MIL-STD-499A(USAF)
1 MAY 1974

Superseding
MIL-STD-499(USAF)
17 July 1969

MILITARY STANDARD

Engineering Management

FSC - MISC.

DEPARTMENT OF DEFENSE
Washington, D. C. 20301

1. This Military Standard is approved for use by the Department of the Air Force.

2. Recommended corrections, additions, or deletions should be addressed to:

Commander, Air Force Systems Command
ATTN: SDDE
Andrews AFB, Washington, D. C. 20331

FOREWORD

MIL-STD-499A(USAF) has been developed to assist Government and contractor personnel in defining the system engineering effort in support of defense acquisition programs. This Standard applies to internal Department of Defense (DOD) system engineering as well as joint Government-industry applications for Government contracts. The term "contractor", as used throughout this Standard, also means "government agency" when acquisition is being done in-house. The fundamental concept of this Standard is to present a single set of criteria against which all may propose their individual internal procedures as a means of satisfying engineering requirements. Economy is thus achieved by permitting a contractor's internal procedures to be used in support of Air Force programs. In those cases where multi-associate contractors are involved or when more specific direction to a contractor is essential, as determined by the program manager, a set of specific engineering task statements tailored to the specific needs of the program may be specified in the Request for Proposal (RFP).

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ENGINEERING MANAGEMENT

1. SCOPE

1.1 Purpose. This standard provides the program manager:

(a) Criteria for evaluating engineering planning and output.

(b) A means for establishing an engineering effort and a System Engineering Management Plan (SEMP).

(c) Task statements that may be selectively applied to an acquisition program.

1.2 Application. This standard may be applied at the discretion of the program manager to any system or major equipment program or project. When this standard is applied on a contract, the prime contractor may, at his option, or as specified by the Government, impose tailored requirements of this standard on subcontractors.

1.3 Implementation. This standard may be used in preparing requirements for inclusion in solicitation documents, contract work statement, and System Engineering Management Plans. It is intended that the provisions of this standard be selectively applied in the following combinations:

(a) Section 5, or

(b) Section 5 and selected paragraphs from Appendix A.

1.4 Tailoring. Selected and tailored task statements of Appendix A may be used by:

(a) Contractors proposing contractual wording in response to an RFP.

(b) Program managers in preparation of solicitation documents.

In each application of Appendix A task statements, this standard will be tailored to the specific characteristics of a particular system, program, project, program phase, and/or contractual structure. Tailoring takes the form of deletion, alteration or addition to the task statements. In tailoring the tasks, the depth of detail and level of effort required, and the intermediate and output engineering data expected must be defined. Subsequent tailoring may be done by the contractor and the Government during contract negotiations. The agreement reached on the engineering effort and the SEMP shall be reflected in the resultant contract.

2. REFERENCED DOCUMENTS

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

STANDARDS

MILITARY

MIL-STD-480	Configuration Control - Engineering Changes, Deviations, and Waivers
MIL-STD-483(USAF)	Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs
MIL-STD-881	Work Breakdown Structure for Defense Materiel Items
MIL-STD-1521(USAF)	Technical Reviews and Audits for Systems, Equipment, and Computer Programs.

SPECIFICATIONS

MILITARY

MIL-S-83490	Specifications, Types and Forms

OTHER PUBLICATIONS

AFLCM/AFSCM 800-4	Optimum Repair-Level Analysis (ORLA)

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

3. DEFINITIONS

The definitions included in applicable documents listed in Section 2 shall apply. Additional definitions established by this document are listed in subsequent paragraphs.

3.1 Engineering Management - The management of the engineering and technical effort required to transform a military requirement into an operational system. It includes the system engineering required to define the system performance parameters and preferred system configuration to satisfy the requirement, the planning and control of technical program tasks, integration of the engineering specialties, and the management of a totally integrated effort of design engineering, specialty engineering, test engineering, logistics engineering, and production engineering to meet cost, technical performance and schedule objectives.

3.2 Technical Program Planning and Control - The management of those design, development, test, and evaluation tasks required to progress from an operational need to the deployment and operation of the system by the user.

3.3 System Engineering Process - A logical sequence of activities and decisions transforming an operational need into a description of system performance parameters and a preferred system configuration.

3.4 Engineering Specialty Integration - The timely and appropriate intermeshing of engineering efforts and disciplines such as reliability, maintainability, logistics engineering, human factors, safety, value engineering, standardization, transportability, etc., to insure their influence on system design.

3.5 Technical Performance Measurement - The continuing prediction and demonstration of the degree of anticipated or actual achievement of selected technical objectives. It includes an analysis of any differences among the "achievement to date", "current estimate", and the specification requirement. "Achievement to Date" is the value of a technical parameter estimated or measured in a particular test and/or analysis. "Current Estimate" is the value of a technical parameter predicted to be achieved at the end of the contract within existing resources.

4. GENERAL CRITERIA

The contractor's engineering management shall conform to the following general criteria. These criteria are the basis for evaluation of individual program engineering planning and output.

(a) Technical Objectives. Technical objectives shall be established for each program so that meaningful relationships among need, urgency, risks, and worth can be established.

(b) Baselines. Functional, allocated, and product baselines shall be developed progressively. Appropriate specifications shall be prepared in accordance with MIL-STD-490.

(c) Technology. Specification requirements shall be delineated in light of acceptable technological risks defined by risk assessment.

(d) Realistic System Values. Realistic Reliability, Maintainability, and other such system values shall be established prior to the full-scale development phase.

(e) Design Simplicity. The concept of design simplicity and standardization shall be evident.

(f) Design Completeness. The design shall be complete from a total system element viewpoint (hardware, facilities, personnel, computer programs, procedural data).

(g) Documentation. The concept of minimum documentation shall be evident. Where possible stipulated plans, reports, and other data items shall be used to record the engineering outputs. The repository of this accumulated data will be defined. Engineering data shall be the sole source of performance requirements used in the design and production of the system.

(h) Engineering Decision Studies. Engineering decisions regarding design alternatives and the technical program shall reflect consideration of system cost effectiveness analysis based on the specified figure(s) of merit, performance parameters, program schedule, resource constraints, producibility, and life cycle cost factors.

(i) Cost Estimates. Cost estimates shall include acquisition and ownership costs. This shall include any established "design to" cost goals and a current estimate of these costs.

(j) Technical Task and Work Breakdown Structure Compatibility. Elements of the Contract Work Breakdown Structure and associated technical tasks shall be identified and controlled in accordance with this standard and MIL-STD-881.

(k) Consistency and Correlation of Requirements. System and technical program requirements shall be consistent, correlatable, and traceable throughout the Contract Work Breakdown Structure so that the impact of technical problems can be promptly determined and accurately appraised.

(l) Technical Performance Measurement. Progress in achieving technical requirements shall be continually assessed. Problems and risk areas shall be identified.

(m) Interface Design Compatibility. Intra-system and intersystem design compatibility of engineering interfaces shall be delineated as interface requirements in appropriate specifications. Interface control requirements and drawings related to (1) the major system elements of a prime contractor's contractual responsibility, (2) other equipment, computer programs, facilities, and procedural data furnished by the Government, and (3) other program participants, shall be coordinated, established and maintained (MIL-STD-483(USAF)). Clear lines of communication and timely dissemination of changes to these documents shall be maintained.

(n) Engineering Specialty Integration. Engineering efforts such as Integrated Logistics Support (ILS), test engineering, production engineering, transportability, reliability and maintainability engineering, value engineering, safety engineering, electromagnetic compatibility, standardization, etc., shall be integrated into the mainstream design effort.

(o) Engineering Decision Traceability. Significant engineering decisions shall be traceable to the system engineering process activities on which they were based.

(p) Historical Data. Historical engineering/operational data available to system designers shall be identified.

(q) Responsiveness to Change. Changes to system and program requirements in response to directed changes by the procuring activity, or problem solutions identified shall be evaluated for total program impact with respect to performance, cost and schedules.

(r) Compatibility with Related Activities. Engineering Management activities shall be compatible with related program management activities such as cost schedule control system criteria, contract administration, production management, etc.

5. DETAILED REQUIREMENTS. A fully integrated engineering effort meeting the general criteria of Section 4 shall be planned and executed.

5.1 System Engineering Management Plan (SEMP). A System Engineering Management Plan for satisfying the requirements of this Standard shall be submitted as a separate and complete entity within the contractor's proposal. The plan shall be comprehensive and describe how a fully integrated engineering effort will be managed and conducted. The SEMP shall be in three parts:

Part I

Technical Program Planning and Control. This portion of the plan shall identify organizational responsiblities and authority for system engineering management, including control of subcontracted engineering; levels of control established for performance and design requirements and the control method to be used; technical program assurance methods; plans and schedules for design and technical program reviews; and control of documentation.

Part II

System Engineering Process. The plan shall contain a detailed description of the process to be used, including the specific tailoring of the process to the requirements of the system and project; the procedures to be used in implementing the process; in-house documentation; the trade study methodology; the types of mathematical and/or simulation models to be used for system and cost effectiveness evaluations; and the generation of specifications.

Part III

Engineering Specialty Integration. The integration and coordination of the program efforts for the engineering specialty areas, to achieve a best mix of the technical/performance values incorporated in the contract, shall be described in the SEMP with the detailed specialty program plans being summarized or referenced, as appropriate. The SEMP shall depict the integration of the specialty efforts and parameters into the system engineering process and show their consideration during each iteration of the process. Where the specialty programs overlap, the SEMP shall define the responsibilities and authorities of each.

5.1.1 Contractual Provisions. The contractor shall indicate the items in his SEMP which are proposed for inclusion in the contract. Only those items which are basic to the satisfaction of program objectives and the applicable portions of this Standard will be placed on contract.

5.1.2 Non-Contractual Provisions. The contractor shall identify in his SEMP in-house procedures and other planning baselines in sufficient detail to support the procuring activity need for visibility, validation, and verification of the contractual items. Non-contractual items will normally include the details of the engineering organization and key personnel, and other coverage not appropriate for contract change control by the procuring activity.

5.2 Review of Contractor's Engineering Management. Upon request of the procuring activity, the contractor shall make available his engineering management procedures and data for review to determine his capability to satisfy the requirements of this standard and the SEMP. The review shall consist of a combined demonstration and analysis of those features of the contractor's procedures which are key to the satisfaction of the requirements of the contract.

6. NOTES

6.1 Relationship of Technical Program Planning to Cost and Schedule Planning. The technical program planning function defines the detailed planning requirements. It forms the basis for allocation of resources, scheduling of task elements, assignments of authority and responsibility, and the timely integration of all aspects of the technical program. This planning function is carried out to the prescribed contractual levels and integrated with the cost and scheduled control system criteria. The allocated resources becomes the budgeted cost. This relationship pertains both to initial program definition and to the redefinition which is a part of the decision and control process. (See 10.1.4).

6.2 Relationship of Technical Performance Measurement (TPM) to Cost and Schedule Performance Measurement. The purpose of performance measurement is to: (1) provide visibility of actual vs planned performance, (2) provide early detection or prediction of problems which require management attention, and (3) support assessment of the program impact of proposed change alternatives. TPM assesses the technical characteristics of the system and identifies problems through engineering analyses or tests which indicate performance being achieved for comparison with performance values allocated or specified in contractual documents. Cost/schedule performance measurement assesses the program effort from the point of view of the schedule of increments of work and the cost of accomplishing those increments. By comparing the planned value of work accomplished with both the planned value of work scheduled and the actual cost of work accomplished, problems may surface in the schedule and cost areas. In addition to

problems due to unrealistic cost and schedule planning, cost/schedule performance measurement may show up technical inadequacies, just as technical problems identified through TPM can surface inadequacies in budget of time or dollars. Basically, however, cost and schedule performance measurement assumes adequacy of design to meet technical requirements of the system element under consideration; TPM is the complementary function to verify such adequacy. Further, by assessing design adequacy, TPM can deal with the work planned to complete major design and development milestones which need to be changed and thereby provide the basis for forecasting cost and schedule impacts. TPM assessment points should be planned to coincide with the planned completion of significant design and development tasks, or aggregation of tasks. This will facilitate the verification of the results achieved in the completed task in terms of its technical requirements. Thus, TPM and cost/schedule performance measurement are complementary in serving the purpose of program performance measurement.

6.3 Relationship of Integrated Logistic Support (ILS) to System Engineering. ILS planning impacts upon and in turn is impacted by the engineering activities throughout a system life cycle. Initially, support descriptors in the form of criteria and constraints are furnished with the top level system operational needs. These descriptors will include such items as basing concepts, personnel, or training constraints, repair level constraints, and similar support considerations. ILS descriptors should be quantified whenever possible and then be continually and progressively refined and expanded with the evolution of the design. System engineering, in its evolution of functional and detail design requirements, has as its goal the achievement of proper balance among operational, economic, and logistic factors. This balancing and integrating function is an essential part of the system/cost effectiveness trade-offs and studies. Normally, the lower ILS descriptors will influence and be influenced by their relationship to costs of ownership and Reliability and Maintainability (R&M) parameters. Thus, the integration of ILS concepts and planning considerations into the system engineering process is a continual and iterative activity, with the output being the optimal balance between performance and support considerations and optimal trade-offs among costs of ownership, schedule, and system effectiveness.

6.4 Minimum Documentation. The iterative nature of the engineering process requires a continual flow of information and documentation. Contractor management information/program control systems, and reports emanating therefrom, shall be utilized to the maximum extent practicable. Imposed changes to existing systems shall consist of only those necessary to satisfy established engineering requirements.

6.5 Data. Selected data items in support of this standard will be reflected in a Contractor Data Requirements List (DD Form 1423), supported by Data Item Descriptions (DD Form 1664) attached to the request for proposal, invitation for bid, or the contract, as appropriate.

Custodians:

Air Force - 10

Preparing Activity:

Air Force - 10

Project No. MISC-0814

Review Activities:

Air Force - 10, 11, 13, 18, 19

APPENDIX A

TASK STATEMENTS

10. This non-mandatory appendix provides specific tasks which may be selected to fit program needs. The scope and depth of the specific tasks chosen for application shall be consistent with the needs of the program. Following their adjustment to specific program needs and subsequent contract negotiations, the following tasks may become specific contractual requirements.

10.1 Technical Program Planning and Control.

10.1.1 Development of Contract Work Breakdown Structure (CWBS) and Specification Tree. The contractor's engineering activity shall develop the technical elements of the Contract Work Breakdown Structure. He shall also prepare a specification tree that relates to his CWBS (MIL-STD-881).

10.1.2 Program Risk Analysis. The program definition and redefinition effort shall include a continuing analysis of the risks associated with the related cost, schedule, and technical parameters. This analysis shall identify critical areas and shall further investigate methods for system or hardware proofing, prototyping, testing, and backup development. The program risk analysis shall also identify test requirements, technical performance measurement parameters, and critical milestones.

10.1.3 System Test Planning. The objectives, scope, and type of system testing shall be products of the engineering effort wherein all engineering specialties are integrated to define an effective and economical total system test program. Whenever practicable, tests for different objectives shall be combined. Test data that is useful for TPM analysis shall be identified and integrated with program planning functions for maximum utility in updating and verifying the technical parameters being tracked. Verification of the acceptability and compatibility of human performance requirements, personnel selection, training, and man-machine interfaces of system procedural data shall also be integrated into the system test program.

10.1.4 Decision and Control Process. Technical, budgetary, and scheduling problems shall be diagnosed as early as possible to determine their impact.

Problems and solution alternatives shall be studied to derive the overall impact upon the technical program to insure that the alternatives are assessed with regard to consideration of side effects that may be induced by the solution. Problem solutions involving changes to the contract requirements or configuration baselines shall be processed in accordance with the change control procedures of the contract.

10.1.5 Technical Performance Measurement (TPM). A TPM effort tailored to meet specific program needs shall be planned and executed.

10.1.5.1 Parameters. The technical performance parameters selected for tracking shall be key indicators of program success. TPM parameter inter-relationships shall be depicted through construction of tiered dependency trees similar to the specification tree. Each parameter thus identified shall be correlated with a specific CWBS element. Parameters to be reported shall be selected from the total parameters tracked and shall be identified in the SEMP.

10.1.5.2 Planning. The following data, as appropriate, shall be established during the planning stage of this task for each parameter to be tracked:

(a) Specification requirement.

(b) Time-phased planned value profile with a tolerance band. The planned value profile shall represent the expected growth of the parameter being tracked. The boundaries of the tolerance band shall represent the inaccuracies of estimation at the time of the estimation, and shall also indicate the region within which it is expected that the specification requirement will be achieved within allocated budget and schedule.

(c) Program events significantly related to the achievement of the planned value profile.

(d) Conditions of measurement (type of test, simulation, analysis, etc.).

10.1.5.3 Implementation of TPM. As the design and development activity progresses, the "achievement to date" shall be tracked continually for each of the selected technical performance parameters. In case the "achievement to date" value falls outside the tolerance band, a new profile or "current estimate" shall be developed immediately. The "current estimate" shall be determined from the "achievement to date" and the remaining

schedule and budget. The variation shall be determined by comparing the "achievement to date" against the corresponding value on the planned value profile. An analysis shall be accomplished on the variation to determine the causes and to assess the impact on higher level parameters, on interface requirements, and on system cost effectiveness. For technical performance deficiencies, alternate recovery plans shall be developed with cost, schedule, and technical performance implications fully explored. For performance in excess of requirements, opportunities for reallocation of requirements and resources shall be assessed.

10.1.5.4 Relating TPM to Cost and Schedule Performance Measurement. The contractor shall indicate how he proposes to relate TPM to cost and schedule performance measurement. Cost, schedule, and technical performance measurement shall be made against common elements of the contract work breakdown structure.

10.1.6 Technical Reviews. Technical reviews shall be conducted in accordance with MIL-STD-1521(USAF) to assess the degree of completion of technical efforts related to major milestones before proceeding with further technical effort. The schedule and plan for conduct of technical reviews shall be included in the contractor's System Engineering Management Plan. The reviews shall be a joint effort by contractor and Government representatives. The contractor shall be chairman of the requirements and design reviews and shall assure that decisions made as a result of the design review are implemented. Specific reviews shall be identified in the System Engineering Management Plan. The following technical reviews are normally required:

10.1.6.1 System Requirements Review(s). These reviews shall be conducted to ascertain progress in defining system technical requirements and implementing other engineering management activity. The number of such reviews will be determined by the procuring activity.

10.1.6.2 System Design Review. This review shall be conducted to evaluate the optimization, correlation, completeness, and the risks associated with the allocated technical requirements. Also included is a summary review of the system engineering process which produced the allocated technical requirements and of the engineering planning for the next phase of effort. This review will be conducted when the system definition effort has proceeded to the point where system characteristics are defined and the allocated configuration identification has been established. This review will be in sufficient detail to insure a technical understanding among all participants on (1) the updated or completed system or system segment specification, (2) the completed configuration item (CI) development and critical item specifications, and (3) other system definition efforts, productions, and plans.

10.1.6.3 Preliminary Design Review. This review shall be conducted for each CI or aggregate of CIs to (1) evaluate the progress, technical adequacy, and risk resolution (on a technical, cost, and schedule basis) of the selected design approach, (2) determine its compatibility with performance and engineering specialty requirements of the CI development specification, and (3) establish the existence and compatibility of the physical and functional interfaces among the CI and other items of equipment, facilities, computer programs, and personnel.

10.1.6.4 Critical Design Review. This review shall be conducted for each CI when detail design is essentially complete. The purpose of this review will be to (1) determine that the detail design of the CI under review satisfies the performance and engineering specialty requirements of the CI development specifications, (2) establish the detail design compatibility among the CI and other items of equipment, facilities, computer programs and personnel, (3) assess producibility and CI risk areas (on a technical, cost, and schedule basis), and (4) review the preliminary product specifications.

10.1.7 Subcontractor/Vendor Reviews. The contractor shall assure that equipment developed by his subcontractors is reviewed in accordance with the requirements of this standard. These reviews may be accomplished by the contractor or his subcontractors, as desired. The contractor shall assure that actions required as a result of these design reviews are accomplished. Government participation in subcontractor/vendor reviews shall be as specified by the procuring activity.

10.1.8 Work Authorization. Organizational elements responsible for the technical program effort shall be identified and lines of communication defined for control of resources and accomplishment of specific elements of the CWBS. Detailed work authorization (or work orders) shall be compatible with the cost/schedule control system and shall include technical measures of task accomplishment. These technical measures shall be compatible with the contractor Technical Performance Measurement (TPM) process. Work authorization changes may be only those permitted within the general scope of the contract as set forth therein. The contractor shall inform the cognizant Contract Administration Services (CAS) of work authorization changes made.

10.1.9 Documentation Control. Control of in-house drawings, analysis reports, raw test data, work orders, and other technical data shall be traceable, responsive to changes of requirements, and consistent with the configuration management change control requirements of the contract (MIL-STD-480). These data shall be identified for control purposes in a manner similar to engineering drawings.

10.2 System Engineering Process.

10.2.1 Mission Requirements Analysis. Impacts of the stated system operational characteristics, mission objectives, threat, environmental factors, minimum acceptable system functional requirements, technical performance, and system figure(s) of merit as stipulated, proposed, or directed for change shall be analyzed during the conduct of the contract. These impacts shall be examined continually for validity, consistency, desirability, and attainability with respect to current technology, physical resources, human performance capabilities, life cycle costs, or other constraints. The output of this analysis will either verify the existing requirements or develop new requirements which are more appropriate for the mission.

10.2.2 Functional Analysis. System functions and sub-functions shall be progressively identified and analyzed as the basis for identifying alternatives for meeting system performance and design requirements. System functions as used above include the mission, test, production, deployment, and support functions. All contractually specified modes of operational usage and support shall be considered in the analysis. System functions and sub-functions shall be developed in an iterative process based on the results of the mission analysis, the derived system performance requirements, and the synthesis of lower-level system elements. Performance requirements shall be established for each function and sub-function identified. When time is critical to a performance requirement, a time line analysis shall be made.

10.2.3 Allocation. Each function and sub-function shall be allocated a set of performance and design requirements. These requirements shall be derived concurrently with the development of functions, time-line analyses, synthesis of system design, and evaluation performed through trade-off studies and system/cost effectiveness analysis. Time requirements which are prerequisites for a function or set of functions affecting mission success, safety, and availability shall be derived. The derived requirements shall be stated in sufficient detail for allocation to hardware, computer programs, procedural data, facilities, and personnel. When necessary, special skills or peculiar requirements will be identified. Allocated requirements shall be traceable through the analysis by which they were derived to the system requirement they are designed to fulfill.

10.2.4 Synthesis. Sufficient preliminary design shall be accomplished to confirm and assure completeness of the performance and design requirements allocated for detail design. The performance, configuration, and arrangement of a chosen system and its elements and the technique for their test, support, and operation shall be portrayed in a suitable form such as a set of schematic diagrams, physical and mathematical models, computer simulations, layouts, detailed drawings, and similar engineering graphics. These portrayals shall illustrate intra- and inter-system and item interfaces, permit traceability between the elements at various levels of system detail, and provide means for complete and comprehensive change control. This portrayal shall be the basic source of data for developing, updating, and completing (a) the system, configuration item, and critical item specifications; (b) interface control documentation; (c) consolidated facility requirements; (d) content of procedural handbooks, placards, and similar forms of instructional data; (e) task loading of personnel; (f) operational computer programs; (g) specification trees; and (h) dependent elements of work breakdown structures.

10.2.5 Logistic Engineering. The contractor shall perform logistic engineering as a part of the mainstream engineering effort to develop and achieve a supportable and cost-effective system. This effort will result in establishing the optimal logistic requirements for the deployment and operational phases of the program.

10.2.5.1 Logistic Support Analyses. The contractor shall conduct logistic support analyses leading to the definition of support needs (e. g., maintenance equipment, personnel, spares, repair parts, technical orders, manuals, transportation and handling, etc.). These analyses shall address all levels of operations and maintenance and shall result in requirements for support.

10.2.5.1.1 Maintenance Engineering Analysis. The contractor shall conduct a Maintenance Engineering Analysis (MEA) which facilitates (a) systematic and complete development of maintenance requirements; (b) sorting and combining logistics data; (c) determination of the quantity of maintenance equipment, personnel, and spares; (d) inputs to system effectiveness and life cycle cost analyses in terms of required factors; and (e) identification of system calibration and measuring standard requirements.

10.2.5.1.2 Repair Level Analysis. The contractor shall conduct a repair level analysis in accordance with AFLCH/AFSCM 800-4. The criteria for conduct of this analysis shall be consistent with the system maintenance concept.

10.2.5.1.3 Logistic Support Modeling. The contractor shall evaluate the impact of support alternatives upon system/equipment life cycle cost, availability, equipment and manpower loading, and stocking of parts shall be predicted and evaluated using modeling techniques when appropriate to the program. The logistic model(s) shall be compatible with and shall not duplicate other system engineering models. Specific models and manual procedures may be identified or provided by the procuring activity.

10.2.6 Life Cycle Cost Analysis. The contractor shall perform and periodically update life cycle cost analyses to include the cost of acquisition and ownership. This effort will result in an identification of the economic consequences of equipment design alternatives.

10.2.7 Optimization. Optimization shall take into consideration the associated risks, technical performance, schedule, and life cycle costs.

10.2.7.1 Trade-off Studies. Desirable and practical trade-offs among stated operational needs, engineering design, program schedule and budget, producibility, supportability, and life cycle costs, as appropriate, shall be continually identified and assessed. Trade-off studies shall be accomplished at the various levels of functional or system detail or as specifically designated to support the decision needs of the system engineering process. Trade-off studies, results and supporting rationale shall be documented in a form consistent with the impact of the study upon program and technical requirements.

10.2.7.2 System/Cost Effectiveness Analysis. A continuing system/cost effectiveness analysis shall be conducted to insure that engineering decisions, resulting from the review of alternatives, are made only after considering their impact on system effectiveness and cost of acquisition and ownership. The contractor shall identify alternatives which would provide significantly different system effectiveness or costs than those based upon contract requirements.

10.2.7.3 Effectiveness Analysis Modeling. System effectiveness model(s) shall be used when they contribute to the decision process. The model(s) shall allow the imput parameters to be varied individually so that their relative effect on total system performance and life cycle cost can be determined. Parameters in the effectiveness model(s) shall correlate to parameters expressed in the performance characteristics allocated to system functions. The model(s) and data file shall be maintained, updated, and modified as required.

10.2.8 Production Engineering Analysis. Production engineering analysis shall be an integral part of the system engineering process. It includes producibility analyses, production engineering inputs to system effectiveness, trade-off studies, and life cycle cost analyses and the consideration of the materials, tools, test equipment, facilities, personnel, and procedures which support manufacturing in RDT&E and production. Critical or special producibility requirements shall be identified as early as possible and shall be an input to the program risk analysis. Where critical or special production engineering requirements provide a constraint on the design, these requirements shall be included in applicable specifications. Long lead time items, material limitations, transition from development to production, special processes, and manufacturing constraints shall also be considered and documented during the system engineering process. The contractor shall identify and take necessary steps to reduce high-risk manufacturing areas as early as possible.

10.2.9 Generation of Specifications. The system engineering process shall generate system and item configuration specifications for program peculiar items in accordance with MIL-STD-490 and MIL-S-83490. The specification effort shall be compatible with the configuration management requirements of the program.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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