earlier and continue through the entire process. It also shows that VE incentives and RIWs are not used until relatively late in the acquisition process.

Mission Area Analysis

As a routine part of planning, DoD components continuously analyze their assigned mission areas to identify deficiencies in capabilities or more effective means of performing assigned tasks. These ongoing analyses may identify deficiencies or opportunities that can lead to the start of a major system acquisition program. When it is likely that a new system will be required, activity centers on development of the MENS to be presented for the approval of the Secretary of Defense.

Procurement planning, in accordance with DAR 1-21, starts with the initiation of documentation to obtain program approval. Projected deficiencies in operational readiness, mission success, maintenance manning, and logistic support are documented as mission area needs, but quantitative R&M requirements are deferred to the conceptual phase.

Affordability, as measured by the order of magnitude of resources the component is willing to commit and the relative priority of the program to satisfy the need, is reconciled with overall capabilities, priorities, and resources.

From the early phases, the costs of production are factored into system affordability. The program manager also is expected to consider ways to increase the possibilities for competition during production.

Finally, an ILS program, structured to meet system readiness objectives within established cost, schedule, performance, and logistic constraints, is developed so as to begin at Milestone 0.

Milestone 0, Approval to Explore Alternative Concepts

Normally, the Secretary of Defense designates a system to be managed as a major system when approving the MENS. Affordability is considered. A program normally is not approved for concept exploration unless sufficient resources are or can be programmed for that phase.

A program manager is assigned, with an approved charter, as soon as feasible after Milestone 0. The program manager is to acquire and field a cost-effective solution to the approved mission need that can be acquired, operated, and supported within the resources projected in the SDDM.

The initial program acquisition strategy is completed by the DoD component as soon as possible after Milestone 0. Logistic supportability is to be a design requirement as important as cost, schedule, and performance.

Logistic support analysis is used to evaluate alternative support concepts, to perform tradeoffs between system design and ILS elements, and to perform tradeoffs among ILS elements in order to meet system readiness objectives at minimum cost.

For R&M, a system life profile is defined and a tentative operational goal is established for each applicable system R&M parameter. (System R&M parameters are measurements directly related to operational readiness, mission success, manpower maintenance cost, and logistic support cost.) The goals are to be responsive to documented mission area needs and achievable. A new system is to be designed to minimize both numbers and skill requirements of people needed for operation and support. Integration of manpower and personnel considerations with the system starts with initial concept studies and manpower requirements are subjected to tradeoffs with system characteristics and support concepts. Concepts are analyzed to determine the minimum essential quality and R&M characteristics.

ILS plans and programs are to be tailored to the specific system. Alternative maintenance concepts are assessed during concept development and other points in the life cycle. Readiness problems and support cost drivers of current systems are analyzed to identify potential areas of improvement to be addressed.

Existing items and engineering practices and documents prepared under the Defense standards and specifications program are used only to the extent use satisfies program needs and does not compromise program objectives. Application of specifications, standards, and related documents is limited to those necessary to achieve mission-oriented requirements specified for the concept exploration phase.

For design to cost (DTC), an initial estimate of resources available for allocation to the program is made and cost objectives are established. Minimum essential performance characteristics are quantified to avoid tradeoffs below that necessary to satisfy the required operational capability. Each technically feasible alternative is analyzed and cost/performance tradeoffs are made to ensure selection of the lowest life cycle cost solution.

Milestone I, Approval to Demonstrate and Validate Alternative System Concepts

Approval to proceed to the demonstration and validation phase depends on assurance by the component that it plans to acquire and operate the system and that sufficient RDT&E resources are available or can be programmed to complete development. Affordability considerations are used in determining the selection of alternative concepts. Program resource estimates are compared with the latest PPBS projections and the component ranks the emerging system in relation to its other major systems in the same mission area and general time frame. If program cost estimates exceed latest budget projections, the component identifies potential offsets necessary to provide the resources to execute the remaining phases of the program.

A life cycle cost estimate is prepared at Milestone I and updated for each subsequent milestone. Milestone I cost, schedule, performance, and supportability goals will not inhibit the program manager's tradeoffs among these elements in developing the most cost-effective solution to the mission need. Programs using design to cost concepts are reviewed on a life cycle cost basis at this and following milestones or equivalents. The design to cost goal is established before Milestone I or at the earliest practical date thereafter, but no later than Milestone II.

Costs of production are considered from the earliest phases of the program. Affordability must be considered in production planning. The program manager also considers means to increase possibilities for competition during production.

The operational concept specifies how the system will be integrated into the force structure and deployed and operated to satisfy the mission need. An initial operational concept and system readiness objective is developed for each alternative at Milestone I and finalized at Milestone II.

The program manager is responsible for ILS and is supported by an ILS manager, named by Milestone I, to be the focal point for manpower and other logistic planning. The program manager includes ILS as an integral part of the acquisition program; allocates appropriate development and production resources and schedule for ILS; and balances system readiness with cost, schedule, and performance goals. The development program budget includes adequate funding for ILS planning, analysis, and cost reduction efforts starting with program initiation. Support costs, manpower requirements, and R&M of current comparable equipment are identified at a system and subsystem level at Milestone I to provide comparative baselines for estimates of new systems and to identify and set targets for improvement in the new system.

Development and operational T&E is accomplished, when appropriate, before Milestone I to assist in selecting preferred alternative system concepts.

Contractor-furnished equipments are designed to prevent operational R&M deficiencies typical of current items. Government-furnished equipments and off-the-shelf commercial products meet their allocated R&M goals for the new system under equal or more severe environmental stresses. O&S concepts are tailored to prevent operational R&M deficiencies.

Standardization is applied in design to reduce costs of production and operational support and to accelerate timely operational readiness. A standardization program, including a parts control program, is applied. Existing items and engineering practices and documents prepared under the Defense standardization and specifications program are used only to the extent they satisfy program needs and their use will not compromise program objectives.

Application of specifications, standards, and related documents is limited to those necessary to achieve the mission-oriented requirements specified for this phase.

Cost requirements and achievement of cost goals are evaluated with the same rigor as technical requirements and the achievement of performance goals. Practical tradeoffs between system capability, cost, and schedules are continually examined to ensure that the system developed will have the lowest life cycle cost consistent with schedule and performance. Although the initial DTC goal uses a production cost element, the control of future operating and support cost continues to be a management objective. Major operating and support costs have measurable numeric goals such as numbers of O&S personnel and R&M factors and these are emphasized to the same degree as other cost factors in acquisition cost management.

Quality characteristics are identified and defined and quality requirements and plans are updated and refined.

Milestone II, Approval to Enter Full-Scale Development

At the earliest practical date and no later than Milestone II, the program manager has a comprehensive strategy for full-scale development, T&E, and production.

Approval to move into full-scale development depends on the component's assurance that resources are available or can be programmed to complete development and acquisition and to operate and support the deployed system as prescribed by the Secretary of Defense. A favorable decision to move into full-scale development is not made unless the system's projected life cycle cost, including product improvement and other modifications, are within the amounts in the latest FYDP/EPA, or unless compensating changes are made to other items in the defense program.

Goals and thresholds for cost, schedule, performance, and supportability are documented in the SDDM. Firm DTC goals are established for the system or systems selected for full-scale development. Program accomplishments against cost, schedule, and supportability goals are evaluated with the same rigor as the evaluation of technical performance.

The cost goals established and "designed to" in development are extended into subsequent phases of the system's life cycle. Production cost is rigorously controlled to the production cost goal. VE supports "design to" efforts by training engineers and others to apply VE principles as a normal part of their duties and to use VE clauses to encourage contract changes which reduce future acquisition and support costs.

R&M goals and thresholds are proposed at Milestone II for system R&M parameters directly related to operational readiness, mission success, survivability and endurance, maintenance manpower cost, and logistic support cost. Goals are realistically achievable and specified as minimum values acceptable in service. R&M growth is assessed and enforced so that R&M thresholds will be met well before the production decision. Resources are identified for incorporation and verification of R&M design corrections.

Predicted R&M growth is stated as a series of intermediate milestones, with associated goals and thresholds.

T&E begins as early as possible. Adequate development T&E is accomplished before the Milestone II decision to identify the preferred technical approach, technical risks, and feasible solutions. Decisions at Milestone II to commit funds for production of long lead items or limited production are supported by operational T&E results.

Program ILS goals are based on quantitative analysis and established at Milestone II. Manpower goals and thresholds consistent with projected activity levels, maintenance demands, and support concepts are identified at Milestone II. Tradeoffs are conducted for maintenance effectiveness among manpower numbers, occupations, and skill levels, support equipment, system design, and the support structure.

Application of specifications, standards, and related documents for transition to full-scale development provides for achieving the specified performance, operational, and configuration baseline requirements for this phase.

Configuration management of interface baseline characteristics is applied, before approval for full-scale development, if the developmental item interfaces with specified configuration baselines of other configuration items or if the item is to be compatible with an existing or planned maintenance program.

Producibility and quality engineering analyses are performed and designs are reviewed for quality characteristics.

R&M growth is required during full-scale development. An estimate of operational effectiveness and suitability, including logistic suitability, is made before deciding to go to full-scale production.

Detailed milestone plans to meet ILS objectives are developed early in full-scale development. Positive controls are established to identify interdependencies among ILS elements, design activities, and deployment plans, and to integrate schedules.

Existing items and engineering practices and documents prepared under the standardization and specification program are used in full-scale development wherever cost effective. A parts control program is used to reduce costs and logistic burden caused by item proliferation.

Development T&E is done before Milestone III to ensure that engineering is reasonably complete, that all significant design problems have been identified, with solutions in hand. Operational T&E is done to provide a valid estimate of the system's operational effectiveness and suitability.

Milestone III, Approval to Produce and Deploy

The acquisition strategy is updated at Milestone III. A favorable decision is not made at Milestone III unless the system's projected life cycle costs are within the amounts in the latest FYDP/EPA, or unless compensating changes are made to other items in the Defense program. The component reaffirms its assurance of affordability before approval is given to proceed into production and deployment.

Previous use, operational test results, and verified design corrections are considered in the production decision. Design corrections are verified under conditions no less severe than design requirements. Proposed corrections do not count, unless concurrency has been approved and specific provisions have been made to verify their effectiveness.

The operational T&E agency provides an independent evaluation of operational T&E results. The evaluation includes recommendations regarding the system's readiness for operational use.

Firm support requirements are established before Milestone III. Logistic and manpower plans are adjusted based on follow-on T&E and other reviews.

Plans are developed at Milestone III for follow-on readiness assessments, continuing until the system design and support configurations are mature. Manpower and training requirements are developed at Milestone III.

Existing items and engineering practices and documents prepared under the standardization and specifications program are used wherever cost effective. A parts control program is used to reduce the costs and logistic burden caused by item proliferation.

Application of additional documents for transition to production will provide for an optimum match between stated performance; operational, and support requirements and mission needs; and defined costs and schedules.

Appropriate configuration management is continued to the extent required for readiness support.

VE is a primary tool for cost reduction during production and logistic support. The VE incentive clause is used to motivate contractors to submit cost reduction contract change proposals.

As the system is deployed, operation and support cost goals are used to control outfitting cost, personnel, spares, rework, etc. Change requests generated by operational use and fed back to design engineering reflect use of DTC principles and tradeoffs necessary to ensure the lowest cost for acceptable performance.

A RIW may be used starting in the production phase and continuing into the operation and support phase.

Baseline control of engineering changes and configuration is established. Quality assurance plans are updated and implemented.

:h is required during initial deployment. Predicted growth
ries of intermediate milestones, with associated goals and

; are identified for incorporation and verification of R&M
during initial deployment. Assessment of current R&M
corrective action are required until all R&M thresholds
)ne III have been achieved in service or approved by waiver.
cy continues to correct operational R&M deficiencies due to
ıd quality. Responsibility for correcting operational R&M
i by operating or support concepts will be defined.

4. CONCLUSIONS

Numerous programs, concepts, and techniques have been introduced over the the past 25 years to lower some component of life cycle cost. They have grown independently during that time.

The phased weapon system acquisition process is the integrating framework within which the programs, concepts, and techniques work to control life cycle cost. The phases of the process are separated by review and decision milestones that serve to assure that prerequisites for the next phase have been satisfied.

Each program, concept, or technique is an aid to at least one milestone decision by the military department or the DSARC. Each is used in establishing plans, providing estimates, or making necessary trade-offs.

The programs, concepts, and techniques are necessary because some of the causes of cost containment problems cannot or should not be eliminated:

- use of high risk technology as an approach to weapon system development
- competition for funds among weapon system programs, with the resultant strong temptation to understate program costs
- difficulty of eliminating low priority programs to allow full funding of high priority programs at efficient production rates
- program manager's short tenure and accountability for current acquisition costs coupled with lack of visibility of future operating and support costs
- compartmentalization of funds which can lead, for example, to premature production just because procurement funds for a program have been budgeted

The programs, concepts, and techniques reduce the undesirable effects by promoting balance among four objectives: performance, schedule, cost, and supportability. Furthermore, many of these efforts promote attention to

logistic support functions early in the acquisition process so that they can be included in plans and influence designs before they are firm and therefore difficult and usually costly to change.

In sum, these efforts provide a logical approach to life cycle cost management and have proved to be complementary and mutually reinforcing within the framework of the phased weapon system acquisition process.

APPENDIX

ANALYSIS OF DoD LIFE CYCLE COST MANAGEMENT
DIRECTIVES AND INSTRUCTIONS STUDIED

I. LIST OF DIRECTIVES AND INSTRUCTIONS

DoDD 4105.62 Selection of Contractual Sources for Major Defense Systems
6 Jan 76 (ASD(I&L))

DoDD 4120.3 Defense Standardization and Specification Program
10 Feb 79 (USDR&E)

DoDI 4120.19 DoD Parts Control System
11 Jun 81 (USDR&E)

DoDI 4120.20 Development and Use of Non-Government Specifications and Standards
28 Dec 76 (ASD(I&L))

DoDD 4120.21 Application of Specifications, Standards, and Related Documents in the Acquisition Process
3 Nov 80 (USDR&E)

DoDD 4155.1 Quality Program
10 Aug 78 (USDR&E)

DAR Sec. XIV Procurement Quality Assurance

DoDD 5000.1 Major System Acquisitions
19 Mar 80 (USDRE)

DoDI 5000.2 Major System Acquisition Procedures
19 Mar 80 (USDRE)

DoDD 5000.3 Test and Evaluation
26 Dec 79 (USDR&E)

DoDD 5000.4 OSD Cost Analysis Improvement Group
30 Oct 80 (ASD(PA&E))

DoDD 5000.28 Design to Cost
23 May 75 (DDR&E)

DAR 1-338 Design to Cost

DoDD 5000.39 Acquisition and Management of Integrated Logistic Support for Systems and Equipment
17 Jan 80 (ASD(MRA&L))

DoDD 5000.40	Reliability and Maintainability 8 Jul 80 (USDR&E)
DoDD 5010.8	DoD Value Engineering Program 12 May 76 (ASD(I&L))
DAR 1-1700	Value Engineering
DoDD 5010.19	Configuration Management 1 May 79 (USDR&E)
DAR 1-21	Procurement Planning

II. DESCRIPTIVE ANALYSIS OF POLICIES AND PROCEDURES

A. OBJECTIVES

1. Major System Acquisition (DoDD 5000.1)

Each DoD official who has responsibility for the acquisition process...shall make every effort to achieve the most cost-effective balance between acquisition and ownership costs and system effectiveness, and integrate support, manpower, and related concerns into the acquisition process.

2. Reliability and Maintainability (DoDD 5000.40)

The objectives of Defense reliability and maintainability (R&M) activities shall be to reduce demand for maintenance and logistic support of attached and detached item components, and to field items that can be operated and maintained with skills and training expected to be available in the Department of Defense.

3. Quality Assurance (DoDD 4155.1)

DoD components shall develop and manage a quality program to achieve the following objectives:

a. Assure mission and operational effectiveness and user satisfaction with DoD products.

b. Assure that all services provided and products acquired by or for DoD conform to specified requirements.

c. Assure that only minimum essential quality and related technical requirements are specified, consistent with a. above.

d. Tailor contractual quality requirements to meet the needs of each acquisition.

e. Assure that all of the above are cost-effective.

4. Integrated Logistic Support (DoDD 5000.39)

Integrated logistic support (ILS) planning shall be based on review and assessment of alternative strategies to support the operational requirement for the system at the lowest life cycle cost; logistic (including manpower) and affordability constraints identified at Milestone 0; realistic estimates of system and subsystem R&M and other parameters which drive manpower and other logistic demands; and documented logistic support analyses, which quantitatively link related design parameters and ILS requirements to system readiness objectives and detailed support element requirements.

5. Defense Standardization and Specification Program (DoDD 4120.3)

The objectives of the Defense standardization and specification program (DSSP) are to improve the operational readiness of DoD components and assure cost-effective mission performance of systems and equipment by fostering the efficient use of resources and optimum reuse of the products of engineering efforts.

6. DoD Parts Control System (DoDI 4120.19)

The objective of the DoD parts control system is to conserve resources and to reduce life cycle cost by reducing the varieties of component parts and by promoting the use of parts of known performance during the design, development, production, or modification of equipments and weapon systems.

7. DoD Value Engineering Program (DoDD 5010.8)

The objectives are to eliminate or modify unessential characteristics and functions and minimize cost through the organized use of value engineering (VE). Definition of the terms value engineering and VE discipline underscore these objectives. Value engineering operationally implies the

timely application of the VE discipline and VE contract clauses. VE discipline is a sequential process for systematically analyzing high cost areas of functional requirements of DoD systems, equipment, facilities, procedures, operations, maintenance, and materiel to achieve the essential functions at the lowest total cost of effective ownership, consistent with requirements for performance, reliability, quality, maintainability, and safety.

8. Design to Cost (DoDD 5000.28)

The objectives of design to cost are to establish cost as a parameter equal in importance with technical requirements and schedules throughout the design, development, production, and operation of weapon systems, subsystems, and components and to establish cost elements as management goals for acquisition managers and contractors to achieve the best balance between life cycle cost, acceptable performance, and schedule.

B. CONCEPTS AND POLICIES

1. Concepts

a. Acquisition Strategy (DoDI 5000.2)

Acquisition strategy is the conceptual basis of the overall plan that a program manager follows. It reflects the management concepts that shall be used in directing and controlling all elements of the acquisition in response to specific goals and objectives of the program and in ensuring that the system being acquired satisfies the approved mission need. Acquisition strategy encompasses the entire acquisition process. The strategy shall be developed to permit competitive exploration of alternative system design concepts in the concept exploration phase. Additionally, sufficient planning must be accomplished for succeeding program phases, including production, for those considerations that may have a direct influence on competition and design efforts by contractors. The acquisition strategy shall evolve through an iterative process and become increasingly definitive.

b. Estimates (DoDI 5000.2)

The validity of decisions depends upon the quality of cost, schedule, performance, and supportability estimates presented at the milestone reviews. Although there is considerable uncertainty early in the acquisition process, the best available data and techniques must be used in developing estimates. Bands of uncertainty shall be identified for point estimates. Broad bands of uncertainty shall be expected early in the acquisition process, with smaller bands as the program matures and uncertainty decreases. Traceability of successive cost estimates, to include adjustments for inflation and to segregate estimating error from program changes, shall be maintained starting with program cost estimates approved at Milestone I.

c. Programming and Budgeting (DoDI 5000.2)

Milestone decisions are based upon review of details of one particular program and reflect the readiness of that system to progress to the next acquisition phase. The program must compete for funds with other programs in the program planning and budgeting system (PPBS) process. The milestone decision is based on specific schedule, cost, and operational effectiveness estimates which, if changed significantly, might alter the decision. PPBS actions that cause schedule and cost estimates to change significantly enough to call into question the last milestone decision, shall be explained by the DoD component or OSD staff element proposing the change in the PPBS document.

Affordability, the ability to provide adequate resources to acquire and operate a system, is principally a determination of the PPBS process. The ability to provide sufficient resources to execute a program in an efficient and effective manner is a fundamental consideration during milestone reviews. Requests or proposals to proceed into the next acquisition phase

shall be accompanied by assurance that sufficient resources are or can be programmed to execute the program.

d. Logistic Support Budgets (DoDD 5000.39)

Support acquisition budgets and decisions and manpower requirements shall be based upon and directly traceable to system readiness goals and the latest estimates of initial and mature R&M values. They shall be revised using test data and operational experience as these become available. For early deployment, support decisions shall balance the risks of initial readiness needs and premature investment. The degree of uncertainty of the data used in such early deployment decisions shall be recognized and quantified, if possible.

e. Defense Standardization and Specification Program (DoDD 4120.3)

The DSSP shall be a planned program under which specifications, standards, handbooks, engineering drawings, and other standardization documents are prepared and maintained to meet essential requirements with optimum efficiency; and a decentralized program with management authority and responsibilities for portions of the program delegated to the DoD components.

2. Policies

a. Competitive Concept Development (DoDI 5000.2)

Alternative concept solutions to the mission need shall be obtained competitively unless the Secretary of Defense, in approving the MENS, has approved pursuing a single concept. Even then, competition should be considered.

Maximum use should be made of architectual standards and functional specifications that include only minimum requirements. Specifications stated in detailed or how to language should be avoided, when possible.

b. Life Cycle Cost (DAR 1-335)

It is essential that the costs of operating and supporting a system or equipment over its useful life be considered in development and acquisition decisions in order that proper consideration can be given to those systems or equipments that will result in the lowest life cycle cost to the Government.

c. Source Selection (DoDD 4105.62)

A prime objective of the solicitation, evaluation, and source selection process is to select the source whose proposal has the highest degree of realism and credibility and whose performance is expected to best meet Government objectives at an affordable cost.

d. Reliability and Maintainability Engineering (DoDD 5000.40)

Reliability engineering shall focus on the prevention, detection, and correction of design deficiencies, weak parts, and workmanship defects. Maintainability engineering shall reduce maintenance and repair time, number of tasks required for each preventive and corrective maintenance action, and the need for special tools and test equipment. Program plans shall stress early investment in R&M engineering in order to avoid subsequent costs and schedule delays.

DoD components shall define fundamentals of design, manufacture, and management which result in delivery of reliable and maintainable items. These fundamentals shall be the baseline for selection and tailoring of R&M engineering tasks and tests.

(1) Design fundamentals should include: (a) parts and materiel history, qualification and acceptance, (b) design simplification and standardization, (c) parts application stress analysis and derating, (d) sneak circuit analysis for electronics, (e) failure modes and effects analysis,

(f) maintenance and repair analysis, and (g) R&M growth testing to disclose design deficiencies, and to verify the effectiveness of corrective actions.

(2) Manufacturing fundamentals should include: (a) process controls to minimize introduction of weak parts and workmanship defects, (b) environmental stress screening of parts and equipment to disclose latent defects as early and as efficiently as possible, and (c) failure-free acceptance criteria.

(3) Engineering management fundamentals should include: (a) integrated failure, maintenance, and repair reporting throughout design and manufacture, (b) failure analysis, with supporting laboratory facilities, (c) corrective action policies to minimize recurrence of failures and maintenance or repair difficulties, and (d) follow-up to ensure verification of corrective actions.

e. Reliability and Maintainability Accounting (DoDD 5000.40)

R&M accounting shall provide information essential to acquisition, operations, and support management and include properly defined inputs for estimates of operational effectiveness and ownership cost. Cost and schedule investment in efforts to obtain management data (such as R&M demonstrations) shall be clearly visible and carefully controlled.

Separate R&M terms shall be directly related to operational effectiveness and ownership cost and be defined in accordance with the following provisions:

System R&M shall be measured in four separate ways, using units of measurement directly related to operational readiness, mission success, maintenance manpower cost, and logistic support cost. These four ways of measuring R&M shall be the system R&M parameters.

(1) All system R&M parameters do not apply to all systems, but a separate term shall be defined for each applicable system R&M parameter. Insofar as possible, these terms shall be standardized by major system types, such as land vehicles, ships, aircraft, and missiles.

(2) System R&M parameters shall be expressed in operational R&M values, not inherent R&M values, and shall include both contractor-furnished equipment (CFE) and government-furnished equipment (GFE) elements of the system.

(3) Requirements and achievements for each applicable system R&M parameter shall be numerically traceable through all phases of the system life cycle, between levels of assembly, between DoD program documents and contracts, and between DoD data systems for acquisition and ownership.

f. Basic R&M Terms and R&M By Design (DoDD 5000.40)

(1) Basic terms for R&M shall be defined in units of measurement capable of describing the system R&M parameters related to maintenance manpower cost. Audit trails shall be used to relate the other applicable system R&M parameters to these basic units of measurement.

(2) Tradeoffs between performance and reliability, and among required values for system R&M parameters, shall balance the design effort devoted to operational effectiveness with that devoted to ownership cost reduction.

(3) Design features shall be considered according to their effects on both operational effectiveness and ownership cost. For example, redundancy and alternate modes of operation improve mission reliability, but they reduce maintenance-related reliability and thus basic reliability.

g. Test and Evaluation (DoDD 5000.3)

Test and evaluation (T&E) shall begin as early as possible and be conducted throughout the system acquisition process to assess and reduce acquisition risks and to estimate the operational effectiveness and operational suitability of the system being developed. Meaningful critical issues, test objectives, and evaluation criteria related to the satisfaction of mission need shall be established before tests begin.

Successful accomplishment of T&E objectives will be a key requirement for decisions to commit significant additional resources to a program or to advance it from one acquisition phase to another. Acquisition schedules, financial plans, and contractual arrangements shall be based on this principle.

h. Specifications, Standards, and Related Documents (DoDD 4120.21)

The objective is to ensure the cost-effective application of specifications, standards, and related documents in system and equipment acquisition programs, and to assign appropriate responsibilities to the various levels of management.

The provisions apply to all system and equipment acquisition solicitations and contracts having an anticipated research, development, testing, and evaluation (RDT&E) value over $1 million or an anticipated production value of $10 million or more. The principles shall be applied, where appropriate, to solicitations and contracts for lesser amounts.

The provisions shall be applied at the earliest possible time in the acquisition cycle. The application process shall continue throughout the acquisition program and shall be used in the development of the solicitation, contract, and system and equipment specifications. Premature application of specifications, standards, and related documents, not essential

to achieve the requirements of the specific acquisition phase, shall be avoided.

Solicitations and contracts shall stress the achievement of performance, operational, and support requirements rather than detailed procedures or methods of accomplishment. Offerors and contractors should not be restricted by imposing arbitrary compliance with specifications, standards, and related documents.

When consistent with the acquisition strategy, solicitations shall include explicit provisions for offerors to submit recommendations for the application and tailoring of cited nonproduct documents without compromising the performance and operational requirements stated in the solicitation.

During each acquisition phase, contractors shall be required to provide recommendations for selection and tailoring of specifications, standards, and related documents that have applications to the succeeding phase.

i. Nongovernment Specifications and Standards (DoDI 4120.20)

Nongovernment specifications and standards should be adopted and used in lieu of the development and promulgation of a new document when there is no substantial or demonstrable advantage in the development of a new document. The advantage shall be determined by comparison of costs, logistic support, performance requirements, quality control, and usable life of the item under existing specifications versus the proposed new military specification or purchase description.

j. DoD Parts Control System (DoDI 4120.19)

Military parts control advisory groups shall advise DoD components and their contractors on selection and use of parts during the design, development, production, and modification of systems, subsystems, and equipments.

k. Configuration Management (DoDD 5010.19)

It is the policy to apply configuration management to ensure operational efficiency and control cost, and to achieve uniformity in configuration management procedures and practices within the Department of Defense and between DoD and industry.

The degree of configuration management applied for an item shall be consistent with the complexity, size, quantity, intended use, mission criticality, and life-cycle phase of the item.

l. Value Engineering (DoDD 5010.8)

It is the policy to continuously review systems and equipment against "design to" objectives for acquisition and ownership cost.

m. Design To Cost (DoDD 5000.28)

Cost is a parameter during a system's design and development phase and provides a cost discipline to be used throughout the acquisition and operation of a system.

Life cycle cost objectives shall be established for each acquisition and separated into cost elements within the broad categories of development, production, operation, and support. As system definition continues, the cost elements are firmed into cost goals to which the system will be designed and its cost controlled.

C. PHASED MAJOR SYSTEM ACQUISITION

1. Mission Area Analysis

a. Planning (DAR 1-21). Procurement planning should start with the initiation of documentation to obtain program/project approval. Its purpose is to obtain a quality product, in a timely manner, and at a reasonable cost.

b. Reliability and Maintainability (DoDD 5000.40). Projected deficiencies in operational readiness, mission success, maintenance manning, and logistic support shall be documented as needs of the mission area. Establishment of quantitative R&M requirements shall be deferred to conceptual phase.

2. Milestone 0 and Concept Exploration

a. System Designation (DoDD 5000.1)

The Secretary of Defense normally shall designate those systems to be managed as major systems when approving the MENS. In addition to other factors, the decision may be based on the estimated requirement for the system's RDT&E, and procurement funds, and the estimated requirement for manpower to operate, maintain, and support the equipment in the field.

b. Program Manager (DoDD 5000.1)

The DoD component head shall ensure that a program manager is assigned and that a program manager's charter is approved as soon as feasible after Milestone 0. The program manager shall acquire and field, in accordance with instructions from line authority, a cost-effective solution to the approved mission need that can be acquired, operated, and supported within the resources projected in the Secretary of Defense decision memorandum.

c. Acquisition Strategy (DoDI 5000.2)

Development of the initial program acquisition strategy shall be completed by the cognizant DoD component as soon as possible after Milestone 0. The program acquisition strategy is unique for each program and should be tailored by the program manager to the circumstances surrounding the program. Intended exceptions to DoD directives and instructions should be noted in the acquisition strategy summary. Advice and assistance should be

sought from business and technical advisors and experienced managers of other major system programs.

d. Affordability (DoDD 5000.1)

Affordability shall be considered at every milestone. At Milestone 0, 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 will be reconciled with overall capabilities, priorities, and resources. A program normally shall not proceed into concept exploration unless sufficient resources are or can be programmed for Phase 0.

e. Logistic Supportability (DoDD 5000.1)

Logistic supportability shall be a design requirement as important as cost, schedule, and performance. A continuous interface between the program management office and the manpower and logistics communities shall be maintained throughout the acquisition process.

f. Logistic Support Analysis (DoDD 5000.39)

Logistic support analysis (LSA) shall include use of appropriate analytical tools and models throughout the acquisition cycle to evaluate alternative support concepts, to perform tradeoffs between system design and ILS elements, and to perform tradeoffs among ILS elements in order to meet system readiness objectives at minimum cost. LSA shall be used to effect integration of support planning and design and consistency among ILS elements. LSA shall commence at Milestone 0 and be performed in increasing depth throughout the acquisition phases.

g. Reliability and Maintainability (DoDD 5000.40)

A measured baseline value shall be obtained for each system R&M parameter that applies to each alternative system concept, from operation and support experience with a similar system or systems. A system life profile

shall be defined, to include one or more mission profiles; then a tentative operational goal shall be established for each applicable system R&M parameter. These goals shall be responsive to documented needs of the mission area, and realistically achievable in comparison to baseline values.

h. Manpower and Training (DoDI 5000.2)

New systems shall be designed to minimize both numbers and skill requirements of people needed for operation and support, consistent with system availability objectives. Manpower and personnel factors, to include numbers, occupations, and skill levels of manpower required, shall be included as considerations and constraints in system design. Integration of manpower and personnel considerations with the system shall start with initial concept studies and shall be refined as the system progresses to form the basis for crew station design, personnel selection and training, training devices and simulator design, and other planning related to manpower and personnel.

Where applicable, planning for training shall consider provisions for unit conversion to the fielded system and training of reserve component personnel. Such planning shall consider tradeoffs conducted among equipment design, technical publications, formal training, on-the-job training, unit training, and training simulators and shall develop a cost-effective plan for attaining and maintaining the personnel proficiency needed to meet mission objectives.

After Milestone 0, manpower requirements shall be subjected to tradeoffs with system characteristics and support concepts.

i. Integrated Logistic Support Plans (DoDI 5000.2)

ILS plans and programs shall be structured to meet peacetime readiness and wartime employment system readiness objectives tailored to the specific system. Beginning early in the system development process, both DoD

and industry shall consider innovative manpower and support concepts. Alternative maintenance concepts shall be assessed during concept development and at other appropriate points of the life cycle. Readiness problems and support cost drivers of current systems shall be analyzed to identify potential areas of improvement to be addressed during concept formulation.

j. Defense Standardization and Specifications Program (DoDD 4120.3)

Existing items and engineering practices and documents prepared under the DSSP shall be used only to the extent that they satisfy the program needs and their use will not compromise the program objectives.

k. Specifications, Standards (DoDD 4120.21)

During the concept exploration phase, application of specifications, standards, and related documents shall be limited to only those necessary to achieve the mission-oriented requirements specified for these phases.

l. Design to Cost (DoDD 5000.28)

An initial estimate of the resources available for allocation to the program shall be made and cost objectives established during concept formulation. Likewise, the minimum essential performance characteristics shall be quantified to avoid tradeoffs below that necessary to satisfy the required operational capability. Each technically feasible alternative will be analyzed and cost/performance tradeoffs made to ensure selection of the lowest life cycle cost solution. As soon as the system is definitized to the extent that cost associated with minimum performance needed can be estimated with confidence, a firm design to cost goal shall be recommended for the program.

m. Quality Program (DoDD 4155.1)

Concepts will be analyzed to determine minimum essential quality characteristics and R&M. Initial quality assurance plans will be developed.

3. Milestone I and Demonstration and Validation

a. Affordability (DoDD 5000.1)

Approval to proceed into the demonstration and validation phase shall be dependent on DoD component assurance that it plans to acquire and operate the system and that sufficient RDT&E resources are available or can be programmed to complete development.

b. Affordability (DoDI 5000.2)

The DoD component shall describe in the MENS the general magnitude of resources it is prepared to commit to acquire a system to satisfy the need. At Milestone I, affordability considerations shall be used as a factor in determining the selection of alternative concepts.

c. Affordability Requirements - Milestones I, II, and III (DoDI 5000.2)

The DoD component briefing presented to the DSARC at Milestones I, II, and III shall include the following affordability considerations:

(1) Comparison of program resource estimates with latest PPBS projections (including the extended planning annex).

(2) Identification of the relative ranking for this system and the DoD component's other major systems in the same mission area and general time frame in the latest program or budget submission.

(3) Analysis of variation in unit cost (recurring hardware, flyaway, and procurement) with production rate (Milestones II and III).

(4) Identification of potential offsets necessary to provide the resources to execute the remaining phases of the program where program

cost estimates provided to the DSARC exceed latest budget projections. Where joint programs are involved, offset identifications shall not be limited to the lead DoD component.

d. Life Cycle Cost Estimate (DoDI 5000.2)

A life cycle cost estimate shall be prepared at Milestone I, using the best available data and techniques. An updated life cycle cost estimate shall be provided for each subsequent milestone. These cost estimates shall be developed as soon as ongoing development activities permit to eliminate unnecessary delays in the milestone decision process.

Milestone I cost, schedule, performance, and supportability goals shall not inhibit tradeoffs among these elements by the program manager in developing the most cost-effective solution to the mission need.

e. Life Cycle Cost Estimate (DoDD 5000.28)

A life cycle cost estimate shall be made at the initiation of the validation phase or at the earliest practical date thereafter by using, for example, cost model equations. These estimates will be updated prior to the initiation of the full-scale engineering development phase and the production phase of the program.

Programs being conducted in accordance with design to cost concepts shall be reviewed periodically (at least each DSARC milestone or equivalent program phase) on a life cycle cost basis.

f. Design to Cost (DoDD 5000.28)

The design to cost goal shall be established before Milestone I or at the earliest practical date thereafter, but in no case later than entry into full-scale development. Once established, the goal becomes a highly visible cost goal against which, in large measure, the success of the program

and the cost performance of the DoD component and program manager are measured. The recommended goal shall be included in the DCP and submitted as part of the normal DSARC review. Applicable rationale to support the goal shall be included. The recommended goal will be reviewed by the OSD CAIG and the DSARC advised on its achievability. Recommendations shall be made to the Secretary of Defense who will establish the official design to cost goal for the program.

g. Thresholds (DoDI 5000.2)

Threshold values shall be established at Milestones I, II, and III for cost, schedule, performance, and supportability. These values shall reflect reasonable variances that are acceptable for the goals proposed in the DCP. At Milestone I, threshold values shall be established for only a few items and the distance between the goal and the threshold for individual items may be larger than at subsequent milestones. Program managers are responsible for reporting actual and projected threshold breaches immediately to each line official and the Defense Acquisition Executive (DAE). Following this initial report, the DoD component shall provide the DAE with an assessment of the problem, a description of the action to be taken to resolve the problem and, if required, a recommendation to establish new threshold values. Approved changes to thresholds shall be documented in a SDDM.

h. Reliability and Maintainability (DoDI 5000.2)

CFE items shall be designed to prevent operational R&M deficiencies typical of current items. Items that are selected as GFE or off-the-shelf commercial products shall have met, or shall be required to meet, their allocated R&M goals for the new system under equal or more severe environmental stresses. Operating and support concepts shall be tailored to prevent operational R&M deficiencies.

i. Production Planning (DoDI 5000.2)

From the early phases of the program, consideration shall be given to the costs of production, including total Government investment required to ensure adequate production facilities, availability of critical materials, and capability. Affordability must be considered in production planning. The program manager shall also consider means to increase the possibilities for competition during production.

j. Operational Concept (DoDI 5000.2)

The operational concept specifies how the system shall be integrated into the force structure and deployed and operated in peacetime and wartime to satisfy the mission need. It establishes required readiness and activity rates and provides the basis for further ILS planning. An initial operational concept and system readiness objective must be developed by Milestone I for each alternative and finalized by Milestone II. The operational concept and system readiness objective shall be maintained throughout the program.

k. Integrated Logistic Support (DoDD 5000.39)

The program manager is responsible for ILS and shall be supported by a ILS manager, designated by Milestone I, to serve as the program focal point for manpower and other logistic planning.... Support acquisition costs are selected development and procurement costs...associated with a weapon system during the acquisition phase that are required to ensure that planned support of that weapon system is achieved....

The program manager shall have a current ILS plan to support milestone decisions. The ILS plan shall identify manpower and other support goals and demonstrated achievements; define support concepts and plans; and document ILS element requirements, and the schedules, funding requirements,

and responsibilities for ILS activity planned for the succeeding program phases.

Development program budgets shall include adequate funding for ILS planning, analysis, and cost reduction efforts starting with program initiation.

During the formulation of the acquisiton strategy and supporting plans, consideration shall be given to ILS goals and objectives to determine source selection factors, contract type and structure, incentives, and degree of competition. Innovative contractor efforts to improve support costs and system readiness shall be solicited and considered in source selection weighting and contract incentives. To the maximum practical extent, ILS contract requirements shall be identified under definitized contract line items in the prime contract. Contractors shall be provided appropriate Government data to use as a basis for ILS planning and LSA (such as baseline and operating scenario and maintenance concept, system readiness goals, schedules, maintenance and support cost data on current systems, and manpower/skills availability).

l. Integrated Logistic Support Baseline (DoDD 5000.39)

The support costs, manpower requirements, and R&M of current comparable equipment shall be identified at a system and subsystem level by Milestone I to provide comparative baselines for estimates of new systems, and to identify and set targets for improvement in the new system.

m. Program Manager and Integrated Logistic Support (DoDD 5000.39)

Program managers shall include ILS as an integral part of their acquisition programs, allocate appropriate development and production resources and schedule for ILS, and balance system readiness with cost, schedule, and performance goals.

n. Test and Evaluation (DoDD 5000.3)

When appropriate, development T&E shall be accomplished before Milestone I to assist in selecting preferred alternative system concepts.

As appropriate, operational T&E will be accomplished before Milestone I to assess the operational impact of candidate technical approaches and to assist in selecting preferred alternative system concepts.

o. Standardization in Engineering Design (DoDD 5000.40)

Standardization shall be applied in design during the demonstration and validation phase and the full-scale development phase to reduce cost of production and operational support and to accelerate timely operational readiness. This can be done through optimum utilization of existing or codeveloped subsystems, equipment, components, parts, and materials common to other systems and available in supply. Standardization shall be optimized to enhance nuclear and nonnuclear survivability and endurance, quality, reliability, maintainability, supportability, and life cycle cost, but shall not compromise essential performance or excessively inhibit the application of new technology and innovative, advanced design. A standardization program, including a parts control program, shall be applied.

p. Standardization and Specifications (DoDD 4120.3)

Existing items and engineering practices and documents prepared under the DSSP shall be used in the demonstration and validation phase only to the extent that they satisfy the program needs and their use will not compromise the program objectives.

q. Specifications, Standards, and Related Documents (DoDD 4120.21)

During the demonstration and validation phase, application of specifications, standards, and related documents shall be limited to only

those necessary to achieve the mission-oriented requirements specified for this phase.

r. Design to Cost (DoDD 5000.28)

During design and development, cost requirements and the achievement of cost goals will be evaluated with the same rigor as technical requirements and the achievement of performance goals. Practical tradeoffs between system capability, cost, and schedules must be continually examined to ensure that the system developed will have the lowest life cycle cost consistent with schedule and performance requirements.

Although this initial goal uses a production cost element, the management objective during design and development shall continue to include the control of future operating and support cost. The major operating and support cost factors shall have goals established in the form of measurable numbers (e.g., numbers of O&S personnel, R&M factors, etc.) which can be monitored during T&E as well as in operation. These factors shall have emphasis equal to other cost factors in acquisition cost management.

s. Quality Program (DoDD 4155.1)

Quality characteristics will be identified and defined. Contract quality provisions will be prepared. Quality requirements and the quality assurance plan will be updated and refined.

4. Milestone II and Full-Scale Development

a. Acquisition Strategy (DoDI 5000.2)

While the acquisition strategy does not require DAE approval, the program manager shall be required to keep all management levels informed on strategy and shall be required to summarize certain aspects of it at the milestone decision points. At the earliest practical date and no later than

Milestone II, the program manager shall have a comprehensive strategy for full-scale development, test and evaluation, and production.

b. Affordability (DoDD 5000.1)

Approval to proceed into the full-scale development phase shall be dependent on DoD component assurance that resources are available or can be programmed to complete development and acquisition and to operate and support the deployed system in the manner prescribed by the Secretary of Defense.

c. Affordability and the FYDP/EPA (DoDI 5000.2)

At Milestones II and III, a favorable decision shall not be made unless the system's projected life cycle costs, including product improvement and other modifications, are within the amounts reflected in the latest FYDP/EPA or unless compensating changes are made to other items in the defense program.

d. Design to Cost (DoDI 5000.2)

Goals and thresholds for cost, schedule, performance, and supportability shall be documented in the SDDM. At Milestone II, firm design to cost goals shall be established for the system or systems selected for full-scale development. Program accomplishments shall be evaluated against cost, schedule, and supportability goals with the same rigor as the evaluation of technical performance.

e. Design to Cost (DoDD 5000.28)

The cost goals established and "designed to" in the development phase will be extended into subsequent phases of the system's life cycle. Production cost will be rigorously controlled to the production goals.

Because of the ability to more accurately estimate production costs and the supportive production cost data base available, initial goals for design to cost shall be established in the form of average unit flyaway

(rollaway, sailaway) cost. Programs to strengthen the data base of weapon system O&S cost shall continue. As the ability to translate O&S cost elements into "design to" requirements improves, design to cost goals may be extended into this area.

f. Value Engineering (DoDD 5010.8)

VE supports "design to" efforts, particularly during engineering development, by training engineering and other personnel to apply VE principles as a normal part of their duties, using VE clauses as a convenient mechanism for contract changes which reduce future acquisition and support costs, and selectively using both internal and contractor VE task teams to reduce areas of high cost or over design to cost targets.

g. Reliability and Maintainability (DoDI 5000.2)

R&M goals and thresholds shall be proposed in the DCP at Milestone II for system R&M parameters directly related to operational readiness, mission success, nuclear and nonnuclear survivability and endurance, maintenance manpower cost, and logistic support cost. R&M goals and thresholds shall be defined in operational terms and shall include both CFE and GFE elements of the system.

(1) R&M goals shall be realistically achievable in service. When possible, operational R&M deficiencies shall be precluded by design of CFE, by careful selection of GFE, and by tailoring of R&M-related operating and support concepts, policies, and planning factors.

(2) The R&M thresholds recommended at Milestone II shall be the minimum operational values acceptable to the DoD component. Thresholds approved in the SDDM at Milestone II shall be achieved before Milestone III. Thresholds approved in the SDDM at Milestone III shall be achieved during initial deployment.

(3) R&M growth shall be predicted and graphically displayed in the IPSs prepared for Milestones II and III. The SDDM shall include threshold values, with specified confidence levels, at interim review points. A threshold breach shall be reported at these points if these threshold values are not achieved.

h. Reliability and Maintainability Goals and Thresholds (DoDD 5000.40)

At Milestone II, a firm goal and a threshold shall be established for each applicable system R&M parameter. Goals shall be realistically achievable and thresholds shall be acceptable in service. Goals shall be stated as specified values and thresholds as minimum acceptable values, in both CFE & GFE contracts. R&M growth shall be assessed and enforced so that R&M thresholds are met well before the production decision.

i. Reliability and Maintainability Design Corrections (DoDI 5000.2)

Resources shall be identified for incorporation and verification of R&M design corrections during full-scale development and initial deployment. Assessment of current R&M values and timely corrective action are required until all R&M thresholds approved at Milestone III have been achieved in service or approved by waiver.

j. Reliability and Maintainability Growth (5000.40)

R&M growth is required during full-scale development, concurrent development and production (where concurrency is approved), and during initial deployment. Predicted R&M growth shall be stated as a series of intermediate milestones, with associated goals and thresholds, for each of these phases.

k. Test and Evaluation (DoDI 5000.2)

Test and evaluation shall commence as early as possible. An estimate of operational effectiveness and operational suitability, including

logistic supportability, shall be made prior to a full-scale production decision. The most realistic test environment will be chosen to test an acceptable representation of the operational system.

l. Test and Evaluation (DoDD 5000.3)

Before the Milestone II decision, adequate development T&E shall be accomplished to identify the preferred technical approach, including the identification of technical risks and feasible solutions. Operational T&E also will be accomplished, as necessary, to examine the operational aspects of the selected alternative technical approaches and estimate the potential operational effectiveness and suitability of candidate systems. Decisions made at Milestone II to commit funds for production long lead items or limited production must be supported by OT&E results.

m. Integrated Logistic Support (DoDI 5000.2)

Program goals shall be based on quantitative analysis and established by Milestone II.

n. Integrated Logistic Support (DoDD 5000.39)

Detailed milestone plans to meet ILS objectives shall be developed early in full-scale engineering development. Positive controls (such as network scheduling systems, WBS) shall be established to identify interdependencies among the ILS elements, design activities, and deployment plans, and to integrate schedules.

o. Manpower (DoDI 5000.2)

Manpower goals and thresholds consistent with projected activity levels, maintenance demands, and support concepts shall be identified by Milestone II. Tradeoffs for maintenance effectiveness among manpower (numbers, occupations, and skill levels), support equipment, system design, and the support structure shall be conducted.

p. Standardization and Specifications (DoDD 4120.3)

Existing items and engineering practices and documents prepared under the DSSP shall be used in the full-scale engineering development and the production and deployment phases wherever cost effective. A parts control program shall be employed to reduce the costs and logistic burden associated with item proliferation.

q. Specifications and Standards (DoDD 4120.21)

The application of specifications, standards, and related documents for transition to the full-scale development phase shall provide for achieving the specified performance, operational, and configuration baseline requirements as determined for this phase.

r. Configuration Management (DoDD 5010.19)

Appropriate DoD configuration management of interface baseline characteristics shall be applied to any developmental item, before approval for full-scale engineering development, if the item is required to interface with specified and configuration baselines of other configuration items under development, in production, or in supply; or, if the item is required to be compatible with an existing or planned maintenance program.

Appropriate DoD configuration management shall be applied to any item to be developed wholly or partially with Government funding, immediately following approval for full-scale engineering development.

s. Test and Evaluation (DoDD 5000.3)

Before the Milestone III decision, adequate DT&E shall be accomplished to ensure that engineering is reasonably complete (including survivability/vulnerability, compatibility, transportability, interoperability, reliability, maintainability, safety, human factors, and logistic

supportability), that all significant design problems have been identified, and that solutions to these problems are in hand.

Also before the Milestone III decision, adequate OT&E shall be accomplished to provide a valid estimate of the system's operational effectiveness and suitability. The items tested must be sufficiently representative of the expected production items to ensure that a valid assessment can be made of the system expected to be produced.

t. Quality Program (DoDD 4155.1)

Producibility and quality engineering analyses will be performed. Designs will be reviewed for quality characteristics. Contract provisions for quality production will be prepared.

5. Milestone III and Production and Deployment

a. Acquisition Strategy (DoDI 5000.2)

The strategy for production shall be updated at Milestone III.

b. Affordability (DoDD 5000.1)

Assurance of affordability will be reaffirmed by the DoD component prior to receiving approval to proceed into the production and deployment phase. Affordability, a function of cost, priority, and availability of fiscal and manpower resources, shall be established and reviewed in the context of the PPBS process.

c. Reliability and Maintainability (DoDI 5000.2 and DoDD 5000.40)

Previous use, operational test results, and verified design corrections shall be inputs for the production decision at Milestone III. Design corrections shall have been verified under conditions no less severe than design requirements. Proposed design corrections don't count, unless concurrency has been approved and specific provisions have been made to verify their effectiveness. Recurrence of failures due to weak parts and workmanship

defects shall be precluded by specific quality control provisions in production contracts. R&M growth shall be assessed and enforced to ensure R&M thresholds are met (or met again) during initial deployment.

d. Test and Evaluation (DoDD 5000.3)

After the Milestone III decision, development T&E shall be an integral part of the development, acceptance, and introduction of system changes to improve the system, react to new threats, and reduce life cycle costs.

During initial production and deployment of the system, the DoD component's OT&E agency will manage follow-on operational T&E, as necessary, to ensure that the initial production items meet operational effectiveness and suitability thresholds and to evaluate system, manpower, and logistic changes to meet mature system readiness and performance goals.

The operational T&E agency shall provide an independent evaluation of operational T&E results at key decision milestones. The Milestone III evaluation shall include recommendations regarding the system's readiness for operational use.

e. Support Planning (DoDI 5000.2)

Detailed support planning shall be initiated during full-scale development, and firm requirements shall be established before Milestone III. The supportability of a system's nuclear hardness design shall receive explicit consideration. Logistics and manpower planning shall be adjusted based on follow-on T&E and other appropriate reviews. Before Milestone III, the acquisition strategy shall be updated to include follow-on support.

f. Integrated Logistic Support (DoDD 5000.39)

Plans shall be developed by Milestone III for follow-on readiness assessments, beginning with initial deployment and continuing until the

AD-A113 684 LOGISTICS MANAGEMENT INST WASHINGTON DC F/G 14/1
THE FRAMEWORK FOR LIFE CYCLE COST MANAGEMENT,(U)
JAN 82 R P WHITE MDA903-81-C-0166
UNCLASSIFIED LMI-RE103 NL

system design and support configuration are mature. These plans shall include milestones, responsibilities, and acquisition strategies for making system design and support resource improvements needed to meet system readiness objectives.

g. Manpower (DoDI 5000.2)

The manpower and training requirements to support peacetime readiness objectives and wartime employment shall be developed by Milestone III. These requirements shall be based upon considerations that include available OT&E results and current field experiences with similar equipment.

h. Specifications and Standards (DoDD 4120.21)

The application of additional documents for transition to the production phase shall provide for an optimum match between stated performance, operational and support requirements and mission needs, and defined costs and schedules, as determined by preceding phases.

i. Configuration Management (DoDD 5010.19)

During the deployment/operation/support phase, appropriate configuration management shall be continued to the extent required for readiness support.

j. Value Engineering (DoDD 5010.8)

VE is a primary mechanism for cost reduction during production and logistic support. During these phases the VE incentive clause is used to motivate contractors to submit cost reduction contract change proposals.

k. Design to Cost (DoDD 5000.28)

As the system is introduced, operation and support cost goals will be used to control initial outfitting cost, personnel, spares, rework, etc. In the operational feedback process, change requests generated by operational usage and fed back to design engineering will reflect the use of design

to cost principles and tradeoffs necessary to ensure the lowest cost is obtained to achieve acceptable performance.

1. Reliability Improvement Warranties

A RIW is a contractual technique by which a contractor agrees to repair or replace all equipment that fails during a specified or measured period of use. By its nature, it can't be used before the production phase.

m. Quality Program (DoDD 4155.1)

In production phase, baseline control of engineering changes and configuration will be established. Quality assurance plans will be updated and implemented. After deployment, the initially deployed systems will be monitored to assure user satisfication.

6. In Service

a. Reliability and Maintainability (DoDD 5000.40)

The acquiring agency shall continue to correct operational R&M deficiencies due to materiel design and quality, to ensure R&M goals reaffirmed at the production decision are achieved in service. Responsibility for correction of operational R&M deficiencies caused by operating or support concepts shall be clearly defined.

Blank

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A113684	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* THE FRAMEWORK FOR LIFE CYCLE COST MANAGEMENT		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER LMI TASK RE103
7. AUTHOR(s) RICHARD P. WHITE		8. CONTRACT OR GRANT NUMBER(s) MDA903-81-C-0166
9. PERFORMING ORGANIZATION NAME AND ADDRESS LOGISTICS MANAGEMENT INSTITUTE 4701 Sangamore Road, P. O. Box 9489 Washington, D. C. 20016		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Director of Contracts and Systems Acquisition, Under Secretary of Defense for Research and Engineering		12. REPORT DATE January 1982
		13. NUMBER OF PAGES 101
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

"A" Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Life Cycle Cost, Affordability, Life Cycle Cost Management, Reliability and Maintainability, Value Engineering, Quality Program, Reliability Improvement Warranty, Life Cycle Costing, Cost-Plus-Award-Fee Contract, Total Cost of Ownership

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The existing phased acquisition process, with key milestone decisions by the Secretary of Defense, is the framework for managing the life cycle costs of major weapon systems developed and produced under contracts and operated and supported by the military departments. This report defines life cycle cost and describes the framework and the several regulations, directives, and instructions that guide and direct the performance of the wide variety of functions that are parts of and influence the costs of the planning, design-

(continued)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

(20. continued)

ing, managing, acquiring, operating, and supporting of major DoD weapon systems. These include the policies and procedures for major system acquisition, the DSARC process, CAIG, R&M, quality, standardization, and contracting techniques of the award fee contract, life cycle costing, value engineering programs and incentives, and reliability improvement warranties. The report also fits each of these functions and activities into the framework, showing when each may, or must, be performed. It highlights the role of the program manager and the need for joint DoD/contractor management of the high risk process of developing major programs to meet mission needs.