Systems and Software Engineering

DEFENSE ACQUISITION PROGRAM SUPPORT METHODOLOGY

Version 2.0

Office of the Deputy Under Secretary of Defense
for Acquisition and Technology

Systems and Software Engineering

Defense Acquisition Program Support (DAPS) Methodology

Contents

Figures

Tables

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Foreword

In 2004, the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) established the Systems and Software Engineering (SSE) Directorate to revitalize systems engineering in Department of Defense (DoD) programs. The Directorate was to assess the adequacy of current Department-level SE policies, practices, guidance, tools, education, and training and make recommended systems engineering improvements to promote acquisition excellence. USD(AT&L) also directed SSE to conduct constructive program assessments on ACAT ID programs to identify and resolve issues that preclude program success.
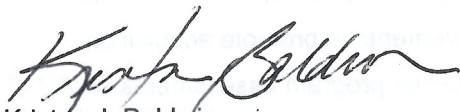
The Director, SSE established the Program Support Review (PSR) process in early 2004 to provide a standardized approach for reviewing all ACAT ID programs for which the USD(AT&L) is the Milestone Decision Authority. These reviews focus on systems engineering but are broader in scope to consider all aspects of acquisition management including resource planning, management methods and tools, earned value management, logistics, and other areas.

This Defense Acquisition Program Support (DAPS) Methodology provides the tailorable framework for conducting PSRs to assist program managers and DoD decision makers in preparation for milestone decision reviews. The methodology is composed of a robust listing of programmatic and technical areas, sub-areas, and factors, developed to be both broad in scope and detailed enough to enable application to programs of all types. The methodology provides a standardized approach (detailed review typology) to conducting PSRs, allowing for the participation of a broad cadre of subject matter experts while expecting the same level of coverage and quality among all reviews.

The methodology also has enabled the creation of a database of program issues and root causes. The database allows systemic analysis that can be used to effect improvements to the acquisition process (e.g., policies, tools, and education) and to identify best practices.

This version of the methodology is the first update to the original publication of October 2004. It correlates with the Defense Acquisition Guidebook and contains more than 20 additions of new content. Examples include environmental safety and occupational health, human systems integration, earned value management, corrosion, spectrum management, technical baselines, and expanded software coverage.

The office of primary responsibility for this publication is the Office of the Deputy Under Secretary of Defense for Acquisition and Technology, Systems and Software Engineering, Assessments and Support (ODUSD(A&T)SSE/AS). This office will develop periodic updates as required, based on policy changes and customer feedback. To provide feedback to SSE/AS, please send e-mail to ATL-AS@osd.mil.

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Introduction

Department of Defense Decision Support Systems

The Department of Defense (DoD) has three principal decision-making support systems: the Joint Capabilities Integration and Development System (JCIDS), the Defense Acquisition System (DAS), and the Planning, Programming, Budgeting, and Execution System (PPBES).

Joint Capabilities Integration and Development System

The JCIDS is the systematic method established by the Joint Chiefs of Staff for assessing gaps in military joint warfighting capabilities and recommending solutions to resolve these gaps. To ensure effective integration of the capabilities identification and acquisition processes, JCIDS guidance was developed in close coordination with the revision to the acquisition regulatory guidance (DoD 5000 series).

Defense Acquisition System

The DAS is the management process by which DoD acquires weapon systems and automated information systems. DAS is a structured, logical approach designed to allow DoD to identify and acquire the best systems necessary to support the needs and capability requirements of the operational warfighter. Although the system is based on centralized policies and principles, it allows for decentralized and streamlined execution of acquisition activities. This approach provides flexibility and encourages innovation, while maintaining strict emphasis on discipline and accountability.

The DAS includes three milestones and a number of other decision points at which a new system acquisition program can be initiated, continued, revised, or canceled. The acquisition process involves a number of acquisition phases following the milestones and decision points during which the development of the program proceeds.

Planning, Programming, Budgeting and Execution System

The PPBES is DoD's strategic planning, program development, and resource determination process. The PPBES is used to craft plans and programs that satisfy the demands of the National Security Strategy with resource constraints.

Defense Acquisition Program Support

Purpose

The Defense Acquisition Program Support (DAPS) program facilitates effective and quality execution of acquisition programs across DoD.

Objectives

- Improve the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD(AT&L)) decision-making process for Major Defense Acquisition Programs and Major Automated Information Systems programs through quality systems engineering and program assessment support.
- Facilitate successful execution of a program through the provision of independent, actionable recommendations to the government program management office (PMO).

Scope

DAPS reviews are cross-functional, multidisciplinary assessments of Acquisition Category (ACAT) ID and other programs as requested. These reviews focus on systems engineering (SE) but address all aspects of a program, including management processes. Reviews are conducted using a consistent process and methodology. The Systems and Software Engineering (SSE) Assessments and Support (AS) "core" review teams may be supported by members of other Office of the Secretary of Defense (OSD) organizations, such as the Cost Analysis Improvement Group (CAIG), Logistics and Materiel Readiness, Portfolio Systems Acquisition, Defense Procurement and Acquisition Policy (DPAP), and Defense Contract Management Agency (DCMA), as well as by members from Service Component organizations. These organizations may be further supplemented by experts from industry and academia.

Full assessments are conducted 9 to 12 months before each milestone, resulting in detailed findings, risk areas, and recommendations provided to the program management office (PMO). These assessments are conducted in collaboration with the PMO rather than entirely from an oversight perspective.

"Quick-look" reviews are conducted 2 to 3 months before the milestone, using the same form and formats as a full assessment. They are conducted as a "for record" review to support the Defense Acquisition Board's (DAB) Integrated Process/Product Teams (IPTs), Overarching Integrated Product Teams (OIPTs), or if requested, for the DAB.

SSE/AS collects systemic findings from the reviews in a database of lessons learned. These findings and lessons learned serve to inform recommendations (with non-attribution to specific programs) for changes to DoD acquisition policies, guidance, and best practices; Quarterly Defense Acquisition Executive Summary (DAES) assessments; and Test and Evaluation Master Plan (TEMP) and Systems Engineering Plan (SEP) development and approval.

Program Support Review

Purpose

The Program Support Review (PSR) serves as the assessment tool within the DAPS program. The DAPS methodology defines the PSR approach that is used to assess defense system development programs by the OSD Program Support Team (PST). The following paragraphs describe the components of the methodology and provide guidance on its application.

Objectives

The DAPS methodology ensures that all PSRs are conducted using a consistent approach, and that the PST addresses all relevant review areas.

Scope

Key assessment areas described by this methodology include: mission capabilities/requirements generation, resources, management, technical process, program performance, and environment. The methodology is composed of a robust listing of programmatic and technical areas, sub-areas, and factors. The listing has been developed to be both broad in scope and specific (detailed) enough to enable application to programs of all types (e. g., weapons, ships, aircraft, ground vehicles, electronics, computers, avionics, and communications). The methodology is intended for use at all phases of design, development, production, and deployment. Specific criteria and focus questions pertain to programs approaching their respective milestone A, B, or C. The methodology is tailorable, to enable quick-look assessments as well as more comprehensive milestone decision assessments. The following model illustrates the DAPS Methodology:

Defense Acquisition Program Support Methodology
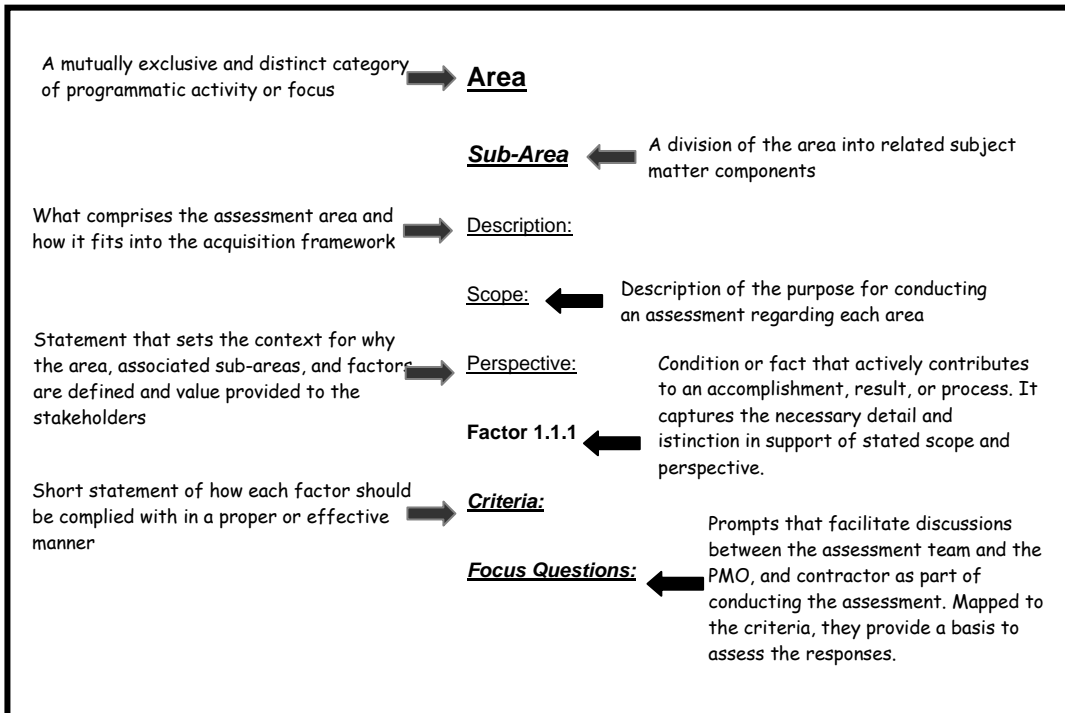
The methodology's areas, sub-areas, and factors contained in each of the milestone applications should not be viewed as a checklist to be followed rigidly, nor must each assessment address *all* assessment areas and sub-areas listed. On the contrary, the list should be regarded as a resource that can be adapted or used as a guide.

The methodology accommodates the transition to JCIDS from the traditional "requirements-based" acquisition programs that currently exist. In addition, the methodology addresses most of the content of the new Defense Acquisition Guidebook (DAG) (especially Chapter 4, which pertains to the application of systems engineering). Users should refer to the DAG in conjunction with the DAPS methodology.

Program Support Team

Structure: The Program Support Team PST is composed of a team leader from SSE/AS and core subject matter expert members from OSD staff (AT&L, CAIG, DPAP, Networks and Information Integration (NII), and Director, Operational Test and Evaluation (DOT&E)). Additional subject matter experts may be recruited from the Services, DoD agencies, Federally Funded Research and Development Centers (FFRDCs), and academia based on specific assessment needs matched with individual expertise.

Planning and Execution Activities

The PSR process includes the following key activities:
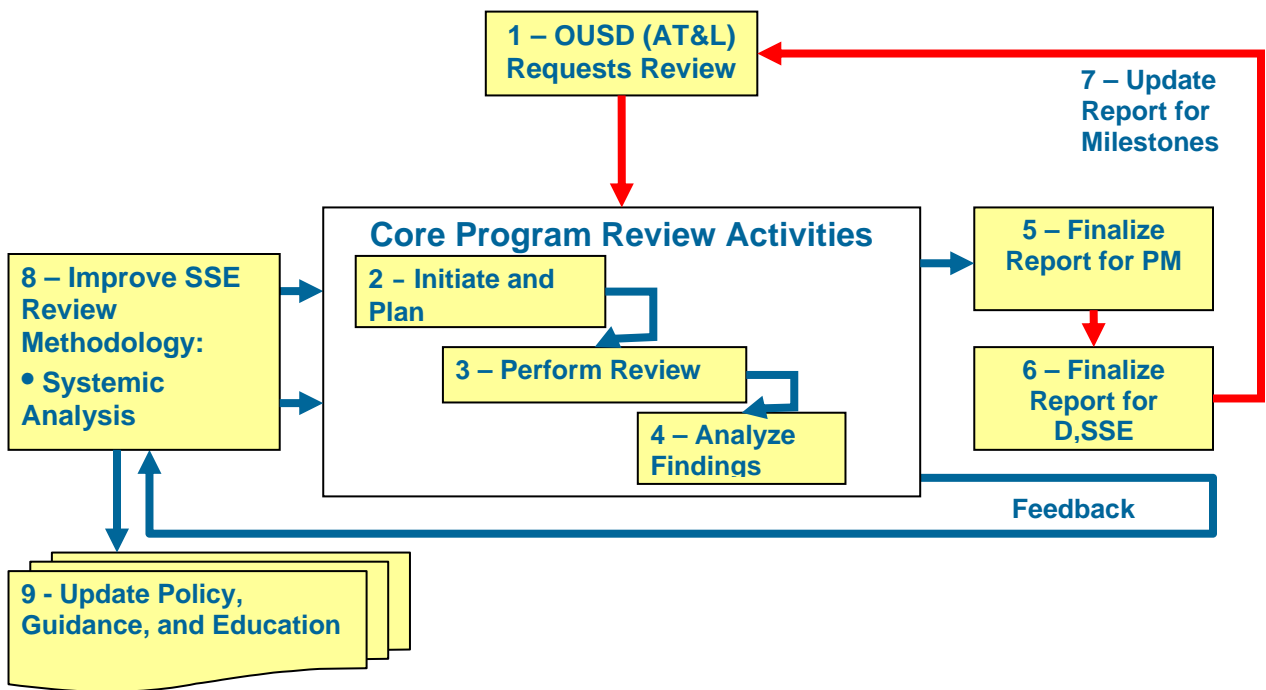
Formal Review

- Initiate Request for Review (OIPT, AT&L, and Service Acquisition Executives)
- Initiate and Plan Review
- Perform Review
- Analyze Findings
- Report Review Results
- Evaluate Review Process and Results
- Evaluate for Trends and Insights
- Update Acquisition Policy, Guidance, and Education

Tailored Review

It is envisioned that the assessment team will tailor the methodology for each assessment and use the methodology as a guide both to ensure that the selected areas are comprehensively examined and addressed and to ensure that important areas are not overlooked. The extent of the tailoring depends upon the status of the program and special interest areas articulated by the requestor(s) of the assessment.

Application

The assessment areas are intended to cover a broad base of areas involved in the development of defense systems and are not meant to be exhaustive. It is not expected that every area will necessarily be used during an assessment; however, the PST members, as part of the issue identification process, should at least review each of the areas. The assessment team leader should look for additional areas to reduce the possibility of "area blindness" (i.e., seeing only what is addressed in the methodology).

The key to applying the assessment process successfully is to select a highly qualified, experienced team leader, and populate the team with experienced senior individuals. Collectively, the assessment team should bring expertise, experience, and knowledge in all areas that the assessment will address.

The assessment areas should be used as a starting point only. Each PST member should apply her or his personal experience and expertise to expand the scope of the criteria as necessary to ensure that a thorough assessment is performed.

The criteria and focus questions in support of each factor provide a robust approach to gathering specific information within a given specific assessment as well as across multiple assessments. For each criterion listed in a given factor, there is at least one question (usually multiple questions) that

corresponds to the criterion (cross-referenced in brackets). This information is used to help create the appropriate assessment context and to guide the assessment process. Often, it will be necessary to apply each area differently based upon either a customer or a supplier perspective. For example, sufficiency of the cost and schedule to accomplish the development effort might be viewed differently from the program manager's perspective or the contractor's perspective. These viewpoints can be expanded to include all stakeholders, as appropriate.

The assessment is intended to look at a program whether it is a stand-alone system or a system of systems. Thus, the assessment areas, sub-areas, and factors, as well as the criteria and focus questions, although generally framed from the stand-alone system perspective, do offer some questions relevant to a system of systems. It is recognized that certain implementation technologies, such as software, have characteristics that are distinct and different from hardware (e.g., the implementation of the design takes different forms).

1.0 MISSION CAPABILITIES

SUB-AREA 1.1 – CONCEPT OF OPERATIONS

Description: The Concept of Operations (CONOPS) describes the user's approach to the deployment, employment, and operation of a new or upgraded system or capability that is being advocated to meet identified tasks or missions. It may address an operation or a series of operations. The CONOPS is not limited to single systems, commands, or Services, but may rely on other systems and organizations, as required. The operational factors identified in the CONOPS should draw from the Joint Capabilities Integration and Development System (JCIDS) process. The CONOPS describes how a system will be used and identifies associated system interoperability, commonality, and standardization issues. The CONOPS should identify the relationship, dependencies, and desired interfaces envisioned between the new or upgraded system and other existing or planned systems. At a minimum, the CONOPS: documents the purpose of the system and the user's expectations; identifies the capability gap(s) and requirement(s) that the system will meet; describes the basic concepts behind the system and the system's characteristics; and indicates a range of acceptable solutions. It should include illustrations to help clarify the system and the concept. A CONOPS is generally required by the military departments but is not a statutory or regulatory requirement. The material from a CONOPS will feed into many elements of information required by the Department of Defense (DoD), such as the JCIDS process, the Test and Evaluation (T&E) process, and the Analysis of Alternatives (AoA).

Scope: This sub-area involves the assessment of key factors that directly contribute to the manner of the analysis and procedures by which the required capabilities are expected to be met in their intended operational environment.

Perspective: As a high-level capabilities and requirements document, the CONOPS provides a mechanism for users to describe their expectations of the target system in terms that need not be quantifiable and testable, although the CONOPS is typically used as input to the development of a formal, testable system and software requirements. Developing the CONOPS as a team effort helps resolve requirement debates and facilitates completeness of requirements. A complete CONOPS identifies key user interface issues and provides an early basis for ensuring the completeness and consistency of stakeholder requirements. In addition, stakeholders use the CONOPS to clarify communication (e.g., technical language), ensuring capabilities requirements are clear. Finally, the CONOPS forms the foundation for developing the system's Operational Assessment (OA).

Factor 1.1.1 – Mission Description

Pre-Milestone A

Criteria

1.1.1.C1: The system's mission description clearly identifies mission need, objectives, and general capabilities. Included is a suitable description of the operational (including threat) and logistical environments envisioned for the system. Information is current.

1.1.1.C2: There is a clear connection among the Concept of Operations (CONOPS), the capabilities/requirements generation process, and the system architecture.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.1.1.Q1: Are the user's requirements documented in the Joint Capabilities Integration and Development System (JCIDS) documentation (i.e., Initial Capabilities Document (ICD) and Capabilities-Based Assessment (CBA))?

- What are the dates of documents? [1.1.1.C1]

1.1.1.Q2: Is the CONOPS documented in an easily understood manner? [1.1.1.C1]

1.1.1.Q3: Are the operations described from the viewpoints of all key stakeholders? [1.1.1.C1]

1.1.1.Q4: What is the threat as documented in the system threat assessment report?

- How is the threat documented in the Test and Evaluation Strategy (TES) and/or the Acquisition Strategy (AS)? [1.1.1.C1]

1.1.1.Q5: What is the relationship among the CONOPS, the capabilities/requirements generation process, and the system architecture? [1.1.1.C2]

1.1.1.Q6: Is there a high-level Operational View (OV-1)?

- Is there a corresponding System Interface Description (SV-1) that identifies system nodes and systems that support operational nodes, along with their interfaces? [1.1.1.C2]

1.1.1.Q7: Does the ICD adequately describe joint warfighting capability gaps as described in the CONOPS? [1.1.1.C2]

Pre-Milestone B and Pre-Milestone C

Criteria

1.1.1.C3: For a system with external interfaces, the dependencies (i.e., hierarchy) are clearly defined. This definition includes interface control specifications, which will be confirmed early on and placed under strict configuration control. Compatibility with other interfacing systems and common architectures are maintained throughout the development/design process.

1.1.1.C4: Any interfaces with other systems are well defined early enough to enable the program to adequately address the interfaces during system design.

1.1.1.C5: Complex and dynamic operational capabilities/requirements that drive capability improvements are considered in terms of their potential impact on the system design requirements. Corresponding supportability factors also are considered.

1.1.1.C6: The CONOPS has been updated with the latest information on mission need, objectives, and general capabilities. Included are the operational (including threat) and logistical environments envisioned for the system.

1.1.1.C7: There is a clear connection among the CONOPS, the capabilities/requirements generation process, and system performance parameters.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.1.1.Q8: What are the operational capabilities/requirements as they relate to dependencies (e.g., system of systems) on or interface with other systems?

- Describe how these dependencies and interfaces are identified, defined, and controlled. [1.1.1.C4]

1.1.1.Q9: What are the risks associated with possible changes or modifications to operational requirements and their impact on system requirements?

- How are these changes managed within the program baselines? [1.1.1.C5]

1.1.1.Q10: How do the government, contractors, and subcontractors delegate and manage requirements? [1.1.1.C3]

1.1.1.Q11: How is the system's compatibility with other systems addressed in developing and maturing the system design? [1.1.1.C3]

1.1.1.Q12: What common interfaces must the system design be compliant with? [1.1.1.C3]

1.1.1.Q13: Are any developing complementary systems critical to the success of the proposed system (e.g., Joint Tactical Radio System (JTRS))? [1.1.1.C3]

1.1.1.Q14: Are the user's requirements documented in the JCIDS documentation (i.e., Capabilities Development Document (CDD) and Capability Production Document (CPD))?

- What are the dates of documents? [1.1.1.C6]

1.1.1.Q15: If updated, has the CONOPS been approved and by whom?

- Date of approval?
- Is there a plan to mitigate the impact of the capability gaps? [1.1.1.C6]

1.1.1.Q16: Does the CONOPS clearly describe those functions that are jointly performed with other systems, and does it identify the other systems? [1.1.1.C7]

1.1.1.Q17: Is there traceability among the CONOPS, the capabilities/requirements generation process, and system performance parameters to validate the end product through test and evaluation (T&E)? [1.1.1.C7]

1.1.1.Q18: Does the pertinent JCIDS documentation adequately describe joint warfighting capability gaps as described in the CONOPS? [1.1.1.C7]

1.1.1.Q19: Do the architectural "Views" adequately demonstrate compliance under the Department of Defense Architecture Framework (DoDAF)? Note: "Views" consist of Operational Views (OVs), which identify warfighting information needs; System Views (SVs), which overlay capabilities on requirements; and Technical Views (TVs), which identify the rules, standards, and conventions used to integrate system products. [1.1.1.C7]

References

Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.
DoD Architecture Framework Working Group, DoD Architecture Framework, Version 1.0, August 2003.
CJCS 3170,01F, "Joint Capabilities Integration and Development System," May 2007.
IEEE Standard 1362-1998, IEEE Guide for Information Technology – System Definition – Concept of Operations (ConOps), March 1998.

Factor 1.1.2 – Family of Systems/System of Systems Dependencies/Interfaces

Pre-Milestone A

Criteria

1.1.2.C1: The Initial Capabilities Document (ICD) explains how the required capabilities are dependent upon and interface with other systems. It also defines the interoperability requirements of the capabilities in terms of high-level Operational View (OV-1). The lines of the OV-1 show simple connection and what information is exchanged.

1.1.2.C2: A requirement is in place to develop a Capabilities Development Document (CDD) that provides architecture view products: Operational Views (OVs), System Views (SVs), and Technical Views (TVs) in accordance with the product definitions of the Department of Defense Architecture Framework (DoDAF).

Focus Questions

[Pertinent criteria numbers follow each question.]

1.1.2.Q1: How is the candidate program linked with Joint Concepts (i.e., Joint Operational Concept (JOC)/Joint Functional Concept (JFC)/Joint Integration Concept (JIC)) and other standards? [1.1.2.C1]

1.1.2.Q2: Who has the authority and responsibility to develop external interfaces in an FoS or SoS? [1.1.2.C1]

1.1.2.Q3: How will the interoperability Key Performance Parameter (KPP), along with other KPPs, be developed during the Technical Development (TD) phase? [1.1.2.C1]

1.1.2.Q4: What are the plans to develop integrated architecture products required for the CDD?

- Does the OV-1 clearly define Information Exchange Requirements (IERs) between systems that make up the FoS or SoS? [1.1.2.C2]

Pre-Milestone B and Pre-Milestone C

Criteria

1.1.2.C3: The CDD (Capability Production Document (CPD) for Pre-Milestone C) includes the following integrated architecture products: AV-1, OV-2, OV-4, OV-5, OV-6C, SV-4, SV-5, and SV-6; draft Information Technology (IT) standards; interconnectivity profile; Net-Ready KPP (NR-KPP); information assurance compliance; and Net-Ready Key Interface Profile (NR-KIP).

1.1.2.C4: For an SoS, the dependencies (i.e., hierarchy) are clearly defined. These dependencies include architectures and interface control specifications, which will be defined early on and placed under strict configuration control.

1.1.2.C5: An Information Support Plan (ISP) has been developed and supports the CONOPS.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.1.2.Q5: How is compatibility with other interfacing systems and common architectures maintained through the development/design process? [1.1.2.C3]

1.1.2.Q6: Who has responsibility for the development of interfaces in an SoS? [1.1.2.C4]

1.1.2.Q7: For all systems that conform to, or perform functions that conform with, the definitions of IT or National Security Systems, is there a fully developed NR-KPP present in applicable documents? [1.1.2.C4]

1.1.2.Q8: What are the operational capabilities/requirements as they relate to dependencies on (e.g., SoS) or interface with other systems? [1.1.2.C4]

1.1.2.Q9: How is the proposed program responsible for funding and developing interfaces with other systems (e.g., SoS or FoS)? [1.1.2.C4]

1.1.2.Q10: What are the program's architecture views?

- What DoDAF architectures are being developed (e.g., operational, systems, and technical views)?
- How is the architecture specified and documented? [1.1.2.C4]

1.1.2.Q11: If the supporting system is not available, how does the ISP make the program manager (PM) aware of this problem?

- Was there sufficient time to adjust the program in the most cost-effective and operationally efficient manner? [1.1.2.C5]

1.1.2.Q12: How does the ISP use the architecture documentation from the pertinent Joint Capabilities Integration and Development System (JCIDS) documents to analyze the information-related needs in support of the operational and functional capabilities the program will either deliver or contribute to? [1.1.2.C5]

References

Defense Acquisition Guidebook (DAG) . Defense Acquisition University, https://akss.dau.mil/dag/.
DoD Architecture Framework Working Group. "DoD Architecture Framework, Version 1.0." Washington, DC: Department of Defense, November 2003.
CJCS 3170,01F, "Joint Capabilities Integration and Development System," May 2007.
IEEE Standard 1362-1998, IEEE Guide for Information Technology – System Definition – Concept of Operations (ConOps) Document, March 1998.

SUB-AREA 1.2 – ANALYSIS OF ALTERNATIVES

Description: An Analysis of Alternatives (AoA) is a study of the operational effectiveness and estimated life cycle costs (LCC) for non-materiel and materiel systems required to meet or eliminate shortfalls in operational capability (these capability shortfalls are also known as mission needs or operational gaps). AoAs must not only make a case for having identified the most cost-effective alternative(s), they also must make a compelling statement about the capabilities and military utility that acquiring the most cost-effective alternative(s) will provide. Initially, the AoA process typically explores numerous conceptual solutions with the goal of identifying the most promising options, thereby guiding the Concept Refinement phase. Subsequently, at Milestone B, the AoA is used as the operational justification for formal initiation of the acquisition program. An AoA normally is not required at Milestone C unless significant changes to threat, costs, or technology have occurred, or the analysis is otherwise deemed necessary by the Milestone Decision Authority (MDA). Figure 1-1 illustrates the integration of AoAs and the capabilities/requirements process.

Scope: This sub-area involves the assessment of key factors that actively contribute to the manner of the analysis and procedures by which the required capabilities are expected to be cost-effectively met in their intended operational settings. Candidate solutions are defined, contrasted, and evaluated in their ability to provide needed capabilities, given specific criteria for capability, performance, and sustainment.

Perspective: The AoA aids decision makers in judging whether any of the proposed alternatives to an existing system offers sufficient military and/or economic benefit to justify the cost. It requires decision makers and staffs at all levels and in all fields to engage in qualitative discussions of key assumptions and variables, develop better program understanding, and foster joint ownership of the program and program decisions. Therefore, it is imperative that the AoA be based on accurate and certifiable data and information.
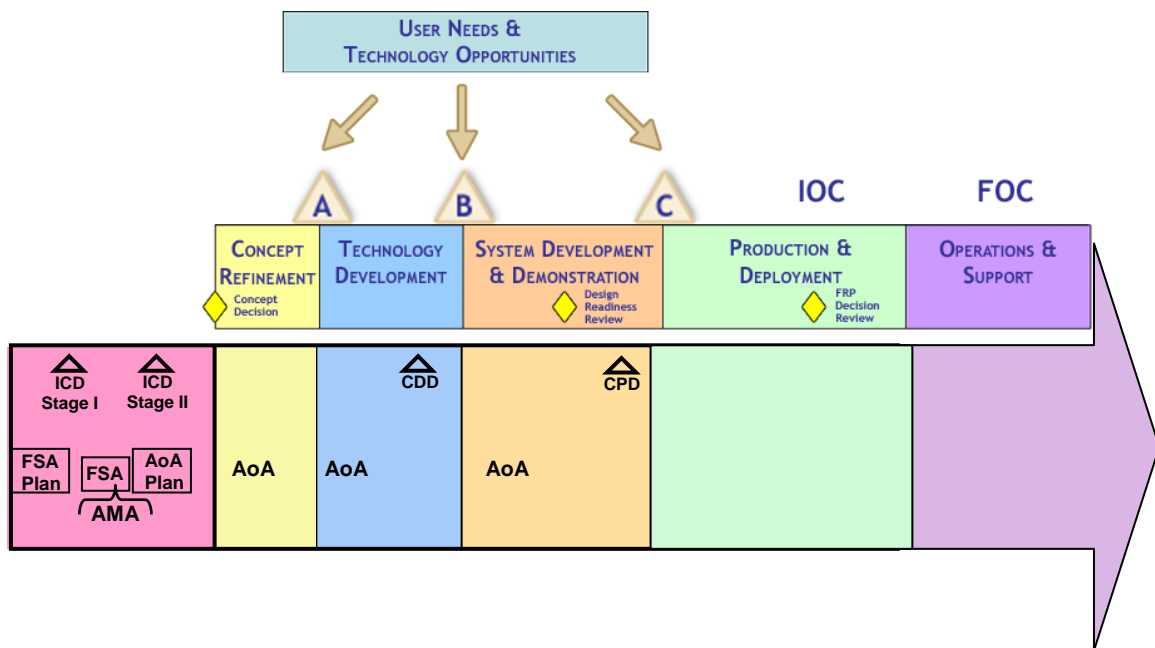
Figure 1-1 Integration of AoAs and Capabilities/Requirements Process

Factor 1.2.1 – Validity and Currency

Pre-Milestone A

Criteria

1.2.1.C1: There is a viable Analysis of Alternatives (AoA) study plan that defines what will be accomplished and how it will be done. Minimum information in the study plan will include: background, purpose, scope, acquisition issues, alternatives, effectiveness and cost methodologies, analytical tools, and schedule to complete the AoA.

1.2.1.C2: The Analysis of Materiel Approaches (AMA), if conducted, provides the best materiel approach or combination of approaches to provide the desired capability or capabilities. The AMA determines the best way(s) to use materiel approaches to provide a joint capability. Note: Generally, the AMA will not consider which specific "systems" or "system components" are best.

That analysis will occur in the AoA conducted after the Initial Capabilities Document (ICD) is approved.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.2.1.Q1: How were mission tasks (MTs), measures of effectiveness (MOEs), and measures of performance (MOPs) derived from relevant guidance on requirements or capabilities (e.g., Mission Needs Statement (MNS), Operational Requirements Document (ORD) (if pertinent), or the problem statement found in the ICD? [1.2.1.C1]

- Are they quantifiable? [1.2.1.C1]

1.2.1.Q2: Are the MOEs stated in terms of military utility and based on value provided to the warfighter?

- Are these MOEs used to identify models, simulations, and other analysis tools required to execute the study? [1.2.1.C1]

1.2.1.Q3: What are the relevant issues and constraints as addressed in the study plan? [1.2.1.C1]

1.2.1.Q4: Is the range of alternatives comprehensive? [1.2.1.C1]

1.2.1.Q5: Are the threats and scenarios realistic and current? [1.2.1.C1]

1.2.1.Q6: Is the cost-effectiveness comparison methodology approach sound? [1.2.1.C1]

1.2.1.Q7: What are the models and simulations used in the study?

- Are they acceptable and accredited? [1.2.1.C1]

1.2.1.Q8: Was an AMA conducted during the Functional Solution Analysis (FSA)?

- Is the analysis quantitative?
- Did the stakeholders confirm the applicable operational environment to be provided when the capability is required? [1.2.1.C2]

1.2.1.Q9: Does the prioritized list resulting from the AMA address technological maturity, technological risk, supportability, and the affordability of each approach using the best available data in the pre-ICD process? [1.2.1.C2]

1.2.1.Q10: Are the cost estimates used in the AMA based on life cycle costs, which include costs of research and development (R&D) supporting engineering design, estimates of the investment costs (procurement), projections of Operations and Support (O&S) costs, and disposal/decommissioning costs? *Note: At this early stage in the study process, the cost estimates may be done at the Rough Order of Magnitude (ROM) level.* [1.2.1.C2]

Pre-Milestone B and Pre-Milestone C (If required)

Criteria
1.2.1.C3: The AoA has been updated with the latest information and assumptions.

1.2.1.C4: The final AoA results have no significant limitations or concerns.

Focus Questions
[Pertinent criteria numbers follow each question.]

1.2.1.Q11: Are MTs, MOEs, and MOPs derived from relevant and current guidance on requirements or capabilities (e.g., MNS, ORD (if pertinent), or the problem statement found in the ICD)? [1.2.1.C3]

1.2.1.Q12: Are the MOEs stated in terms of military utility and based on value provided to the warfighter?

- Are these MOEs used to identify models, simulations, and other analysis tools required to execute the study? [1.2.1.C3]

1.2.1.Q13: Have all relevant issues and constraints addressed in the original study plan been updated, revised, and verified? [1.2.1.C3]

1.2.1.Q14: How is the range of alternatives comprehensive? [1.2.1.C3]

1.2.1.Q15: Were the threats and scenarios used in the study appropriate and approved by Defense Intelligence Agency (DIA)?

- How were Component and Joint architectures considered? [1.2.1.C3]

1.2.1.Q16: Are the models and simulations used in the study acceptable and accredited? [1.2.1.C3]

1.2.1.Q17: Is the cost-effectiveness comparison methodology approach sound? [1.2.1.C3]

1.2.1.Q18: Has the Office of the Secretary of Defense (OSD) Program Analysis and Evaluation (PA&E) directorate assessed the AoA in terms of its comprehensiveness, objectivity, and compliance with the Clinger-Cohen Act? [1.2.1.C3]

1.2.1.Q19: What are the results of the models and data accreditation report?

- When was it signed?
- Was the accreditation reasonable? *Note: Ensures that the modeling and simulation (M&S) tools will provide reasonable and acceptable results.* [1.2.1.C4]

1.2.1.Q20: Are the final operational concepts reasonable?

- Have the warfighter-sanctioned employment concepts been identified (e.g., basing deployment tactics, treaties)?
- Are the interdependencies with existing operational support systems (e.g., navigation, communications, weather) and key support systems (e.g., defense suppression, escort) accounted for in the study? [1.2.1.C4]

References

CJCS 3170,01F. "Joint Capabilities Integration and Development System," May 2007.

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DoD Architecture Framework Working Group. DoD Architecture Framework, Version 1.0, August 2003.

IEEE Standard 362-1998. IEEE Guide for Information Technology–System Definition–Concept of Operations (ConOps), March 1998.

USAF Office of Aerospace Studies, Analysis Handbook–A Guide for Performing Analysis Studies: For Analysis of Alternatives or Functional Solution Analyses, July 2005.

Factor 1.2.2 – Linkage and Traceability

Pre-Milestone A

Criteria

1.2.2.C1: The Analysis of Alternatives (AoA) study plan describes a clear link between the AoA, capability needs, system requirements, and the measures of effectiveness (MOEs) used to evaluate the system(s).

Focus Questions

[Pertinent criteria numbers follow each question.]

1.2.2.Q1: Do the Joint Capabilities Integration and Development System (JCIDS) process and supporting documentation (e.g., Functional Area Analyses (FAA), Functional Needs Analyses (FNA), Functional Solutions Analysis (FSA), and Initial Capabilities Document (ICD)) establish boundary conditions for the scope of all alternatives to be considered in the subsequent AoA? [1.2.2.C1]

1.2.2.Q2: Does the AoA plan build upon the prior analyses conducted as part of JCIDS?

- Is the problem statement used in the AoA provided by the ICD, Capabilities Development Document (CDD), or Capability Production Document (CPD)? [1.2.2.C1]

1.2.2.Q3: Is there a hierarchy among the requirements; that is, do the mission tasks (MTs) reflect the military worth (utility) of the materiel alternatives (capability provided to the warfighter)?

- Are MOEs derived from MTs?
- Are MOEs used for all alternatives?
- Are MOEs independent of the nature of the alternatives?
- Are measures of performance (MOPs) derived from MOEs? [1.2.2.C1]

1.2.2.Q4: Does the AoA plan address the issues unique to the program's Concept Refinement phase and the Technology Development Strategy? [1.2.2.C1]

1.2.2.Q5: Is there a baseline operating system to compare potentially viable solutions and to provide comparative cost-effectiveness assessments? *Note: For most systems, the analysis shall*

consider and establish a baseline against the system(s) that the acquisition program will replace, if they exist. [1.2.2.C1]

1.2.2.Q6: What are the realistic architectures and the Concept of Operations (CONOPS) selected to ensure a clear understanding of potential Command, Control, Communications, Computers, and Intelligence (C4I) interfaces and interoperability needed during military operations to evaluate alternatives?

- Are they approved? [1.2.2.C1]

1.2.2.Q7: Does the AoA study team understand the relationship among the modeling and simulation (M&S) models that are used together in a federated form to accomplish the M&S function? [1.2.2.C1]

1.2.2.Q8: How does the AoA support the detailed development of documents, that is, ICD, CDD, and CPD? [1.2.2.C1]

Pre-Milestone B and Pre-Milestone C (If required)

Criteria

1.2.2.C2: The results of the AoA demonstrate a clear link among capability needs, system requirements, and the MOEs used to evaluate the system.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.2.2.Q9: Do the JCIDS process and supporting documentation (e.g., FSA, ICD, CDD, CPD) establish the boundary conditions for the scope used to compare all materiel alternatives, both in effectiveness and costs? [1.2.2.C2]

1.2.2.Q10: Do the results of the AoA build upon the prior analyses conducted as part of JCIDS?

- Has the problem statement used in the AoA provided by the ICD, CDD, or CPD been updated, if required? [1.2.2.C2]

1.2.2.Q11: Is there a hierarchy among the requirements?

- Do MTs reflect the military worth (utility) of the materiel alternatives (capability provided to the warfighter)?
- Are MOEs derived from MTs?
- Are MOEs used for all alternatives?
- Are MOEs independent of the nature of the alternatives?
- Are MOPs derived from MOEs still valid and viable? [1.2.2.C2]

1.2.2.Q12: How is the baseline operating system compared with potentially viable solutions to provide comparative cost-effectiveness assessments? *Note: For most systems, the analysis shall*

consider and establish a baseline against the system(s) that the acquisition program will replace, if they exist. [1.2.2.C2]

1.2.2.Q13: How does the program use realistic and current architectures and the CONOPS to derive alternative solutions and to ensure a clear understanding of potential C4I interfaces and interoperability needed during military operations?

- Were the alternatives approved? [1.2.2.C2]

1.2.2.Q14: How well does the AoA study team understand the linkage of the M&S models that were used?

- Are they in a federated form to accomplish the M&S function? [1.2.2.C2]

1.2.2.Q15: Does the life cycle costs analysis estimate how much each alternative will cost to develop, produce, operate, and retire during its projected lifetime? [1.2.2.C2]

References
Analysis Handbook–A Guide for Performing Analysis Studies: for Analysis of Alternatives or Functional Solution Analyses. USAF Office of Aerospace Studies, July 2005.

CJCS 3170,01F, "Joint Capabilities Integration and Development System," May 2007.

Defense Acquisition Guidebook (DAG) . Defense Acquisition University, https://akss.dau.mil/dag/.

DoD Architecture Framework Working Group, DoD Architecture Framework, Version 1.0, August 2003.

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SUB-AREA 1.3 – CAPABILITIES

Description: Of the three processes in the Department of Defense (DoD) that work in concert to deliver the capabilities required by the warfighter, the key one is the requirements generation process. The requirements generation process exists to identify, develop, and validate defense-related needed capabilities as detailed in the National Security Strategy, National Defense Strategy, National Military Strategy, planning guidance outlined in the Quadrennial Defense Review, Strategic Planning Guidance, Joint Programming Guidance, Transformation Planning Guidance, and the family of Joint Operations Concepts (JOpsC). The Joint Capabilities Integration and Development System (JCIDS) implements the requirements generation process through a capabilities-based approach that leverages the expertise of all government agencies and industry to identify improvements to existing capabilities and to develop new warfighting capabilities. The process validates warfighting capability needs while considering the full range of materiel and non-materiel solutions. New capabilities are defined within the "art of the possible" and grounded within real-world constraints of time, technology, and affordability. The development of the JCIDS documents are the result of detailed analysis of operational tasks required to accomplish military objectives, the ability of the current and programmed joint capabilities to accomplish the required

tasks, and an assessment of Doctrine, Training, Materiel, Leadership, Personnel and Facilities (DOTMLPF) to determine the right approach to solve warfighting capability gaps. If the analysis indicates a materiel solution is required, then an Initial Capabilities Document is prepared. The ICD is the first of three capability documents that will drive the program:

- Initial Capabilities Document (ICD). The ICD replaced the Mission Needs Statement. The ICD documents the need for a materiel approach to a specific capability gap derived from an initial analysis of materiel approaches executed by the operational user and, as required, an independent analysis of materiel alternatives. The ICD, due at the Concept Decision and at Milestone A, is probably the single most important document that defines the requirements and establishes ensuing acquisition activities to develop, produce, and field systems. The ICD describes the capability gap derived from the JCIDS process and proposes materiel approaches to resolve the gap. It considers the Defense Intelligence Agency (DIA)-validated threats, operational environment, joint concepts, and other considerations to capture the evaluation of different materiel approaches. Usually the ICD is not updated once approved. It becomes the baseline document for links between associated Capabilities Development Documents and Capability Production Documents. The ICD supports the Analysis of Alternatives (AoA), Technology Development Strategy (TDS), Milestone A decisions, and subsequent Technical Development (TD) phase activities.

- Capabilities Development Document (CDD). The CDD replaced the Operational Requirements Document. The CDD is the sponsor's primary means of defining authoritative, measurable, and testable capabilities needed by the warfighter to support the System Development and Demonstration (SDD) phase of the acquisition program. Integrated architectures, applicable Joint Capabilities Documents (JCDs), the ICD, the AoA (unless waived by the Milestone Decision Authority (MDA)), and the TDS guide development of the CDD. The CDD captures the information necessary to deliver an affordable and supportable capability using relatively mature technologies as described in the Acquisition Strategy. The CDD must contain a description of the DOTMLPF and policy impacts and constraints. The CDD will be validated and approved before Milestone B. The CDD will be validated and approved prior to program initiation for shipbuilding programs. The CDD provides the operational performance attributes necessary for the acquisition community to design a proposed system(s) and establish a program baseline. It identifies the performance attributes, including Key Performance Parameters (KPPs), that guide the development and demonstration of the proposed system.

- Capability Production Document (CPD). The CPD is the sponsor's primary means of providing authoritative, testable capabilities for the Production and Deployment phase. A CPD is finalized after the design readiness review and must be validated and approved before the Milestone C acquisition decision. Because a CPD is finalized after the Design

Readiness Review and after the majority of capability development, it is usually not appropriate to introduce new requirements at this point. New requirements should be included in the next increment in an evolutionary program or in a future modification or upgrade if no additional increments are planned. The development of the CPD is guided by the integrated architectures; applicable JCDs, ICDs, and CDD; AoA and/or supporting analytical results; developmental and operational test results; and the Design Readiness Review. The CPD must include a description of the DOTMLPF and policy impacts and constraints. The CPD captures the information necessary to support production, testing, and deployment of an affordable and supportable system within an Acquisition Strategy. The CPD refines the threshold and objective values for the performance attributes and KPPs that are validated in the CDD for the production phase. The refinement of performance attributes and KPPs is the most significant difference between the CDD and CPD.

Scope: The review of mission capabilities is concerned with their clarity, completeness, reasonableness, testability, and stability; capabilities/requirements; the implication for the resulting system operational requirements; and constraints by which the ensuing acquisition program is structured and executed. This includes interdependencies and interoperability requirements with other systems.

Perspective: Within DoD there is a distinct separation between the requirements authority and the acquisition authority, which requires early and continued collaboration between both communities in order for the processes to work effectively together. All stakeholders in the acquisition framework must know why the warfighter needs a particular capability, how and where it will be used, who will use it, when it is needed, and how it will be supported and maintained. For a materiel solution to a capability requirement, fielding an operational capability starts with sound strategies for requirements, acquisition, test and evaluation (T&E), and support and sustainment. To be viable, these strategies will be developed in concert and require early and ongoing collaboration among operators, developers, acquirers, testers, sustainers, and operations analysts. No one strategy can stand alone and still be viable because all are interdependent and require the integration of the others to be effective.

Factor 1.3.1 – Reasonableness, Stability, and Testability

Pre-Milestone A

Criteria
1.3.1.C1: Milestone A review will not normally take place without a Joint Requirements Oversight Council (JROC)-approved Initial Capabilities Document (ICD) that has been fully vetted through the

Joint Capabilities Integration and Development System (JCIDS) analysis process. The ICD describes capability gaps and explains clearly why the recommended materiel approach is the best solution. The ICD clearly states required capabilities in broad and time-phased operational goals. It also will capture the results of the Functional Area Analysis (FAA), Functional Needs Analysis (FNA), and Functional Solutions Analysis (FSA).

1.3.1.C2: All changes to capabilities/requirements are reviewed by the JCIDS analysis process addressing changes to concept of operations (CONOPS), Joint Concepts, Integrated Architectures, capability attributes, interoperability, Doctrine, Training, Materiel, Leadership, Personnel and Facilities (DOTMLPF), technology maturity, and responsiveness of the approaches.

1.3.1.C3: Required attributes of the capability contain appropriate measures of effectiveness (MOEs), general enough so as not to prejudice a particular materiel solution. They are also defined by metrics, such as time and distance, that can be measured and tested.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.3.1.Q1: What are the capability gaps in terms of the missions, tasks, and functions, and the attributes of the desired capabilities in terms of desired effects? [1.3.1.C1]

1.3.1.Q2: Are the desired effects general enough so as not to prejudice decisions in favor of a particular solution but specific enough to evaluate alternative approaches? [1.3.1.C1]

1.3.1.Q3: Does the ICD describe the capability gaps clearly, and what rationale does it provide for the materiel approach recommended as the best solution? [1.3.1.C1]

1.3.1.Q4: How are the required capabilities in the ICD stated?

- Are the capabilities stated in broad and time-phased operational goals? [1.3.1.C1]

1.3.1.Q5: How does the ICD describe the threats and the operational environment in which the capabilities are to be exercised?

- Were the threats and scenarios validated by the Defense Intelligence Agency (DIA)? [1.3.1.C1]

1.3.1.Q6: How are the required capabilities in the ICD "linked" with operational concepts and architectures?

- Joint Operational Concepts (JOCs)?
- Joint Functional Concepts (JFCs)?
- Joint Integration Concepts (JICs)?
- Integrated Architectures? [1.3.1.C1]

1.3.1.Q7: What is the required Initial Operational Capability (IOC) date?

- Are there any potential mission gaps as a result of the IOC?
- Is there a plan to mitigate the impact of the gaps? [1.3.1.C1]

1.3.1.Q8: Were any changes made to the ICD between JROC approval and the Milestone A decision review?

- How were these changes vetted through the requirements generation and acquisition management processes?
- Did the ICD consider the best materiel approaches based on analysis of the relative cost, efficacy, performance, technology maturity, fielding time frame, and risk?
- Have changes to the ICD, if any, been reviewed by the JCIDS analysis process for a complete analysis? [1.3.1.C2]

1.3.1.Q9: Are the ICD parameters stated in measurable terms? Note: Measures are numerical values assigned to *attributes according to defined criteria. Some examples are size, cost, and defects.* [1.3.1.C3]

1.3.1.Q10: Is the expected environment and operating condition of the capability clearly stated in the definitions of the measures of effectiveness and suitability? [1.3.1.C3]

1.3.1.Q11: Are the interoperability requirements identified in the high-level Operational View (OV-1) measurable and testable? [1.3.1.C3]

Pre-Milestone B

Criteria

1.3.1.C4: Operational capabilities/requirements are clearly stated, are testable, and can be implemented within the scheduled time and budget (dollars) established to execute the program (i.e., within the program baselines). The required technology is sufficiently mature to support the development within the program baselines.

1.3.1.C5: Stable operational capabilities/requirements are documented in an approved Capabilities Development Document (CDD).

1.3.1.C6: Test strategy is clearly defined and addresses all requirements and capabilities.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.3.1.Q12: How does the user address the operational environment in terms of corrosion considerations, threat, force composition, concept of operations, geography, radio frequency (RF) conditions, etc., in formulating the operational requirements of the system within the schedule, budget, and technical feasibility of the program? [1.3.1.C4]

1.3.1.Q13: Are the near-, mid-, and far-term threats that the system is expected to counter fully defined? [1.3.1.C4]

1.3.1.Q14: How does the program address supportability to ensure that the system reliability is increased, the logistical footprint is reduced, and the total life cycle cost is reduced? [1.3.1.C4]

1.3.1.Q15: Can the program manager (PM) discuss the content of the CDD with respect to the stability of the operational requirements?

- When was the CDD signed/approved? [1.3.1.C4]

1.3.1.Q16: To what degree are the operational capabilities/requirements flexible enough to adjust to and accommodate the evolution of the design maturity, including incremental capability improvements? Note: At the same time, there should be little or no "requirements creep" during the execution of each phase of the program. [1.3.1.C5]

1.3.1.Q17: What controls are in place to prevent "requirements creep" and to force new requirements to be defined through an engineering change proposal process? [1.3.1.C5]

1.3.1.Q18: Do the operational capability requirements impose proprietary, design-specific solutions from a particular vendor? *Note: Such practices limit a PM's flexibility to develop a system based on open architecture and will limit program access to multiple sources of supply over the life of the system.* [1.3.1.C5]

1.3.1.Q19: Are the measures of effectiveness and suitability, Key Performance Parameters (KPPs), and critical technical parameters stated as quantifiable parameters?

- Are the operational capabilities/requirements clearly stated in testable terms (i.e., realistically measurable, and their demonstration is not precluded by safety restraints)? [1.3.1.C4 and 1.3.1.C6]

Pre-Milestone C

Criteria

1.3.1.C7: Modification, deletion, deferment, or addition of requirements during the development program are reflected in the product baseline, are traceable to the system design, and are verifiable in test or simulation.

1.3.1.C8: Design trade-off analyses are well documented and supported by quantifiable benefits to the final design.

1.3.1.C9: System thresholds and objectives, documented in the acquisition and support strategies, include reliability, maintainability, and availability.

1.3.1.C10: Compatibility with other interfacing systems is maintained and verified through system-level testing as defined in interface specifications, through the development/design process, and is traceable to the architecture of the system. Interface specifications are under formal configuration control.

1.3.1.C11: The interoperability and net-readiness of the system within the context of the current and projected Global Information Grid (GIG) architecture are clearly defined and reflect the technical requirements, and are tracked and verified as an integral part of the system design. Interoperability of systems designed outside the GIG architecture are clearly defined.

1.3.1.C12: Verification of all KPPs, MOEs, measures of suitability (MOSs), and Critical Technical Parameters (CTPs) are demonstrated by prototypes or engineering development models operating in the system's intended environment. Results are documented in test and evaluation reports described and documented in accordance with the Test and Evaluation Master Plan (TEMP). Deficiencies have been documented and analyzed, and the associated risks for successful testing are manageable.

1.3.1.C13: Verification of all Reliability, Availability, Maintainability (RAM), and Built-In-Test (BIT) requirements has been completed and documented in accordance with the TEMP. Deficiencies have been documented and analyzed, and the associated risks are manageable.

1.3.1.C14: Computer/software configuration items have completed test verification, and the system software capability is determined to be mature. All known deficiencies have been documented and evaluated, and fixes have been identified and rescheduled for verification. An Independent Verification and Validation (IV&V) assessment of the contractor/materiel developer has been performed.

Focus Questions

[Pertinent criteria numbers follow each question.]

1.3.1.Q20: What is the degree of active participation by the joint capabilities, operational requirements, test and evaluation (T&E), and support communities in the design development process?

- Does the as-designed system address all operational requirements in the most cost-effective and supportable manner? [1.3.1.C7 and 1.3.1.C9]

1.3.1.Q21: Is the supportability of the system as-designed reasonable and viable, meaning that the operation, maintenance, logistics support, testing, environmental impact, and disposal of the system fit into the user operational environment with minimum disruption to the user, and with an affordable life cycle cost impact to the mission? [1.3.1.C7, 1.3.1.C8, and 1.3.1.C9]

1.3.1.Q22: How are the operational requirements described in the Capability Production Document (CPD), as revised from the CDD, traced to the current design configuration of the system?

- Include an explanation of how the life cycle cost analyses influenced the system design by achieving the optimal solution. [1.3.1.C10]

1.3.1.Q23: For each configuration item of the system, have the KPPs, MOEs, MOSs, CTPs, and other performance requirements, both explicit and derived, been tested, and verified?

- What deficiencies have been documented? [1.3.1.C12]

   1.3.1.Q24: For computer/software configuration items, is there sufficient progress in testing and test results?

- What is the status of the software testing? What is the status of open problem reports/deficiency reports (i.e., the numbers of open software trouble reports by level of

severity), and how will these open deficiencies affect successful Initial Operational Test and Evaluation?

- Who performed software IV&V, what were the findings, and was a report published? [1.3.1.C14]

1.3.1.Q25: Has verification of all KPPs, MOEs, MOSs and CTPs been demonstrated by prototypes or engineering development models operating in the system's intended environment?

- Are the results documented in test and evaluation reports described and documented in accordance with the TEMP?
- Have deficiencies been documented and analyzed, and are the associated risks for successful testing manageable? [1.3.1.C12]

1.3.1.Q26: Has verification of all RAM and BIT requirements been completed and documented in accordance with the TEMP?

- Have all deficiencies been documented and analyzed, and are the associated risks manageable? [1.3.1.C13]

1.3.1.Q27: Is the interoperability and net-readiness of the system within the context of the current and projected GIG architecture clearly defined and reflected in the technical requirements?

- Are interoperability and net-readiness tracked and verified as integral parts of the system design?
- Are the interoperability of systems designed outside the GIG architecture clearly defined? [1.3.1.C11]

1.3.1.Q28: Have all computer/software configuration items completed test verification, and is the system software capability mature?

- Have all known deficiencies been documented and evaluated, and have fixes been identified and rescheduled for verification?
- Has an independent (of the contractor/materiel developer) IV&V assessment been performed? [1.3.1.C14]

References

Analysis Handbook–A Guide for Performing Analysis Studies: for Analysis of Alternatives or Functional Solution Analyses. USAF Office of Aerospace Studies, July 2005.

CJCS 3170,01F. "Joint Capabilities Integration and Development System," May 2007.

Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.

DoD Architecture Framework Working Group, DoD Architecture Framework, Version 1.0, August 2003.

IEEE Standard 1362-1998. IEEE Guide for Information Technology–System Definition–Concept of Operations (ConOps) Document, March 1998.

Factor 1.3.2 – Key Performance Parameters and Key System Attributes

Pre-Milestone A

Criteria

1.3.2.C1: Mandated Key Performance Parameters (KPPs) and Key System Attributes (KSAs) have been established and documented.

1.3.2.C2: The Initial Capabilities Document (ICD) appropriately addresses interoperability with the required National Security System and Information Technology System infrastructure support, such as Defense Information Systems Network (DISN), Global Command and Control System, and Global Combat Support System.

1.3.2.C3: Plans are identified to develop a Net-Ready KPP during Technical Development (TD). A separate Net-Ready KPP is identified for each block.

1.3.2.C4: Plans are identified for net-centric attributes to migrate from "point-to-point" interoperability to a "many-to-many" net-centric environment.

1.3.2.C5: The Technology Development Strategy (TDS) includes collaboration with the Department of Defense (DoD) Net-Centric Operations Warfare Reference Model (NCOW RM).

Focus Questions

[Pertinent criteria numbers follow each question.]

1.3.2.Q1: Can program management office (PMO) personnel identify the Life Cycle Sustainment Outcome Metrics (e.g., materiel availability, materiel reliability, ownership cost, and mean down time) that have been defined as KPPs and KSAs for the program? [1.3.2.C1]

1.3.2.Q2: Does the ICD include a high-level Operational View (OV-1) that presents a top-level view of the interoperability requirements? [1.3.2.C2]

1.3.2.Q3: How are interoperability requirements within the Global Information Grid (GIG) considered in the ICD? [1.3.2.C2]

1.3.2.Q4: How is interoperability defined in the ICD?

- How is it measured? [1.3.2.C2]

1.3.2.Q5: What are the information exchanges between systems that make up the family of systems (FoS) or system of systems (SoS)?

- Are they defined as high-level Information Exchange Requirements (IERs)? [1.3.2.C3]

1.3.2.Q6: Are the interoperability requirements included in the ICD?

- Have the requirements considered interoperability with the GIG? [1.3.2.C3]

1.3.2.Q7: After reviewing the table with the program's KPPs, including Net-Ready and Force Protection KPPs, can the PMO personnel explain the rationale for the thresholds and objectives?

- How does the Net-Ready KPP change in each phase?

- What are the Net-Ready Key Interface Profiles (NR-KIPs) for each block? [1.3.2.C3 and 1.3.2.C4]

1.3.2.Q8: What regulations and policies are required to implement net-ready interoperability?

- What standards are used to support interoperability? [1.3.2.C4]

1.3.2.Q9: What is the roadmap to migrate from interoperability through "point-to-point" interfaces to "many-to-many" typical of a network environment? [1.3.2.C4]

1.3.2.Q10: What is the plan to align net-ready requirements of the capability with the latest version of the DoD NCOW RM? [1.3.2.C5]

Pre-Milestone B

Criteria
1.3.2.C6: KPPs and KSAs have been allocated from the system level to lower levels of indenture.

1.3.2.C7: The interoperability and net-readiness of the system within the context of the current and projected GIG architecture is clearly defined and reflected in the technical requirements, and will be tracked as an integral part of the system design.

1.3.2.C8: Programs will use standardized architectural products and conventions, data formats, and open interface standards and protocols to enable interoperability.

Focus Questions
[Pertinent criteria numbers follow each question.]

1.3.2.Q11: What was the process by which the metrics have been allocated throughout the system and lower levels of indenture? [1.3.2.C6]

1.3.2.Q12: After reviewing the table with the program's KPPs, including Net-Ready and Force Protection, what is the rationale for the thresholds and objectives? [1.3.2.C6]

1.3.2.Q13: How are the interoperability capabilities/requirements documented, and how are they addressed in the overall system design and development process of the program? [1.3.2.C7]

1.3.2.Q14: What is the program's approach to facilitate interoperability? [1.3.2.C7]

1.3.2.Q15: What are the interoperability capabilities/requirements of the system in terms of the mission requirements with other platforms, both within the command structure and with other U.S. and foreign defense forces? [1.3.2.C7]

1.3.2.Q16: How were the technical standards in the Technical View (TV) products identified, and how are they to interoperate with the GIG Enterprise services identified for the system's net-centric roles? [1.3.2.C7]

1.3.2.Q17: What is the relationship between open systems architecture and interoperability? [1.3.2.C8]

1.3.2.Q18: How does the system interface with and use GIG NCES Core-enterprise services? [1.3.2.C8]

1.3.2.Q19: What are the architecture view products (Operational View (OV), System View (SV), TV) that comply with the product definitions in the Department of Defense (DoD) Architecture Framework (DoDAF)? [1.3.2.C8]

1.3.2.Q20: What are the plans for developing Software-in-the-Loop simulation to test a system of systems or other required interfaces before developing the hardware? [1.3.2.C8]

Pre-Milestone C

Criteria
1.3.2.C9: KPPs and KSAs are appropriately reviewed and updated for validity and currency.

1.3.2.C10: The interoperability and net-readiness of the system within the context of the current and projected GIG architecture and the NCOW RM will be clearly defined and reflected in the technical requirements, and will be tracked as an integral part of the system design.

Focus Questions
[Pertinent criteria numbers follow each question.]

1.3.2.Q21: What is the process by which the KPPs/KSAs have been documented/updated for each life cycle phase; for example, have the ICD, Capabilities Development Document (CDD), and Capability Production Document (CPD) been updated? [1.3.2.C9]

1.3.2.Q22: Review the table with the program's KPPs, including the Net-Ready and Force Protection KPPs.

- Can the PMO personnel explain the rationale for the thresholds and objectives?
- What is the progress in achieving the KPPs? [1.3.2.C9]

1.3.2.Q23: Are standardized architectural products and conventions, data formats, and open interface standards and protocols used by the PMO to enable interoperability and net-centricity? [1.3.2.C10]

1.3.2.Q24: Is the interoperability of systems designed outside of the GIG clearly defined? [1.3.2.C10]

1.3.2.Q25: Are all of the data that can and should be shared externally beyond the programmatic bounds of the program, visible (advertised), available, and usable to all authorized consumers of the data? [1.3.2.C10]

1.3.2.Q26: Does the PMO provide discovery metadata, in accordance with the DoD Discovery Metadata Standard (DDMS), for all data posted to shared spaces? [1.3.2.C10]

1.3.2.Q27: What is the relationship between open systems architecture and interoperability? [1.3.2.C10]

1.3.2.Q28: How do the architecture view products (OV, SV, TV) comply with the product definitions in the DoDAF? [1.3.2.C10]

References

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2.0 RESOURCES

SUB-AREA 2.1 – PROGRAM SCHEDULE OVERVIEW (TIER 1)

Description: Program resources (funding, schedule, staffing, and processes*)* are the assets available to meet the program's objective of developing and procuring a new or upgraded system or capability to meet identified tasks or missions. Through the Defense Acquisition Management System (DAMS), the Department of Defense (DoD) continues to acquire the world's most technologically advanced and capable weapon systems. However, this process often proves costly and inefficient. One of the primary reasons for cost overruns, schedule delays, and performance shortfalls is the overly optimistic cost and schedule estimates. These two types of estimates affect each other but are conducted *independently* according to the current process. The result is an event-driven schedule, as stipulated in the Defense Acquisition Guidebook, that is defined and statused at a detailed level, whereas cost is often collected and calculated at a summary level. This disconnection frequently leads to program instability and increased cost.

The Acquisition Strategy describes the program manager's plan to achieve program goals and summarizes the program planning and resulting program structure. The Acquisition Strategy includes a program schedule, which illustrates the Acquisition Strategy. This program schedule is a single diagram similar to the one shown in Figure 2-1. It defines the relationship among acquisition phases, decision milestones, solicitations, contract awards, systems engineering design reviews, contract deliveries, test and evaluation activities, production releases, and operational deployment objectives. It includes quantities to be procured and delivered by fiscal year by phase in terms of prototypes, engineering development models, low-rate initial production, and full-rate production. The program schedule is a key decision review/milestone document; it summarizes the program and is built from many other more detailed schedules found in functional plans such as test and evaluation, contracting, etc.

Figure content (Program Schedule):

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14

Milestones & Phases: CR TD ... A ... B ... SD&D ... LRIP ... C ... FRP&D ... IOC ... B ... Blk II ... C

Final RFP Release: SD&D ... LRIP ... PROD

Contract Award: CR TD ... SD&D ... LRIP ... LRIP (option) ... PROD

Technical Reviews

Developmental Testing: Prototype Testing ... Fly-Off ... DT&E ... LFT&E

Operational Testing: EOA ... OA ... IOT&E ... FOT&E

Deliveries: (eng dev models) ... EDM ... LRIP Production

Funding:
RDT&E
Procurement
O&M
MILCON
Total: MAY 01 ... PS-809-1

Figure 2-1 Program Schedule (Example)

Because schedule stability affects program costs, which may, in turn, affect technical performance, it is clear that schedule stability has a great deal to do with whether the program meets its cost and technical objectives. Since the majority of cost risk is dependent on the elements of schedule, and their corresponding uncertainties, the program management office (PMO) and other stakeholders use a methodical and rigorous quantification of the uncertainties of cost analysis and schedule planning throughout the life of the program to identify schedule risk elements and their impact on the cost risk. This process results in a more accurate picture of cost risk, and subsequently a more detailed cost description. Such rigor is necessary, to ensure a more effective allocation of resources in order to effectively "buy-to-budget."

Scope: The assessment of this sub-area deals with the adequacy of planning/development of a program schedule that will ensure timely completion of the defense program. This program schedule balances the need for the Initial Operational Capability (IOC) and deployment of the system with the ability to achieve those needs with acceptable risk.

Perspective: Experienced program personnel provide data regarding critical and high-risk efforts and identify as realistically as possible the expected schedule, which the program management office then compares with the top-level defense program schedule template to determine the actual

schedule risk and to identify all schedule drivers. With this approach, the probability of overrunning a program schedule can be estimated by determining how much risk exists and where it is greatest. This approach enables program managers (PMs) to estimate early and continuously in the program the possibility of a significant likelihood of overrunning the program schedule by determining how much and where the risk to successful schedule completion is greatest.

The useful life of a defense system must be taken into consideration. When the concentration of the buyer is focused mainly on the system or product, he often overlooks a key point: whether the buyer obtains value upon delivery. The most costly product is one that appears when it no longer fulfills a useful purpose, even though it has been produced at minimum cost. Each month added to the development and production of a new high-technology system or product tends to reduce by 1 month the operational life of the system.

In addition, the program schedule as refined through the different phases is intended to determine whether or not the government's expected schedule is achievable, given the program requirements that are to be communicated to the contractor in venues such as the Request for Proposal. Early industry involvement is essential in the identification of the critical and high-risk efforts in the development of the integrated schedule. Integrated scheduling describes the detailed tasks that support the significant activities identified in integrated planning and timing of tasks. It also can include the resources planned to complete the tasks. When the events and tasks are related to risk-reduction actions, this linkage provides a significant monitoring tool, giving specific insights into the relationships among cost, schedule, and performance risks. In integrated planning, the government and contractor should identify key activities of the program, to include risk-handling actions and success criteria. As the program progresses, the PM monitors the effectiveness of handling activities included in the integrated planning events and schedule by comparing observed activity results with their criteria and determining any deviations from the planned schedule. Any failures of handling actions to meet either the event criteria or schedule should be analyzed to determine the deviation's impact, causes, and need for any modifications to the risk-handling approach.

Unfortunately, budget constraints and other factors, like changes in quantities (items over which the PM has no control), have often been imposed on a program with the comment, "Do the best you can." This may require numerous revisions to the program schedule and affects schedule stability. When a schedule must be revised, the superseded schedule is often discarded. If the new schedule is superseded, the process is repeated. However, there is some value in retaining an obsolete schedule. Often, the government or developer organization causing a slip in schedule becomes a repeat offender elsewhere in the program. The principal value of retaining a former

schedule lies in being able to hold the offender responsible, thus making schedule slips less palatable, minimizing the number of schedule uncertainties, and mitigating the impact on costs.

Note: This sub-area focuses on the identification and planning for the allocation of program resources with respect to the schedule. The success of this planning activity will be subsequently assessed under sub-areas 3.1 and 3.3, Acquisition Strategy, and Program and Project Management, respectively.

Factor 2.1.1 – Viability

Pre-Milestone A

Criteria

2.1.1.C1: The program's overall schedule is viable (i.e., workable and has real meaning and pertinence). The program manager (PM) has utilized subject matter expertise of the stakeholders and the following processes to develop the program schedule:

- Identification of specific activities that must be performed to produce the various program deliverables.
- Identification and documentation of interactivity dependencies to ensure proper sequencing of activities and events.
- Estimation of the duration of the activities and events.
- Implementation of procedure(s) to control changes to the program schedule.
- Analysis of schedule sufficiency (i.e., activities are properly sequenced and their durations understood and resources applied against).

2.1.1.C2: Although the schedule is preliminary, it does provide an understanding of uncertainties inherent in the program, the scope of work required, and the likely structure of the program. It is constructed to depict a likely progression of work through the phases, with the most emphasis on the upcoming Technology Development (TD) phase. The schedule is event driven and developed through participation of all program stakeholders. It permits sufficient flexibility to allow for redesign and retest when inevitable problems arise.

Focus Questions

[Pertinent criteria numbers follow each question,]

2.1.1.Q1: How has the PM made the schedule viable?

- What are the general aspects of the process that the PM used in the development of the program schedule?

- What are the activities that must be performed to produce the various program deliverables?
- What are the interactivity dependencies to ensure proper sequencing of activities and events?
- What is the estimated duration of each activity and event?
- What procedure(s) are in place to control changes to the program schedule?
- Is the schedule sufficient (i.e., activities are properly sequenced, their durations generally understood, and resources are applied against them)? [2.1.1.C1]

2.1.1.Q2: What planning assumptions did the PM, in coordination with other stakeholders, make to ensure adequate analysis of the program schedule (as well as cost and performance risk)? [2.1.1.C1]

2.1.1.Q3: What are the personal experience and subject matter expertise of the Integrated Process/Product Team (IPT) members involved in the development of the program schedule? [2.1.1.C1]

2.1.1.Q4: What analyses and previously executed programs were used in the development of the program schedule? [2.1.1.C1]

2.1.1.Q5: What is the schedule risk in general terms, and how does it apply to or affect the overall program risk?

- What are some of the causes for schedule risk? Note: Answer should include poor estimates for planning purposes, poor performance, or a combination of both. [2.1.1.C1]
- What was the technique used to assess schedule risk? Note: For example, one possible technique involves estimate contributions for each activity's duration and aggregating these distributions using a Monte Carlo simulation or other analytical tools. The resulting program-level schedule is then analyzed to determine the actual schedule risk and to identify the schedule risk drivers. This technique uses a range of times that it will take to complete each activity. [2.1.1.C1 and 2.1.1.C2]

2.1.1.Q6: How has the PM established a time reserve in the schedule?

- Who holds the time reserve? Note: Usually the time reserve is held very closely by the PM to prevent members of the program management office (PMO) team from being tempted to fall back on it prematurely
- How much is the time reserve? Note: Usually a time reserve of about 10 percent is established.
- Where is the time reserve placed in the schedule? Note: The PM may place this reserve under "additional system tests" or another downstream activity such as a built-in safety factor between the manufacturing schedule and the delivery schedule. The point is, the reserve should not be visible. [2.1.1C1]

2.1.1.Q7: What is the highest risk path, both for the overall program schedule and for the TD schedule?

- How has the PM applied resources against the activities on this risk path? [2.1.1C1 and 2.1.1.C2]

2.1.1.Q8: What were the inputs from the potential contractor(s) used in the development of the schedule for the TD phase? [2.1.1.C2]

2.1.1.Q9: What is the process established to monitor program performance through the schedule?

- Are the following identified?
  - Key events
  - Milestones
  - Reviews
  - All integrated technical tasks
  - Accomplishment criteria and schedule metrics [2.1.1.C2]

2.1.1.Q10: What is the PM's plan, made in conjunction with that Service's science and technology (S&T) community, to assess the maturity and viability of technologies in the TD phase, and in the preparation of a Technology Development Strategy (TDS) for Milestone A and subsequently Milestones B and C?

- Does this plan result in higher fidelity requirements that are time-phased to a more realistic schedule with more accurate cost estimates? [2.1.1.C2]

2.1.1.Q11: What were the results of the Alternative System Review (ASR)?

- Did the IPT determine that the operational capabilities, preferred solution(s), available technologies, and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding into the TD phase?
- Is the program schedule executable (technical and/or cost risks)? [2.1.1.C2]

Pre-Milestone B

Criteria

2.1.1.C3: The program's overall schedule continues to be viable (i.e., workable and has real meaning and pertinence). The PM has utilized past analyses and experience of the Concept Refinement (CR) and TD phases, quantified subject matter expertise of the stakeholders, and the following processes to refine (achieve greater fidelity) the program schedule:

- Review and re-identification of specific activities that must be performed to produce the various program deliverables.
- Review and re-documentation of interactivity dependencies to ensure proper sequencing of activities and events.
- Detailed estimation of the duration of the activities and events.

- Revision of the procedure(s) to control changes to the program schedule, if required.
- Further clarification and understanding of schedule sufficiency (i.e., activities are properly sequenced and their durations understood and resources applied against).

2.1.1.C4: There is an Integrated Master Schedule (IMS)—a time reference baseline for the activities and events that make up the program. It depicts a likely progression of effort and work through the remaining phases, with the most emphasis placed on the upcoming System Development and Demonstration (SDD) phase. It permits sufficient flexibility to allow for redesign and retest when inevitable problems arise. *Note: The IMS has been iterated several times during the TD phase, each time increasing the level of detail and confidence of all essential work that has been identified.*

Focus Questions

[Pertinent criteria numbers follow each question.]

2.1.1.Q12: Is the program schedule still viable (i.e., workable and has real meaning and pertinence)?

- How specific is the PM's process used in the development of the program schedule?
    - In detail, what are the activities that must be performed to produce the various program deliverables?
    - In detail, what are the interactivity dependencies to ensure proper sequencing of activities and events?
    - In detail, what is the estimated duration of each activity and event?
    - How are variations in the schedule controlled by the PM?
- Is the schedule relatively stable at this time in the program schedule (i.e., activities are properly sequenced and their durations generally understood and resources applied against)?
- What are the functional schedules derived from the program schedule? [2.1.1.C3]

2.1.1.Q13: How have the original planning assumptions that the PM, in coordination with other stakeholders, made to ensure adequate analysis of the program schedule (as well as cost and performance risk) changed? [2.1.1.C3]

2.1.1.Q14: What are the changes in the personal experience and subject matter expertise of the IPT members involved in the development of the program schedule? [2.1.1.C3]

2.1.1.Q15: What impacts did the CR and TD phases have on the development/refinement of the program schedule? [2.1.1.C3]

2.1.1.Q16: What are the changes to the causes for schedule risk, if any?

- How have these impacts been addressed in the schedule?
- How do these impacts to the schedule affect the overall program risk?

- What were the techniques used to assess schedule risk? *Note: For example, one technique involves estimating contributions for each activity's duration and aggregating these distributions using a Monte Carlo simulation or other analytical tools. The resulting program-level schedule is then analyzed to determine the actual schedule risk and to identify the schedule risk drivers. This technique uses a range of times that it will take to complete each activity.* [2.1.1.C3 and 2.1.1.C4]

2.1.1.Q17: What is the highest risk path, both for the overall program schedule and for the SDD schedule?

- How has the PM applied resources against the activities on this risk path? [2.1.1.C3 and 2.1.1.C4]

2.1.1.Q18: How were the inputs from the potential contractor(s) used in the development of the schedule for the SDD phase? [2.1.1.C4]

2.1.1.Q19: How much schedule "reserve" is the contractor planning for?

- Where has it been placed in the schedule?
- Does the schedule reserve facilitate flexibility in addressing schedule uncertainties? [2.1.1.C4]

2.1.1.Q20: Has the process established to monitor performance through the schedule been changed?

- Are the following identified?
    - Key events
    - Milestones
    - Reviews
    - All integrated technical and testing tasks
    - Accomplishment criteria and schedule metrics [2.1.1.C4]

2.1.1.Q21: What are the most important aspects of the TDS in terms of higher fidelity requirements that are time-phased to a more realistic schedule with more accurate cost estimates? [2.1.1.C4]

2.1.1.Q22: What were the results of the System Requirements Review (SRR)?

- Did the IPT determine that the operational capabilities, preferred solution(s), available technologies, and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding into the SDD phase?
- Is the program schedule executable (technical and/or cost risks)? [2.1.1.C4]

2.1.1.Q23: Was a planning IMS for the contract developed by the government prior to release of the Request for Proposal (RFP)? *Note: The planning IMS is intended to determine whether or not the government's expected schedule is achievable given the program requirements that are to be communicated in the RFP. The details and execution of this planning IMS will be subsequently assessed under sub-areas 3.1 and 3.3, Acquisition Strategy, and Program and Project Management, respectively.* [2.1.1.C4]

Pre-Milestone C

Criteria

2.1.1.C5: The program's overall schedule continues to be viable (i.e., workable and has real meaning and pertinence). The PM has utilized past analyses and experience of the SDD phase, quantified subject matter expertise of the stakeholders, and the following processes to refine (i.e., achieve greater fidelity of) the program schedule:

- Review and re-identification of specific activities that must be performed to produce the various program deliverables.
- Review and re-documentation of interactivity dependencies to ensure proper sequencing of activities and events.
- Detailed estimation of the duration of the activities and events.
- Revision of the procedure(s) to control changes to the program schedule, if required.
- Further clarification and understanding of schedule sufficiency (i.e., activities are properly sequenced and their durations understood and resources applied against).

2.1.1.C6: The IMS depicts a likely progression of effort and work through the remaining activities and events in the Production and Deployment (PD) phase, with the most emphasis on the upcoming Low- Rate Initial Production (LRIP) and subsequent operational evaluation of the system. It permits sufficient flexibility to allow for retest when inevitable problems arise.

Focus Questions

[Pertinent criteria number follow each question.]

2.1.1.Q24: Is the program schedule still viable (i.e., workable and has real meaning and pertinence)?

- What is the specificity of the process that the PM used in the development of the program schedule?
    - In detail, what are the activities that must be performed to produce the various program deliverables?
    - In detail, what are the interactivity dependencies to ensure proper sequencing of activities and events?
    - In detail, what is the estimated duration of each activity and event?
    - How are variations in the schedule controlled by the PM?
- Is the schedule stable at this point of the program schedule (i.e., activities are properly sequenced and their durations generally understood and resources applied against)?
- What are the functional schedules derived from the program schedule? [2.1.1.C5]

2.1.1.Q25: How have the planning assumptions that the PM, in coordination with other stakeholders, originally made and subsequently revised in previous phases, ensured adequate analysis of the program schedule (as well as cost and performance risk)? [2.1.1.C5]

2.1.1.Q26: What are the changes in the personal experience and subject matter expertise of the IPT members involved in the development of the program schedule?

- Are they geared toward the requirements and execution of the PD phase? [2.1.1.C5]

2.1.1.Q27: What impact did the SDD phase have on the development/refinement of the program schedule? [2.1.1.C5]

2.1.1.Q28: What are the changes to the causes for schedule risk, if any?

- How have these impacts been addressed in the schedule?
- How do these impacts to the schedule affect the overall program risk?
- What were the techniques used to assess schedule risk?
- Have these techniques used to assess schedule risk changed over the course of the program? [2.1.1.C5 and 2.1.1.C6]

2.1.1.Q29: What is the highest risk path, both for the overall program schedule and for the PD schedule?

- How has the PM planned/applied resources against the activities on this risk path? [2.1.1.C5 and 2.1.1.C6]

2.1.1.Q30: How were the inputs from the potential contractor(s) used in the development of the schedule for LRIP and operational evaluation activities? [2.1.1.C6]

2.1.1.Q31: Has the process established to monitor performance through the schedule been changed?

- Are the following identified?
  - Key events
  - Milestones
  - Reviews
  - All integrated technical and testing tasks
  - Accomplishment criteria and schedule metrics [2.1.1.C6]

2.1.1.Q32: What were the results of the System Verification Review (SVR) and other technical and programmatic reviews conducted prior to Milestone C and before other decision reviews (e.g., Production Readiness Review (PRR) and full-rate production) during the PD phase?

- Did the IPT determine that the operational capabilities, preferred solution(s), available technologies, and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding into the SDD phase?
- Is the program schedule executable (technical and/or cost risks)? [2.1.1.C6]

2.1.1.Q33: Does the PM understand the process of creating a production plan with its corresponding schedule? *Note: Government PMs will never be responsible for developing a*

production schedule. However, they should understand the process of creating one because the success of a program is dependent upon the producer to plan, schedule, and implement a production plan. [2.1.1.C6]

Factor 2.1.2 – Constraints and Dependencies

Pre-Milestone A, Pre-Milestone B and Pre-Milestone C

Criteria

2.1.2.C1: As part of the development of the overall program schedule, all constraints (defined as restrictions on the degree of freedom an organization has in providing a solution) and dependencies (defined as an activity being contingent upon or influenced, controlled, or determined by something else, or reliant on another activity for support or aid) have been identified, and internal and/or external processes have been established to address them. The end result is a program schedule that has inherent flexibility to accommodate the competing demands of time and resources while ensuring the best capability to the warfighter. *Note: Constraints are effectively global requirements, such as limited development resources or a decision by senior management that restricts the way a system is developed. Constraints can be economic, political, technical, or environmental and pertain to program resources, schedule, environment, or to the system itself.*

2.1.2.C1: Constraints and dependencies have been identified and classified as:

- Mandatory, such as the fact that a production prototype must be fabricated before it can be tested.
- Discretionary, as developed by the program manager (PM) based on "best practices" or specific sequences desired by management.
- External dependencies, such as availability of test sites.

The impacts of these constraints and dependencies on the program schedule have been evaluated and subsequently addressed in the Acquisition Strategy and program baseline. They are reassessed at each milestone.

2.1.2.C2: The program schedule provides the best value in terms of the system providing capability when needed. For a typical program, efficient development usually provides the best combination of development cost and schedule performance. However, there are circumstances when the program must focus on accelerated development and procurement to meet urgent warfighter requirements. The result is rapid acquisition in which the focus is on development and procurement speed, and the schedule is reduced or constrained. The value of a typical program declines gradually as time goes by. Conversely, the value of a rapid acquisition system declines precipitously; that is, if the program could not meet the immediacy of the need, then there was no

need to develop it. Therefore, it is imperative that the rationale for rapid acquisition be correctly identified by the stakeholders as genuine and reassessed at each milestone.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.1.2.Q1: What are all the constraints to the program schedule?

- What are their impacts? [2.1.2.C1]

2.1.2.Q2: What are the dependencies in the program schedule?

- What are their impacts? [2.1.2.C1]

2.1.2.Q3: Has rapid acquisition been determined by the stakeholders as the most pertinent Acquisition Strategy to acquire the system?

- If so, is it based on a genuine reason, or is it a result of a disingenuous stakeholder's attempt to achieve lower cost, save funding, etc.?
- What is the true reason for the stakeholder to disingenuously request a reduction in the schedule through rapid acquisition?
    - Confidence in the program management office (PMO). Note: If the PM has a reputation for missing planned schedules in the past, the warfighter may request "rapid acquisition" with a corresponding schedule constraint. What the warfighter really wants is confidence in the PM's ability to meet the schedule and within costs.
    - Alignment of funding and schedule. Note: The warfighter may desire to align the schedule to meet the funding stream provided by senior leadership. However, in lieu of an external suspense, this is not a genuine reason for rapid acquisition and should not be used as a rationale to reduce the schedule.
    - Cost-as-Independent Variable (CAIV). *Note: Under the CAIV concept, cost-performance tradeoffs should be made on an iterative basis. Aggressive cost goals are established that become more of a constraint, and less of a variable. The PM may be required to trade performance/technical and schedule to meet CAIV cost constraints and reduce cost risk. Again this is not rapid acquisition, and a reduction in schedule may actually increase costs.*
    - What were the other reasons, if any?
- How and when have the disingenuous reasons for constraining the program schedule been brought to the attention of the Milestone Decision Authority?
- What were the results? [2.1.2.C2]

2.1.2.Q4: What are the thread(s) between the program schedule and the specific schedules/supporting detailed functional schedules?

- Do they properly reflect the best balance between competing demands of time and resources? [2.1.2.C1]

2.1.2.Q5: What are the dependencies between the different schedules?

- Between the program schedule and the functional schedules (e.g., computer hardware and software system, test and evaluation, and logistics support schedules)?
- Between the individual functional schedules?
- What are the strengths, weaknesses, and issues associated with these dependencies? [2.1.2.C1]

2.1.2.Q6: How do the security challenges associated with the system's development, procurement, and maintenance affect the program schedule and subordinate functional schedules? [2.1.2.C1]

2.1.2.Q7: What schedule risk assessment technique was used to determine program schedule risk and the inherent impact of schedule constraints and dependencies? [2.1.2.C1]

2.1.2.Q8: What are the schedule metrics used to depict how the program is progressing toward completion? Note: These metrics are refined and matured through multiple iterations as the program progresses.

- How are the constraints and dependencies accounted for in these schedule metrics? *Note: The information provided by the contractor in the earned value management system can serve as these metrics, showing how the actual work accomplished compares with the work planned in terms of schedule and cost. Other sources of cost and schedule metrics include the contractor's cost accounting information and the integrated master schedule.* [2.1.2.C1]

SUB-AREA 2.2 – BUDGET SUFFICIENCY AND PHASING

Description: The Defense Acquisition Management System, documented in the 5000 series documents and the Joint Capabilities Integration and Development System (JCIDS), attempts to create an environment for program stability, cost realism and budgeting, requirements execution realism, joint capabilities program identification, and trade-off flexibility through the philosophy of evolutionary acquisition and spiral development. Never before has the program manager (PM) and the program team been given the kind of flexibility to make smart decisions to bring in programs better, faster, cheaper—to reduce the "cycle time" in providing new or upgraded systems to the warfighter.

In today's performance-based management environment, budgets need to describe the outcomes or results that will be achieved for the funding received. Budgeting for inputs or expected expenses as in the past is no longer acceptable. This means that budgets need to reflect the benefits produced in relationship to the system providing a capability to the warfighter.

As described in Sub-Area 2.1 above, cost and schedule are intrinsically related; the majority of cost risk is dependent on the elements of schedule, and their corresponding uncertainties. The program management office (PMO) and other stakeholders use a methodical and rigorous quantification of the uncertainties of cost analysis and schedule planning throughout the life of the program to identify schedule risk elements and their impact on the cost risk This process results in a more accurate picture of cost risk, and subsequently a more detailed cost description to ensure a more effective allocation of resources in order to effectively "buy-to-budget."

Scope: The assessment of this sub-area deals with the adequacy of planning/development of a program budget that will ensure timely and effective completion of the defense program; that is, assessment of the amount of funding available to complete development and testing, and initial production, including the funding profile and timeline.

Perspective: All participants in the acquisition system view cost as an independent variable and plan programs based on realistic projections of the funding and staffing likely to be available in the future. To the greatest extent possible, programs identify the total ownership costs and the major drivers to this cost. Realistic program planning assumptions are developed to ensure adequate analysis of cost, schedule, and performance risk. This is documented in the Program Office Estimate, which is generally developed from the Cost Analysis Requirements Document for major programs, or a similar document for less than major programs. Budget metrics are designed to show the degree of risk inherent in the current state of the budget both in current execution, and looking forward through the Future Years Defense Program (FYDP).

Sufficiency for each program appropriation is key to program success. Sufficiency is defined as the degree to which the amount and phasing of each appropriation within a program retires programmatic risk. High sufficiency equates to low budgetary risk, and vice versa.

All organizations in the Department of Defense (DoD) prepare life cycle cost estimates in support of their programs and projects. A life cycle cost estimate attempts to identify all the costs of an acquisition, from its initiation through disposal of the resulting system at the end of its useful life. Life cycle cost estimates for the acquisition of capital assets serve two primary purposes. First, they are used at critical decision points and reviews to assess whether the system's cost is affordable, or consistent with overall strategic plans and investment strategies. Second, life cycle cost estimates form the basis for budget requests to Congress. As in other aspects of acquisition management, maximum use is made of the Integrated Project/Product Teams in the development and review of life cycle cost estimates. Estimating cost is a continuous process that begins during the conceptual phase through execution. Early in the project, the cost estimates support the

recommended alternative and Acquisition Strategy. The estimates during this early phase of a project contain considerable uncertainty. As the project matures, parametric estimates and then engineering estimates are used to refine the estimate for budget preparation.

Finally, perturbations in the budget, from within and outside the Service, are a known fact within the acquisition management framework. Unfortunately, budget constraints and other factors, like changes in quantities (items over which the PM has no control), have often been imposed on a program with the comment, "Do the best you can." However, the prudent PM takes the following steps to maintain greater control over maintaining a stable budget. Steps include but are not limited to the following:

- Obtain a high-confidence cost estimate and ensure it is well documented to firmly support budget requests.
- Ensure user advocacy for the program.
- Ensure funding for the execution year(s) is consistent with the contractor's ability to expend the funding according to the current program schedule. *Note: The key is to keep program funding phased correctly and emphasize meeting Office of the Secretary of Defense (OSD) expenditure and obligation goals.*
- Develop a range of independent estimates at completion from earned value data and analysis of the integrated master schedule. Compare the results with the contractor's projected final costs to assess realism and to form the basis for adjusting the program budget.

Note: This sub-area is primarily focused on the identification and planning for the allocation of program resources with respect to the budget. The success of this planning activity will be subsequently assessed under sub-areas 3.1 and 3.3, Acquisition Strategy, and Program and Project Management, respectively.

Factor 2.2.1 – Program Funding and Allocation

Pre-Milestone A

Criteria
2.2.1.C1: Allocated funds are sufficient to complete the Technology Development (TD) phase. Allocated program funding and expenditure rates track with the planned TD schedule and contractor work packages. Systematic estimating methods, which may include past completed program cost and schedule "actuals" (history), independent cost estimates, etc., have been used to determine the required funding (amount and profile).

2.2.1.C2: All multidisciplined technical reviews in the Concept Refinement (CR) phase have been successfully completed and have demonstrated that the program's technical baseline is sufficiently rigorous to support a valid cost estimate, and that the program, as captured in the Cost Analysis Requirements Description (CARD)-like document, is executable.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.2.1.Q1: What are the program's five (5)-year budget and spend rates, including an historical funding profile?

- What are the strengths, weaknesses, and issues?
- What are the Research, Development, Test and Evaluation (RDT&E), procurement, and Operations and Support (O&S) costs across the Future Years Defense Program (FYDP)?
- Explain the impact for any shortfalls and plans to resolve them. [2.2.1.C1]

2.2.1.Q2: What is the program manager's (PM) and assigned Service headquarters action officer's (AO) understanding of the budget and cost history of the program?

- Can they summarize this information in a concise manner, to include turbulence, upcoming budget events, and levels of sufficiency (i.e., enough funding)? [2.2.1.C1]

2.2.1.Q3: What planning assumptions did the PM, in coordination with other stakeholders, make to ensure adequate analysis of the program budget? [2.2.1.C1]

2.2.1.Q4: What is the PM's process to prevent unexpected or unplanned cost growth by adequately identifying and managing risks in the program?

- What is the process to allocate funding (level and timeliness) to cover:
    - Systems Engineering (SE) technical reviews
    - Risk mitigation
    - Engineering changes
    - Test and evaluation (T&E) infrastructure, developmental testing (DT) contingencies, and operational test (OT) support
    - Asset needs (ranges, targets, data collection/reduction/analysis, test participants, and operating costs)? [2.2.1.C1]

2.2.1.Q5: What are the personal experience and subject matter expertise of the Integrated Process/Product Team (IPT) members involved in the development of the program schedule? [2.2.1.C1]

2.2.1.Q6: What analyses and previously executed programs were used in the development of the program budget? [2.2.1.C1]

2.2.1.Q7: What is the cost risk in general terms, and how does it apply to or affect the overall program risk?

- What are some of the causes for cost risk? Note: These include poor estimates for planning purposes, poor performance, or a combination of both. [2.2.1.C1]

2.2.1.Q8: How has the PM established a management reserve in the budget? [2.2.1.C1]

2.2.1.Q9: What were the inputs from the potential contractor(s) used in the development of the budget for the TD phase? [2.2.1.C2]

2.2.1.Q10: How is it determined that the planned and allocated funding and schedule are adequate to accomplish the TD?

- Does the type of funding match the planned scope of work?
- What is covered by the funding and accommodated within the schedule?
- Does planned funding include reserve funding to cover development test contingencies, engineering changes, T&E infrastructure, and asset needs (ranges, targets, data collection/reduction/analysis, test participants, and support) to conduct technology demonstration tests? What are the strengths, weaknesses, and issues? [2.2.1.C2]

2.2.1.Q11: What were the results of the Initial Technical Review (ITR)?

- Is the program's technical baseline sufficiently rigorous to support a valid cost estimate (with acceptable cost risk)?
- How does it enable an independent assessment of the estimate by cost, technical, and program management subject matter experts?
- How does it assess the capability needs and conceptual approach of a proposed program and verify that the requisite research, development, test, engineering, logistics, and programmatic bases for the program reflect the complete spectrum of technical challenges and risks?
- How does the ITR ensure that the historical and prospective drivers of system cost have been quantified to the maximum extent and that the range of uncertainty in these parameters has been captured and reflected in the program cost estimates? [2.2.1.C2]

2.2.1.Q12: How does the PM define program and system parameters in the CARD? [2.2.1.C2]

2.2.1.Q13: Is the program, as captured in the CARD-like document, executable?

- Does the CARD-like document capture the key program cost drivers, development costs (all aspects of hardware, human integration, and software), production costs, and operation and support costs?
- Is the CARD-like document complete and thorough?
- Are the underlying assumptions used in developing the CARD-like document technically and programmatically sound and complete?
- Have the appropriate technical and programmatic competencies been involved in the CARD-like document development, and have the proper subject matter experts been involved in its review?

- Are the risks known and manageable within the cost estimate? [2.2.1.C2]

2.2.1.Q14: What were the results of the Alternative System Review (ASR)?

- Did the IPT determine that the operational capabilities, preferred solution(s), available technologies, and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding into the TD phase?
- Is the program schedule executable (technical and/or cost risks)? [2.2.1.C2]

Pre-Milestone B

Criteria

2.2.1.C3: The program's overall budget continues to be viable (i.e., workable and has real meaning and pertinence). Allocated funds are sufficient to complete the System Development and Demonstration (SDD) phase. Allocated program funding and expenditure rates track with the planned SDD schedule and contractor work packages. All technology integration, demonstrations, analysis, simulation, experimentation, and testing needs along with support activities are accounted for. The funding (amount and profile) to perform all the planned activities (including PM reviews) were determined by systematic estimating methods, which may include past completed program cost and schedule "actuals" (history) and independent cost estimates.

2.2.1.C4: All multidisciplined programmatic and technical reviews in the TD phase have been successfully completed and have demonstrated that the program's technical baseline is sufficiently rigorous to support a valid cost estimate, and that the program is executable in terms of funding.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.2.1.Q15: What are the program's five (5)-year budget and spend rates, to include an historical funding profile)?

- What are the RDT&E, procurement, and O&S costs across the FYDP? Explain the impact for any shortfalls and plans to resolve them. [2.2.1.C3]

2.2.1.Q16: What is the PM's and assigned Service headquarters AO's understanding of the budget and cost history of the program?

Can they summarize this information in a concise manner, to include turbulence, upcoming budget events, and levels of sufficiency (i.e., enough funding)? [2.2.1.C3]

2.2.1.Q17: What planning assumptions did the PM, in coordination with other stakeholders, make to ensure adequate analysis of the program budget? [2.2.1.C3]

2.2.1.Q18: What is the PM's process to prevent unexpected or unplanned cost growth by adequately identifying and managing risks in the program?

- What is the process to allocate funding (level and timeliness) to cover:

- SE technical reviews
- Risk mitigation
- Engineering changes
- T&E infrastructure, DT contingencies, and OT support
- Asset needs (ranges, targets, data collection/ reduction/ analysis, test participants, and operating costs)? [2.2.1.C3]

2.2.1.Q19: What are the personal experience and subject matter expertise of the IPT members involved in the development of the program schedule? [2.2.1.C3]

2.2.1.Q20: What analyses and previously executed programs were used in the development of the program budget? [2.2.1.C3]

2.2.1.Q21: What is the cost risk in general terms, and how does it apply to or affect the overall program risk?

- What are some of the causes for cost risk? *Note: These include poor estimates for planning purposes, poor performance, or a combination of both.* [2.2.1.C3]

2.2.1.Q22: How has the PM established a management reserve in the budget? [2.2.1.C3]

2.2.1.Q23: What were the inputs from the potential contractor(s) used in the development of the budget for the TD phase? [2.2.1.C3]

2.2.1.Q24: How is it determined that the planned and allocated funding and schedule are adequate to accomplish the SDD phase?

- Does the type of funding match the planned scope of work?
- What is covered by the funding and accommodated within the schedule?
- Does planned funding include reserve funding to cover development test contingencies, engineering changes, T&E infrastructure, and asset needs (ranges, targets, data collection/reduction/analysis, test participants, and support) to conduct technology demonstration tests?
- What are the strengths, weaknesses, and issues? [2.2.1.C3]

2.2.1.Q25: What were the results of the System Readiness Review (SRR)?

- Did the IPT determine that the operational capabilities, preferred solution(s), and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding into the Production and Deployment (PD) phase?
- Is the program executable within the existing budget?
- Does the updated cost estimate fit within the existing budget? [2.2.1.C4]

2.2.1.Q26: Is the preliminary CARD consistent with the approved system performance specification? [2.2.1.C4]

2.2.1.Q27: What were the results of the Integrated Baseline Review (IBR)?

- Did the IPT determine that the operational capabilities, preferred solution(s), available technologies, and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding into the TD phase?
- Is the program schedule executable (technical and/or cost risks)? [2.2.1.C4]

Pre-Milestone C

Criteria

2.2.1.C5: The program's overall budget continues to be viable (i.e., workable and has real meaning and pertinence). Allocated program funds are sufficient to complete the PD phase, including production and initial supportability requirements. Production cost estimates reflect program performance and can sustain initial production commitments. Allocated program funding and expenditure rates track with open work packages. All test requirements, support activities, and pre-production transition efforts are accounted for. Funding must be adequate to support operations and maintenance over the term of the life cycle. Program funding must be adequate to support both procurement and sustainment requirements and linked to outcomes.

2.2.1.C6: All multidisciplined programmatic and technical reviews in the SDD phase have been successfully completed and have demonstrated that the program's technical baseline is sufficiently rigorous to support a valid cost estimate, and that the program is executable in terms of funding.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.2.1.Q28: How has the PM utilized past analyses and experience of the CR, TD, and SDD phases, quantified subject matter expertise of the stakeholders, and the following processes to refine (achieve greater fidelity) the program budget? [2.2.1.C5]

2.2.1.Q29: What are the program's five (5)-year budget and spend rates, including an historical funding profile?

- What are the strengths, weaknesses, and issues?
- What are the RDT&E, procurement, and O&S costs across the FYDP? Explain the impact for any shortfalls and plans to resolve them. [2.2.1.C5]

2.2.1.Q30: What is the PM's and assigned Service headquarters AO's understanding of the budget and cost history of the program?

- Can they summarize this information in a concise manner, including turbulence, upcoming budget events, and levels of sufficiency (i.e., enough funding)? [2.2.1.C5]

2.2.1.Q31: What is the PM's process to prevent unexpected or unplanned cost growth by adequately identifying and managing risks in the program?

- What is the process to allocate funding (level and timeliness) to cover:

- SE technical reviews
- Risk mitigation
- Engineering changes
- T&E infrastructure, DT contingencies, and OT support
- Asset needs (ranges, targets, data collection/ reduction/ analysis, test participants, and operating costs)? [2.2.1.C5]

2.2.1.Q32: How do the PM and Service headquarters AO determine that the planned and allocated funding and schedule are adequate to accomplish the program effort?

- Does the type of funding match the planned scope of work? [2.2.1.C5]

2.2.1.Q33: Is the funding profile for performance-based logistics implementation based on a completed Business Case Analysis? [2.2.1.C5]

2.2.1.Q34: Does planned funding include reserve funding to cover operational test contingencies, engineering changes, T&E infrastructure, and asset needs (ranges, targets, software support, data collection/reduction/analysis, test participants, and support)? [2.2.1.C5]

2.2.1.Q35: How does funding address the full life cycle of software, to include post-deployment software support? [2.2.1.C5]

2.2.1.Q36: What impacts did the CR, TD, and SDD phases have on the refinement of the program budget? [2.2.1.C5]

2.2.1.Q37: What are the changes to the causes for cost risk, if any?

- How have these impacts been addressed in the budget?
- How do these impacts to the schedule affect the overall program risk? [2.2.1.C5]

2.2.1.Q38: How were the inputs from the potential contractor(s) used in the development of the budget for the SDD phase? [2.2.1.C5 (Contractor)]

2.2.1.Q39: What were the results of the System Functional Review (SFR), Flight Readiness Review (FRR), Preliminary Design Review (PDR), Critical Design Review (CDR), System Verification Review (SVR), Production Readiness Review (PRR), and Test Readiness Review (TRR)?

- Did the IPT determine that the operational capabilities, preferred solution(s), and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding to the PD phase?
- Is the program executable within the existing budget?
- Does the updated cost estimate fit within the existing budget? [2.2.1.C6]

2.2.1.Q40: Was the CARD updated at required reviews?

- SFR – based on the system functional baseline?
- PDR – based on the system allocated baseline?
- CDR – based on the system product baseline? [2.2.1.C6]

Factor 2.2.2 – Continuity and Stability

Pre-Milestone A, Pre-Milestone B and Pre-Milestone C

Criteria

2.2.2.C1: Flow of funding is stable and steady throughout the phases of the system's acquisition life cycle. The program manager (PM) and contractor plan for perturbations in the budget, both from within and outside their spectrum of control. Accordingly, the PM has taken the following minimal steps to achieve greater control over maintaining a stable budget: obtaining a high-confidence cost estimate that is well documented to firmly support budget requests; ensuring user advocacy for the program; ensuring that funding for the execution year(s) is consistent with the contractor's ability to expend the funding according to the current program schedule; and developing a range of independent estimates at completion from earned value data and analysis of the integrated master schedule. Compare the results with the contractor's projected final costs to assess realism and to form the basis for adjusting the program budget.

Focus Questions

[Pertinent criteria listed after each question.]

2.2.2.Q1: How have program funds have been allocated (by fiscal year) against each phase of the system's acquisition life cycle?

- Has the funding for this program been stable and steady so as to meet program needs?
- How were the total life cycle support requirements analyzed? What was the basis for the estimates? [2.2.2.C1]

2.2.2.Q2: How was funding adequate to facilitate perturbations to the program budget?

- Does funding support Technology Development for immature critical technology components or subsystems, as well as planning for mature technology alternatives to those components or subsystems in the event that critical technologies do not mature quickly enough to support the development schedule.
- Loss/gain of multiyear funding in the budget. [2.2.2.C1]

2.2.2.Q3: How are the total life cycle support requirements and responsibilities addressed in the Logistics Support Plan? What are the bases for the estimates? [2.2.2.C1]

2.2.2.Q4: How does the Logistics Support Plan identify the funding and procedures that will be used in carrying out the total life cycle support requirements and responsibilities? [2.2.2.C1]

Note: The aspects of Factors 2.2.1 and 2.2.2 imbricate (overlap). Questions from 2.2.1 are pertinent to 2.2.2, particularly as they deal with the continuity and stability of funding.

SUB-AREA 2.3 – STAFFING LEVEL

Description: Program management is the mortar that binds the three decision support systems (i.e., Joint Capabilities Integration and Development System (JCIDS), Planning Programming, Budgeting and Execution System (PPBES), and the Defense Acquisition System (DAS)) together to enable successful weapon systems to be acquired. Staffing is one of the key functions of program management (the others are planning, organizing, controlling, and leading). Complementing manning, which focuses on providing sufficient personnel to fill an organization's manpower requirements, staffing addresses the qualifications and special skills that may be required for persons assigned to each position in the program as well as the time-phasing of assignments.

Scope: The assessment of this sub-area deals with the adequacy of identifying, planning, recruiting, selecting, and training of a program management office (PMO) staff that facilitates the acquisition of timely and affordable capabilities to the warfighter within acceptable risk.

Perspective: Staffing is key to the ability of any PMO to execute its responsibilities. Composed of civilian, military, matrix support, and Systems Engineering Technical Assistance (SETA) (aka onsite support contractors), the staff is professional, agile, and motivated. It consistently makes smart business decisions, acts in an ethical manner, and delivers timely and affordable capabilities to the warfighter. A successful staff is more than luck; it is having the "right person" in a position, rather than simply filling a position. The program manager (PM) facilitates this success through improved recruitment, selection, and training.

The PM's consideration of, decisions on, and planning for the staffing of the PMO and support contractor resources available are addressed in the Acquisition Strategy. The PM identifies resource limitations in manning that prevent the PMO from pursuing a beneficial Acquisition Strategy or contracting approach. As a result of this assessment, the PM provides an estimate of the resources needed to implement the desirable strategy or approach.

As part of the risk management process to answer the question "What can go wrong?", the PM continuously reviews the current and proposed staffing at critical points throughout the life cycle of the program (i.e., technical reviews) to identify potential risks and increased demands for resources. A successful review is predicated on the Integrated Process/Product Team's (IPT) determination that the operational capabilities, preferred solution(s), available technologies, and program resources (funding, schedule, staffing, and processes) form a satisfactory basis for proceeding into the phase.

Factor 2.3.1 – Sufficiency of Numbers and Qualifications

Pre-Milestone A

Criteria

2.3.1.C1: There is an established program/process in the program management office (PMO) that provides the right number and mix of qualified personnel to successfully execute the Technology Development (TD) phase. There is sufficient flexibility in the program to address program shortfalls through the use of Systems Engineering Technical Assistance (SETA) contractor personnel.

2.3.1.C2: The contractor has an established program that provides the right number and mix of qualified personnel to successfully execute the TD phase. Key contractor management and technical personnel, including the program manager, chief systems engineer, software architect, and functional area managers, have worked successfully on projects of similar complexity and have had significant work experience relevant to the current program phase.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.3.1.Q1: Is there a staffing plan established?

- What is the process to determine personnel resources and phasing required for the development of the staff, including skills, experience, and education level?
- What are the metrics and standards used to measure the quality of the workforce? [2.3.1.C1]

2.3.1.Q2: Are the following documents that provide manpower, personnel, and training policies available in the program office?

- DoD Directive 1100.4, "Guidance for Manpower Programs"
- DoD Directive 1100.9, "Military-Civilian Staffing of Management Positions in Support Activities"
- DoD Directive 1100.18, "Wartime Manpower Mobilization Planning"
- DoD Directive 1322.18, "Military Training"
- DoD Directive 1430.13, "Training Simulators and Devices"
- DoD Instruction 1322.20, "Development and Management of Interactive Courseware for Military Training"
- Training Transformation Implementation Plan June 2004 [2.3.1.C1]

2.3.1.Q3: How does the PMO describe the personnel issues affecting the program's ability to successfully execute the program?

- What key specialties are missing?
- What key billets are unfilled/about to be vacated? [2.3.1.C1]

2.3.1.Q4: What is the experience level of each of the existing or planned key technical personnel? How is the experience of technical personnel relevant to the current activity? [2.3.1.C1]

2.3.1.Q5: What are the PMO policies and procedures for training staff members? [2.3.1.C1]

2.3.1.Q6: Are the personnel (e.g., program management, contracting, oversight) trained to the appropriate levels in accordance with their acquisition career assignments?

- Are government PMO personnel in acquisition-critical positions trained to the appropriate certification levels in accordance with their acquisition career assignments? [2.3.1.C1]

2.3.1.Q7: What are the in-house training and continuing education programs?

- What are the standard requirements for training TD personnel?
- Describe the training programs for quality engineering, quality assurance, and quality conformance that are available to the employees.
- Describe specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes. [2.3.1.C1]

2.3.1.Q8: How long does it take to train new technical personnel in the tools and methods needed to execute the activity position duties?

- What are the training methods used and the job positions and duration of training required for each? [2.3.1.C1]

2.3.1.Q9: What are the programs to train personnel in simulations, war gaming, and experimentation?

- Is training adequately planned for the TD phase? [2.3.1.C1]

2.3.1.Q10: Did the program meet the exit (success) criteria of the Alternative System Review (ASR); in particular, is the program properly staffed? [2.3.1.C1]

2.3.1.Q11: What is the contractor's program for ensuring the right number and mix of qualified personnel to successfully execute the TD phase? [2.3.1.C2]

2.3.1.Q12: What is the contractor's formal program for workforce efficiency improvement?

- Is the program company-wide, or are individual departments responsible for employee performance and incentives? [2.3.1.C2]

2.3.1.Q13: What are the contractor's training programs for quality engineering, quality assurance, and quality conformance that are available to the employees?

- What is the specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes? [2.3.1.C2]

2.3.1.Q14: How has the contractor committed to having a quality workforce throughout the TD phase? [2.3.1.C2]

Pre-Milestone B

Criteria

2.3.1.C3: The PMO staff is the right mix of qualified personnel to successfully execute the System Development and Demonstration (SDD) phase. Workforce management and training programs receive the highest priority in resources to ensure a qualified workforce to complete the SDD phase and transition to production. There is sufficient flexibility in the program to address program shortfalls through the use of SETA contractor personnel. Policies and standards are in place to ensure the thorough and continual training of the workforce and to evaluate worker performance.

2.3.1.C4: The contractor has an established program that provides the right number and mix of qualified personnel to successfully execute the SDD phase. Key contractor management and technical personnel, including the program manager, chief systems engineer, software architect, and functional area managers, have worked successfully on projects of similar complexity and have had significant work experience relevant to the current program phase. The contractor's policy and actual practice on workforce assignments reflect a commitment to a stable workforce throughout the SDD phase.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.3.1.Q15: Is there a staffing plan established?

- What is the process to determine personnel resources and phasing required for the development of the staff, including skills, experience, and education level?
- What are the metrics and standards used to measure the quality of the workforce? [2.3.1.C3]

2.3.1.Q16: Are the following documents that provide manpower, personnel, and training policies available in the program office?

- DoD Directive 1100.4, "Guidance for Manpower Programs"
- DoD Directive 1100.9, "Military-Civilian Staffing of Management Positions in Support Activities"
- DoD Directive 1100.18, "Wartime Manpower Mobilization Planning"
- DoD Directive 1322.18, "Military Training"
- DoD Directive 1430.13, "Training Simulators and Devices"
- DoD Instruction 1322.20, "Development and Management of Interactive Courseware for Military Training"
- Training Transformation Implementation Plan June 2004 [2.3.1.C3]

2.3.1.Q17: How does the PMO describe the personnel issues affecting the program's ability to successfully execute the program?

- What key specialties are missing?
- What key billets are unfilled/about to be vacated? [2.3.1.C3]

2.3.1.Q18: What is the experience level of each of the existing or planned key technical personnel?

- What engineering expertise is required for the program?
- How is the experience of technical personnel relevant to the current activity? [2.3.1.C3]

2.3.1.Q19: What are the PMO policies and procedures for training staff members? [2.3.1.C3]

2.3.1.Q20: Are the personnel (e.g., program management, contracting, oversight) trained to the appropriate levels in accordance with their acquisition career assignments?

- Are government PMO personnel in acquisition-critical positions trained to the appropriate certification levels in accordance with their acquisition career assignments? [2.3.1.C3]

2.3.1.Q21: What are the in-house training programs and continuing education programs?

- What are the standard requirements for training for SDD personnel?
- Describe the training programs for quality engineering, quality assurance, and quality conformance that are available to the employees.
- Describe specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes. [2.3.1.C3]

2.3.1.Q22: How long does it take to train new technical personnel in the tools and methods needed to execute the activity position duties?

- What are the training methods used and the job positions and duration of training required for each? [2.3.1.C3]

2.3.1.Q23: What are the programs to train personnel in simulations, war gaming, and experimentation?

- Is training adequately planned for the SDD phase? [2.3.1.C3]

2.3.1.Q24: Did the program meet the exit (success) criteria of the System Requirements Review (SRR); in particular, is the program properly staffed? [2.3.1.C3]

2.3.1.Q25: What is the contractor's program for ensuring the right number and mix of qualified personnel to successfully execute the SDD phase? [2.3.1.C4]

2.3.1.Q26: What is the contractor's formal program for workforce efficiency improvement?

- Is the program company-wide, or are individual departments responsible for employee performance and incentives? [2.3.1.C4]

2.3.1.Q27: What are the contractor's training programs for quality engineering, quality assurance, and quality conformance that are available to the employees?

- What is the specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes? [2.3.1.C4]

2.3.1.Q28: How has the contractor committed to having a stable workforce throughout the SDD phase? [2.3.1.C4]

Pre-Milestone C

Criteria

2.3.1.C5: The PMO staff is the right mix of qualified personnel to transition from the SDD phase and successfully execute the Production and Deployment (PD) phase. Workforce management and training programs receive the highest priority in resources to ensure a stable and qualified workforce to complete the SDD phase and transition to production. There is sufficient flexibility in the program to address program shortfalls through the use of SETA contractor personnel.

2.3.1.C6: The contractor has an established program that provides the right number and mix of qualified personnel to successfully execute the PD phase. Key contractor management and technical personnel, including the program manager, chief systems engineer, software architect, and functional area managers, have worked successfully on projects of similar complexity and have had significant work experience relevant to the current program phase.

Focus Questions

[Pertinent criteria number follow each question.]

2.3.1.Q29: Is there a staffing plan established?

- What is the process to determine personnel resources and phasing required for the development of the staff, including skills, experience, and education level?
- What are the metrics and standards used to measure the quality of the workforce? [2.3.1.C5]

2.3.1.Q30: Are the following documents that provide manpower, personnel, and training policies available in the program office?

- DoD Directive 1100.4, "Guidance for Manpower Programs"
- DoD Directive 1100.9, "Military-Civilian Staffing of Management Positions in Support Activities"
- DoD Directive 1100.18, "Wartime Manpower Mobilization Planning"
- DoD Directive 1322.18, "Military Training"
- DoD Directive 1430.13, "Training Simulators and Devices"
- DoD Instruction 1322.20, "Development and Management of Interactive Courseware for Military Training"
- Training Transformation Implementation Plan June 2004 [2.3.1.C5]

2.3.1.Q31: How does the PMO describe the personal issues affecting the program's ability to successfully execute the program?

- What key specialties are missing?
- What key billets are unfilled/about to be vacated? [2.3.1.C5]

2.3.1.Q32: What is the experience level of each of the existing or planned key technical personnel?

- How is the experience of technical personnel relevant to the current activity? [2.3.1.C5]

2.3.1.Q33: What are the PMO policies and procedures for training staff members? [2.3.1.C5]

2.3.1.Q34: Are the personnel (e.g., program management, contracting, oversight) trained to the appropriate levels in accordance with their acquisition career assignments?

- Are government PMO personnel in acquisition-critical positions trained to the appropriate certification levels in accordance with their acquisition career assignments? [2.3.1.C5]

2.3.1.Q35: What are the in-house training programs and continuing education programs?

- What are the standard requirements for training SDD personnel?
- Describe the training programs for quality engineering, quality assurance, and quality conformance that are available to the employees.
- Describe specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes. [2.3.1.C5]

2.3.1.Q36: How long does it take to train new technical personnel in the tools and methods needed to execute the activity position duties?

- What are the training methods used and the job positions and duration of training required for each? [2.3.1.C5]

2.3.1.Q37: What are the programs to train personnel in simulations, war gaming, and experimentation?

- Is training adequately planned for the PD phase? [2.3.1.C5]

2.3.1.Q38: Did the program meet the exit (success) criteria of the technical reviews conducted during the PD phase?

- Is the program properly staffed? [2.3.1.C5]

2.3.1.Q39: What is the contractor's program for ensuring the right number and mix of qualified personnel to successfully execute the PD phase? [2.3.1.C6]

2.3.1.Q40: What is the contractor's formal program for workforce efficiency improvement?

- Is the program company-wide, or are individual departments responsible for employee performance and incentives? [2.3.1.C6]

2.3.1.Q41: What are the contractor's training programs for quality engineering, quality assurance, and quality conformance that are available to the employees?

- What is the specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes? [2.3.1.C6]

2.3.1.Q42: How has the contractor committed to having a stable workforce throughout the PD phase? [2.3.1.C6]

2.3.1.Q43: How does the contractor use outside educational sources for basic technical skills and production training of its workforce? [2.3.1.C6]

Factor 2.3.2 – Continuity and Stability

Pre-Milestone A

Criteria

2.3.2.C1: Workforce management and training programs receive the highest priority in resources to ensure a stable and qualified workforce to complete the Technology Development (TD) phase and transition to development. Policies and standards are in place to ensure the thorough and continual training of the workforce and to evaluate worker performance.

2.3.2.C2: The contractor policy and program practice on workforce assignments reflects a commitment to a stable workforce that will ensure key personnel will exist within the TD program to address technical and other issues as they arise. Metrics used for manpower planning and continuity are verified by contractor experience with similar TD efforts.

Focus Questions

[Pertinent criteria number follow each question.]

2.3.2.Q1: What are the program manager's (PM) procedures and policies that establish the priority of workforce assignments across various activities, including this effort? [2.3.2.C1]

2.3.2.Q2: How is the continuity in the software development staff being addressed to support the software requirements of the TD effort?

- What is the process to determine personnel resources and phasing required for workforce development, including skills, domain and software language experience, and number of people?

- Are there adequate numbers of trained and experienced personnel to manage the software acquisition? If not, what are the shortfalls? [2.3.2.C1]

2.3.2.Q3: Is staffing in place in the program management office (PMO) at the contract startup consistent with the needs and planned staffing ramp-up and profiles? [2.3.2.C1]

2.3.2.Q4: What is the turnover of technical personnel in the TD phase? *Note: An acceptable figure is less than 10 percent.* [2.3.2.C1]

2.3.2.Q5: What are the in-house training and continuing education programs?

- What are the standard requirements for training TD personnel?

- Describe the training programs for quality engineering, quality assurance, and quality conformance that are available to the employees.

- Describe specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes. [2.3.2.C1]

2.3.2.Q6: Did the program meet the exit (success) criteria of the Alternative System Review (ASR); in particular, is there continuity in the program's staff into the next phase? [2.3.2.C1]

2.3.2.Q7: What are the in-place procedures for analyzing data such as turnover rates, complaints, grievances and absenteeism, and the implementation of methods to improve workforce efficiency? [2.3.2.C1]

2.3.2.Q8: How has the contractor committed to having a stable workforce throughout the TD phase? [2.3.2.C2]

2.3.2.Q9: What are the contractor's procedures and policies that establish the priority of workforce assignments across various activities, including this effort? [2.3.2.C2]

2.3.2.Q10: How is the continuity in the contractor's software development staff being addressed to support the software requirements of the TD effort?

- What is the process to determine personnel resources and phasing required for workforce development, including skills, domain and software language experience, and number of people?
- Are there adequate numbers of trained and experienced personnel to manage the software acquisition? If not, what are the shortfalls? [2.3.2.C2]

2.3.2.Q11: Does the contractor have the right staffing in place at the contract startup consistent with the needs and planned staffing ramp-up and profiles? [2.3.2.C2]

2.3.2.Q12: What is the turnover of contractor technical personnel in the TD phase? [2.3.2.C2]

Pre-Milestone B

Criteria

2.3.2.C3: Workforce management and training programs receive the highest priority in resources to ensure a stable and qualified workforce to complete the Systems Development and Demonstration (SDD) phase and transition to production. Policies and standards are in place to ensure the thorough and continual training of the workforce and to evaluate worker performance.

2.3.2.C4: The contractor policy and program practice on workforce assignments reflects a commitment to a stable workforce that will ensure key personnel will exist within the SDD program to address technical and other issues as they arise. Metrics used for manpower planning and continuity are verified by contractor experience with similar SDD efforts.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.3.2.Q13: How was required staffing determined across the program to successfully execute the program within the baselines?

- How is staffing tracked and controlled? [2.3.2.C3]

2.3.2.Q14: How will staffing ramp up to execute the SDD program? [2.3.2.C3]

2.3.2.Q15: What are the estimated turnover rates of the various groups?

- How have the turnover rates affected the program schedule? [2.3.2.C3]

2.3.2.Q16: What is the process for allocating manpower across the schedule phases and parallel development activities, and how is it related to the development sizing/planning estimates? [2.3.2.C3]

2.3.2.Q17: What are the PM's procedures and policies that establish the priority of workforce assignments across various activities, including this effort? [2.3.2.C3]

2.3.2.Q18: How is the continuity in the software development staff being addressed to support the software requirements of the SDD effort?

- What is the process to determine personnel resources and phasing required for workforce development, including skills, domain and software language experience, and number of people?
- Are there adequate numbers of trained and experienced personnel to manage the software acquisition?
- If not, what are the shortfalls? [2.3.2.C3]

2.3.2.Q19: Is staffing in place in the PMO at the contract startup consistent with the needs and planned staffing ramp-up and profiles? [2.3.2.C3]

2.3.2.Q20: What is the turnover of technical personnel in the SDD phase? [2.3.2.C3]

2.3.2.Q21: What are the in-house training and continuing education programs?

- What are the standard requirements for training SDD personnel?
- Describe the training programs for quality engineering, quality assurance, and quality conformance that are available to the employees.
- Describe specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes. [2.3.2.C3]

2.3.2.Q22: Did the program meet the exit (success) criteria of the System Requirements Review (SRR); in particular, is there continuity in the program's staff into the next phase? [2.3.2.C3]

2.3.2.Q23: How has the contractor committed to having a stable workforce throughout the SDD phase? [2.3.2.C4]

2.3.2.Q24: What are the contractor's procedures and policies that establish the priority of workforce assignments across various activities, including this effort? [2.3.2.C4]

2.3.2.Q25: How is the continuity in the contractor's software development staff being addressed to support the software requirements of the SDD effort? [2.3.2.C4]

- What is the process to determine personnel resources and phasing required for workforce development, including skills, domain and software language experience, and number of people?
- Are there adequate numbers of trained and experienced personnel to manage the software acquisition?
- If not, what are the shortfalls? [2.3.2.C4]

2.3.2.Q26: Does the contractor have the right staffing in place at the contract startup consistent with the needs and planned staffing ramp-up and profiles? [2.3.2.C4]

2.3.2.Q27: What is the turnover of contractor technical personnel in the SDD phase? [2.3.2.C4]

Pre-Milestone C

Criteria

2.3.2.C5: Workforce management and training programs receive the highest priority in resources to ensure a stable and qualified workforce to complete the Production and Deployment (PD) phase and transition to operations and support. Policies and standards are in place to ensure the thorough and continual training of the workforce and to evaluate worker performance.

2.3.2.C6: The contractor policy and program practice on workforce assignments reflects a commitment to a stable workforce that will ensure key personnel will exist within the PD program to address technical and other issues as they arise. Metrics used for manpower planning and continuity are verified by contractor experience with similar PD efforts.

Focus Questions

[Pertinent criteria numbers follow each question.]

2.3.2.Q29: How was required staffing determined across the program to successfully execute the program within the baselines?

- How is staffing tracked and controlled? [2.3.2.C5]

2.3.2.Q30: How will staffing ramp up to execute the PD program? [2.3.2.C5]

2.3.2.Q31: What are the estimated turnover rates of the various groups?

- How have the turnover rates affected the program schedule? [2.3.2.C5]

2.3.2.Q32: What is the process for allocating manpower across the schedule phases and parallel development activities, and how is it related to the development sizing/planning estimates? [2.3.2.C5]

2.3.2.Q33: What are the PM's procedures and policies that establish the priority of workforce assignments across various activities, including this effort? [2.3.2.C5]

2.3.2.Q34: How is the continuity in the software development staff being addressed to support the software requirements of the PD effort?

- What is the process to determine personnel resources and phasing required for workforce development. including skills, domain and software language experience, and number of people?
- Are there adequate numbers of trained and experienced personnel to manage the software acquisition? If not, what are the shortfalls? [2.3.2.C5]

2.3.2.Q35: Is staffing in place in the PMO at the contract startup consistent with the needs and planned staffing ramp-up and profiles? [2.3.2.C5]

2.3.2.Q36: What is the turnover of technical personnel in the PD phase? [2.3.2.C5]

2.3.2.Q37: What are the in-house training and continuing education programs?

- What are the standard requirements for training PD personnel?
- Describe the training programs for quality engineering, quality assurance, and quality conformance that are available to the employees.
- Describe specific training content, such as statistical methods and tools, design of experiments, etc., used to ensure quality of test products and processes. [2.3.2.C5]

2.3.2.Q38: Describe the manufacturing planning metrics used to determine manpower requirements, personnel skill levels and training, and other resources required to support the initial and rate production plan. [2.3.2.C5]

2.3.2.Q39: What are the in-place procedures for analyzing data such as turnover rates, complaints, grievances, and absenteeism, and the implementation of methods to improve workforce efficiency? [2.3.2.C5]

2.3.2.Q40: Did the program meet the exit (success) criteria of the technical reviews conducted during the PD phase; in particular, is there continuity in the program's staff into the next phase? [2.3.2.C5]

2.3.2.Q41: What is the contractor's commitment to having a stable workforce through the PD phase? [2.3.2.C6]

2.3.2.Q42: What are the contractor's procedures and policies that establish the priority of workforce assignments across various activities, including this effort? [2.3.2.C6]

2.3.2.Q43: How is the continuity in the contractor's software development staff being addressed to support the software requirements of the SDD effort?

- What is the process to determine personnel resources and phasing required for workforce development, including skills, domain and software language experience, and number of people?
- Are there adequate numbers of trained and experienced personnel to manage the software acquisition? If not, what are the shortfalls? [2.3.2.C6]

2.3.2.Q44: Does the contractor have the right staffing in place at the contract startup consistent with the needs and planned staffing ramp-up and profiles? [2.3.2.C6]

2.3.2.Q45: What is the turnover of contractor technical personnel in the PD phase? [2.3.2.C6]

3.0 MANAGEMENT

SUB-AREA 3.1 – ACQUISITION STRATEGY

Description: An Acquisition Strategy is a high-level business and technical management approach designed to achieve program objectives within specified resource constraints. It is the framework for planning, organizing, staffing, controlling, and leading a program. It provides a master schedule for research, development, test, production, fielding, and other activities essential for program success and for formulating functional strategies and plans. A complete Acquisition Strategy is initially structured during the Technology Development (TD) phase of the program to provide an organized and consistent approach to meeting program objectives within known constraints. Once developed, the Acquisition Strategy is modified as necessary throughout the acquisition cycle. Prior to development of a program Acquisition Strategy in TD, a Technology Development Strategy (TDS) will be formulated during the Concept Refinement phase and approved by the Milestone Decision Authority (MDA) at Milestone A. The TDS contains the research and development strategy to be implemented—particularly in the TD phase—and the rationale for the Acquisition Strategy.

A good Acquisition Strategy is realistically tailored to program objectives and constraints and is flexible enough to allow innovation and modification as the program evolves. The strategy balances cost and effectiveness through development of technology options, exploration of design concepts, and planning and conduct of acquisition activities. These elements are directed toward a planned Initial Operational Capability while adhering to a program budget. The strategy should be structured to achieve program stability by minimizing technical, schedule, and cost risks. Thus the criteria of realism, stability, balance, flexibility, and managed risk should be used to guide the development and execution of an Acquisition Strategy and to evaluate its effectiveness. The Acquisition Strategy must reflect the interrelationships and schedule of acquisition phases and events based on a logical sequence of demonstrated accomplishments; it should not just focus on fiscal or calendar expediency.

Scope: The assessment of this sub-area deals with the adequacy of the Acquisition Strategy to document the ground rules and assumptions that preceded and then lead to program initiation, its quality as a guide and its effectiveness in documenting program progress through periodic updates, and its ability to serve as a standard by which the program progress can be measured.

Perspective: The Acquisition Strategy results from extensive planning and preparation and a thorough understanding of both the specific acquisition program and the general defense acquisition environment. Development of the Acquisition Strategy requires collaboration among the MDA, the program manager (PM), and the functional communities engaged in and supporting Department of Defense (DoD) acquisition. A well-developed strategy minimizes the time and cost required to satisfy approved capability needs and maximizes affordability throughout the program life cycle. Consistent with DoD Directive 5000.1, the PM is the single point of accountability for accomplishing program objectives and goals for total life cycle systems management, including sustainment. The charge of DoD executive leadership is to use common sense and sound business practice in developing the Acquisition Strategy and executing the program. The program manager organizes Integrated Product Teams to assist in developing and coordinating the Acquisition Strategy. When developing the Acquisition Strategy, the PM and supporting team members should keep in mind their total systems responsibility. Consistent with statute and regulation, the PM tailors the program planning and required information to the specific program needs. In addition, the needs of the decision makers who will coordinate or approve the strategy should guide the preparation of the Acquisition Strategy document.

DoD Instruction 5000.2 requires an approved Acquisition Strategy at program initiation. The program should update the Acquisition Strategy for all subsequent major decisions and program reviews and whenever the approved strategy changes. An Acquisition Strategy requires the concurrence of the Program Executive Officer (for programs in all acquisition categories) and the DoD Component Acquisition Executive (for Acquisition Category ID and IAM programs) prior to approval by the MDA. Milestone Decision Authority approval of the Acquisition Strategy may precede a decision point; however, programs may not proceed beyond a decision point without an MDA-approved strategy.

Factor 3.1.1 – Credibility

Pre-Milestone A

Criteria

3.1.1.C1: The program manager (PM) is developing a credible Acquisition Strategy that will provide the basis for meeting program objectives and therefore will be an aid in gaining program acceptance and support. The credibility of the Acquisition Strategy is evaluated on five attributes:

- Realism – the characteristic that program objectives are attainable and the strategic approach to satisfying them can be successfully implemented with reasonable certainty.

- Stability – the characteristic that inhibits negative external or internal influences from seriously disrupting program progress by causing changes in cost, schedule, or performance requirements that can threaten the achievement of milestones.
- Resource balance – the condition of equilibrium between and within major program objectives that are competing for resources.
- Flexibility – the characteristic of the Acquisition Strategy related to the ease with which changes and failures can be accommodated without significant changes in resource requirements.
- Managed risk - the identification of uncertainties that threaten cost, schedule, and performance objectives, and the development and implementation of actions to best deal with those uncertainties within established limits.

Focus Questions

[Pertinent criteria numbers follow each question]

3.1.1.Q1: How is the Acquisition Strategy realistic?

- How are the program objectives attainable?
- What is the strategic approach to attaining the program objectives?
- Can this strategic approach be successfully implemented with reasonable certainty? *Note: There is no simple formula for ensuring the approach is realistic. To evaluate it, reviewers must perform a detailed study of the threat, assess the state-of-the-art in all technology areas, review past performance on similar acquisitions or systems, and survey industry capability, then attain consensus on the complete analysis. Studies take time and resources, but because realism is such an important criterion for a successful strategy, every effort should be made to support this undertaking in critical areas* [3.1.1.C1]

3.1.1.Q2: Does the program face any of the following pressures, which work against the realism of the Acquisition Strategy? If so, how is the PM working to mitigate the impact to the program's Acquisition Strategy? [3.1.1.C1]

- *Competing Alternative Approaches.* An immediate goal of a PM is to gain program acceptance and to see that it is approved, funded, and started. This requirement often induces unrealistic conditions such as matching or exceeding the claimed capability or milestones of a competing approach, or accepting beyond state-of-the-art performance requirements based on an insupportable analysis of a future threat.
- *Acceptance of an Inflexible Set of Requirements.* This stance does not permit trade-offs and forces the PM to force fit an Acquisition Strategy, introducing unrealistic conditions.
- Strategy Directed by Higher Authority. Pressures on the PM from the upper echelons may lead to an Acquisition Strategy with limited alternatives and insufficient planning or may introduce undue optimism with regard to schedule and resource requirements.

- *Low Program Priority within the Service.* If the program is of low priority, the PM may be tempted to recite doctrinally correct program concerns and avoid documentation of relevant interests and concerns.
- *PM's Reaction to Micro-Management.* The PM may adopt a "close-to-the-vest" approach, presenting only minimal details of the concept, which in turn reduces the guidance available to functional managers in their efforts to support the program.
- *Strong Competition.* Competing systems or strong high-level opposition to the program may induce the PM to counter by introducing unrealistic goals or management approaches in the Acquisition Strategy.

3.1.1.Q3: How is the Acquisition Strategy stable? [3.1.1.C1]

3.1.1.Q4: Are any of the potential causes of instability to the Acquisition Strategy present? If so, how is the PM working to mitigate the impact to the program's Acquisition Strategy?

- *The Funding Process.* A number of external factors may produce changes to the yearly funding levels. The changes may require program rescheduling, a reduction in operational capability, or reduced production quantities.
- *Requirements Changes.* The perceived threat level may change, or the user may desire more or less capability, any of which may result in disruption of technical progress.
- *Changing Acquisition Policy or Philosophy.* Changing administrations, executives, or political climates can result in revised policy, which may exert pressure to change the strategy to conform to the new thinking.
- *Industry Risks.* Contractors may be faced with an untenable risk or profit position through buy-in, loss of a major contract, or failure to modernize. The consequences may require additional program money and time, and may result in new contractor sources.
- *Organizational and Personnel Changes.* These changes may result in lack of continuity, lack of accountability, loss of audit trail, or changes in directions, processes, and procedures. [3.1.1.C1]

3.1.1.Q5: How is the PM emphasizing the following "aids" to a stable Acquisition Strategy?

- *Direction.* A strategy must impart a sense of knowing where the program is headed, and when and how each goal will be achieved, by delineating overall program objectives, approaches, and control procedures.
- *Advocacy.* Programs that lack high-level support are initial targets for program changes. The PM must know who the initial supporters are, keep them informed, and if feasible, cultivate new supporters.
- *Commitment.* The PM should strive for agreements that cannot easily be canceled. If the government establishes an agreement with an external party, then a measure of stability is achieved. Two significant examples are a Memorandum of Agreement (MOA) with a

foreign government for joint development or future delivery, and a multi-year procurement contract.

- *Use of Integrated Product Teams.* When properly oriented and challenged, the multifunctional members of the IPT become committed to program success, thereby reducing parochial or functional imbalances that could otherwise lead to future instability. [3.1.1.C1]

3.1.1.Q6: How are resources balanced in the Acquisition Strategy? [3.1.1.C1].

3.1.1.Q7: What is the degree of balance in the Acquisition Strategy in terms of risk in meeting objectives? Note: In this sense, a balanced program is one for which all the risks are approximately equal; the risk measure includes establishing priorities and assessing damages in case of failure [3.1.1.C1]

3.1.1.Q8: Is there flexibility in the Acquisition Strategy?

- What actions has the PM undertaken to achieve program flexibility in the Acquisition Strategy?
- To what extent does the Acquisition Strategy include the following?
    - Requirements flexibility
    - Contract flexibility
    - Functional flexibility
    - Funds management
    - Preplanned Product Improvement (P3I)
    - Design flexibility
    - Design for low ownership cost (including O&S)
    - Evolutionary acquisition, to include either spiral or incremental development [3.1.1.C1]

3.1.1.Q9: Is there effective risk management in the Acquisition Strategy?

- How does the Acquisition Strategy address external risks? Note: External risks exist and originate from factors usually outside the control of the PM, and they are often associated with those requirements and constraints that define the program limits
    - Changes in the threat or poorly defined requirements resulting in redefinition of program performance objectives
    - Funding changes from the assumed level upon which the Acquisition Strategy was/is developed
    - Contractor's ability to function due to adverse impacts from labor strikes or financial difficulties, for example
    - Ramifications due to political influence that cause cost and/or schedule constraints
    - Acts of nature that are clearly outside the control of the PM [3.1.1.C1]
- How does the Acquisition Strategy address internal risks? Note: Internal risks are those over which the PM has more direct control. They result from decisions made within the

program management office (PMO) that affect cost, schedule, performance, and technical approaches to be used when the Acquisition Strategy is developed or modified

- – Ill-defined and/or changing requirements
- – Immature technology(ies)
- – Design and engineering (ability to translate technological capabilities into reliable hardware and software configurations)
- – Manufacturing (ability of the government and/or the contractor to build the designed system to required performance and quality standards)
- – Support in terms of achieving reliability, availability, supportability, and maintainability objectives
- – Cost and schedule
- – Inability of a model or simulation to fully capture and emulate the performance characteristics of the system or component under development [3.1.1.C1]

Pre-Milestone B and Pre-Milestone C

Criteria

3.1.1.C2: The Acquisition Strategy is *credible,* based on the following five attributes: realism, stability, resource balance, flexibility, and risk management. The Acquisition Strategy provides the basis for meeting program objectives, thereby acting as an aid in gaining program acceptance and support.

3.1.1.C3: The Acquisition Strategy documents the ground rules and assumptions under which the program was started and upon which future decisions will be gauged. It becomes more definitive over the execution of the program in describing the relationships of the following essential elements:

- *Requirements* – Strategy provides a summary description of the requirement that the acquisition is intended to satisfy.
- *Structure and Schedule* – Strategy defines the relationship among acquisition phases, decision milestones, solicitations, contract awards, systems engineering design reviews, contract deliveries, test and evaluation (T&E), production releases, and operational deployment objectives.
- *Acquisition Approach* – Strategy identifies the approach the program will use to achieve full capability: an evolutionary approach or a single-step approach.
- *Risk Management* – Strategy identifies the inherent program risk and how it will be managed throughout the life cycle of the program.
- *Program Management* –

- Philosophy/Approach – Philosophy/approach includes the application of acquisition streamlining initiatives, such as integrated product and process development (IPPD), cost as an independent variable (CAIV), and horizontal technology integration (HTI).
- Program Resources – Strategy identifies the planned funding approach, applicable joint funding agreements, highlights of the affordability studies, and known funding or affordability constraints.
    - Cost as an Independent Variable (CAIV) - The concept of CAIV must be used in establishing the Acquisition Strategy.
    - Total Ownership Cost (TOC) - Strategy must consider the total cost to the government over the entire life cycle of the system; the TOC provides balance and perspective to the program as it considers performance and schedule requirements to avoid sub-optimization.
    - Reduction of Total Ownership Cost (R-TOC) - Strategy should include how the program will seek ways to reduce cost to the system owner.
- Information Sharing and DoD Oversight - DoD oversight activities (i.e., contract management offices, contracting offices, technical activities, and PMOs) should consider all relevant and credible information that might mitigate risk and reduce the need for DoD oversight before defining and applying direct DoD oversight of contractor operations.
- Integrated Digital Environment (IDE) - Strategy should describe the data management system and an appropriate digital environment to allow every activity involved with the program to cost-effectively create, store, access, manipulate, and/or exchange data digitally.
- Defense Contract Management Agency (DCMA) Support - Strategy should cover how the PM will make maximum use of DCMA personnel at contractor facilities.
- Government Property in the Possession of Contractors (GPPC) - Strategy should address GPPC to include the process to ensure continued management emphasis on reducing GPPC and prevention of any unnecessary additions to the GPPC.
- Streamlining/Innovative Acquisition - Strategy should show how the program has been tailored and best practices applied so program execution is effective and efficient.
- Simulation-Based Acquisition (SBA) – Acquisition strategy should address SBA, the robust and interactive use of modeling and simulation (M&S) throughout the product life cycle.
- Software-Intensive Programs - Acquisition strategy should address key aspects, including risks, of the proposed software development approach. It should state how the chosen software development approach supports the system-level Acquisition Strategy.

- *Design Considerations* –
  - Technology Transition – The technology portion of the Acquisition Strategy should address the transition of critical technologies that must be applied to the developing systems, as well as the strategies to reduce technological risk.
  - Open Systems – PMs should apply the open systems approach as an integrated business and technical strategy upon defining user needs.
  - Interoperability – Acquisition strategy should describe the treatment of interoperability requirements.
  - Information Technology Supportability – Acquisition Strategy should summarize the information technology (IT), including national security systems (NSS), infrastructure, and support considerations identified in the Initial Capabilities Document (ICD) and Capabilities Development Document (CDD) and described in the Command, Control, Communications, Computers, and Intelligence Support Plan (C4ISP).
  - Program Protection – Acquisition strategy should provide for compliance with the procedures regarding critical program information and anti-tamper measures.
  - Information Assurance – Acquisition strategy should provide for compliance with the procedures regarding information assurance.
- *Support Strategy* -
  - Product Support – PM should develop and document a support strategy within the Acquisition Strategy for life cycle sustainment and continuous improvement of product affordability, reliability, maintainability, and supportability, while sustaining readiness and reducing total ownership cost.
    - o Performance-Based Logistics (PBL) – PBL is the preferred approach for product support implementation. PBL utilizes a performance-based Acquisition Strategy, versus the traditional transaction-based approach.
    - o Logistics Performance Criteria – The strategy describes how support performance will be measured based on high-level metrics, such as availability of mission-capable systems, instead of on distinct elements such as parts, maintenance, and data.
    - o Product Support Integrator – Within the PBL concept, the PM should select a product support integrator from the DoD or private sector; the latter in a form of Contractor Logistics Support (CLS).
  - Affordability Improvements – The overall product support strategy, documented in the Acquisition Strategy, should address actions to continually improve product affordability for programs in initial procurement, re-procurement, and post- production support (O&S cost reduction).

- Source of Support – PM will use the most effective source of support that optimizes performance and life cycle costs (LCC), consistent with military requirements.
  - Depot Maintenance
  - CLS In-Theater
- Human Systems Integration (HSI) – PM should pursue HSI initiatives within the strategy to optimize total system performance and minimize TOC.
- Training – PM should summarize major elements of the training system in the support strategy and identify training initiatives that enhance the user's capabilities, improve readiness, or reduce individual and collective training costs.
- Environmental, Safety, and Occupational Health (ESOH) Hazards – Strategy should contain a summary of the Programmatic ESOH Evaluation (PESHE) document, including ESOH risks, a strategy for integrating ESOH considerations into the systems engineering process, identification of ESOH responsibilities, a method for tracking progress, and a compliance schedule for National Environmental Policy Act (NEPA) and Executive Order (E.O.) 12114.
- Demilitarization and Disposal – Within the Acquisition Strategy, the PM should consider materiel demilitarization and disposal.
- Life Cycle Oversight Responsibility – The overall product support strategy, documented in the Acquisition Strategy, should include life cycle support planning, address actions to ensure sustainment, and address actions to reduce O&S cost.
- Post-Deployment Evaluation – Strategy should describe how the program will use post-employment evaluations (T&E) of the system, beginning at Initial Operational Capability (IOC), to verify whether the fielded system continues to meet or exceed thresholds and objectives for cost, performance, and support parameters approved at full-rate production.
- Other Factors – Acquisition strategy should address miscellaneous support factors, e.g., long-term access to product configuration technical data, that may not have been addressed in the support topics above but that are important to a specific program.

- *Business Strategy Competition* – As part of the Acquisition Strategy, the PM should develop and document a business strategy that describes plans to attain program goals via competition, throughout all phases of the program's life cycle, or that explains why competition is neither practicable nor in the best interests of the government.
  - Potential Sources – Acquisition strategy should consider both international (consistent with possible information security and technology transfer restrictions) and domestic sources that can meet the need, and should consider both commercial and non-developmental items (NDIs) as the primary source of supply.

- o Market Research – primary means to determine the availability and suitability of commercial and NDIs, and the extent to which the interfaces for these items have broad market acceptance, standards-organization support, and stability.
- o Commercial and NDIs – sources of supply that provide for the most cost-effective system throughout the system's life cycle.
- o Dual-use Technologies – system design that facilitates the later insertion of leading-edge, dual-use technologies, and components throughout the system life cycle.
- o Industrial Base Capability – Analysis of the industrial base capability to design, develop, produce, support, and, if appropriate, restart the program for the next program phase.
- o Production – Evidence that the contractor's design is producible and that timely industrial capability will exist to provide the hardware (and associated software) within stated goals.
- o Industry Investment – How the PM will promote sufficient program stability to encourage industry to invest, plan, and bear risks.
- o Small Business Innovative Research (SBIR) – Plans for the use of technologies developed under the SBIR program and favorable consideration for funding of successful SBIR technologies.
- – International Cooperation – Consistent with possible information security and technology transfer limitations, the Acquisition Strategy should discuss the potential for increasing, enhancing, and improving the conventional forces of the NATO and the United States, including reciprocal defense trade and cooperation, and international cooperative research, development, production, and logistic support.
  - o International Interoperability – Strategy should address reciprocal trade and international cooperative programs with allies and friendly nations. Programs should strive to achieve deployment and sustainability of interoperable systems with potential international coalition partners.
  - o Testing for International Programs – Strategy must address the testing strategy for international programs.
- – Contract Approach – For each major contract, the Acquisition Strategy should describe what the basic contract buys; how major deliverable items are defined; options, if any, and prerequisites for exercising them; and the events established in the contract to support appropriate exit criteria for the phase or intermediate development activity.
- *Test and Evaluation (T&E) Approach* – Strategy should address key aspects of the T&E approach that will require special management focus by the PM in order to reduce program risk. The T&E portion of the strategy is concerned with the type, amount, and timing of

testing, with sufficient detail to provide a strategic outline for those who develop the Test and Evaluation Master Plan (TEMP).

Focus Questions

[Pertinent criteria numbers follow each question]

Requirements

3.1.1.Q10: Is the Acquisition Strategy still realistic?

- Are the program objectives still attainable?
- What is the strategic approach to attaining the program objectives?
- Can this strategic approach be successfully implemented with reasonable certainty? *Note: There is no simple formula for achieving a realistic Acquisition Strategy. It entails detailed study of the threat, assessment of the state of the art in all technology areas, review of past performance on similar acquisitions or systems, and a survey of industry capability, followed by the attainment of a consensus when the analysis is complete. Studies take time and resources, but as realism is such an important criterion for a successful strategy, every effort should be made to support this undertaking in critical areas* [3.1.1.C2]

3.1.1.Q11: How did the PM mitigate the following "pressures" (if present) that work against the realism of the Acquisition Strategy? How is the PM working to mitigate the impact of these pressures to the program's Acquisition Strategy for the next phase?

- Competing alternative approaches
- Acceptance of an inflexible set of requirements
- Strategy directed by higher authority
- Low program priority within the Service
- PM reaction to micro-management
- Strong competition [3.1.1.C2]

3.1.1.Q12: Is the Acquisition Strategy still stable? Why? [3.1.1.C2]

3.1.1.Q13: Are any of the potential causes of instability to the Acquisition Strategy still present? How is the PM working to mitigate the impact to the program's Acquisition Strategy for the next phase?

- Funding process
- Requirements changes
- Changing acquisition policy or philosophy
- Industry risks
- Organizational and personnel changes [3.1.1.C2]

3.1.1.Q14: How is the PM emphasizing the following "aids" to a stable Acquisition Strategy?

- Direction

- Advocacy
- Commitment
- Use of IPTs [3.1.1.C2]

3.1.1.Q15: How are resources balanced in the Acquisition Strategy, in particular, for this upcoming phase? [3.1.1.C2]

3.1.1.Q16: What is the degree of balance in the Acquisition Strategy in terms of risk in meeting objectives? *Note: In this sense, a balanced program is one for which all the risks are approximately equal, where the risk measure includes establishing priorities and assessing damages in case of failure* [3.1.1.C2]

3.1.1.Q17: Is flexibility still present in the Acquisition Strategy?

- What actions did the PM undertake to achieve program flexibility in the Acquisition Strategy? Plan to take?
- To what extent are the following in the Acquisition Strategy?
    - Requirements flexibility
    - Contract flexibility
    - Functional flexibility
    - Funds management
    - Preplanned Product Improvement (P3I)
    - Design flexibility
    - Design for low ownership cost (including O&S)
    - Evolutionary acquisition, to include either spiral or incremental development [3.1.1.C2]

3.1.1.Q18: How is there effective risk management in the Acquisition Strategy?

- How does the Acquisition Strategy address external risks? *Note: External risks exist and originate from factors usually outside the control of the PM, and they are often associated with those requirements and constraints that define the program limits*
    - Changes in the threat or poorly defined requirements resulting in redefinition of program performance objectives
    - Funding changes from the assumed level upon which the Acquisition Strategy was/will be developed
    - Contractor's ability to function due to, for example, adverse impacts from labor strikes or financial difficulties
    - Ramifications due to political influence that cause cost and/or schedule constraints
    - Acts of nature that are clearly outside the control of the PM [3.1.1.C2]
- How does the Acquisition Strategy address internal risks? *Note: Internal risks are those over which the PM has more direct control. They result from decisions made within the Program Management Office (PMO) that affect cost, schedule, performance, and technical approaches to be used when the Acquisition Strategy is developed or modified.*

- Ill-defined and/or changing requirements

- Immature technologies

- Design and engineering (ability to translate technological capabilities into reliable hardware and software configurations)

- Manufacturing (ability of the contractor to build the designed system to required performance and quality standards)

- Support in terms of achieving reliability, availability, supportability, and maintainability objectives

- Cost and schedule

- Inability of a model or simulation to fully capture and emulate the performance characteristics of the system or component under development [3.1.1.C3]

3.1.1.Q19: How does the Acquisition Strategy describe the requirements that the acquisition is intended to satisfy? [3.1.1.C3]

- Does it address family of system or mission area requirements for interoperability?

- What are the dependencies on planned capabilities being achieved by other programs?

- For time-phased requirements, how is the initial block defined?

3.1.1.Q20: What are the approved requirements documents? [3.1.1.C3]

Structure and Schedule

3.1.1.Q21: Is there a structure and schedule section in the Acquisition Strategy? If not, why not?

- If yes, how are the following defined: the relationship among acquisition phases, decision milestones, solicitations, contract awards, systems engineering design reviews, contract deliveries, test and evaluation (T&E), production releases, and operational deployment objectives? [3.1.1.C3]

Acquisition Approach

3.1.1.Q22: How does the Acquisition Strategy identify and describe the approach the program will use to achieve full capability: an evolutionary approach or a single-step approach?

- What is the rationale for choosing the approach?

- If an evolutionary approach is being used, how is Block I (the initial deployment capability) described; how will it be funded, developed, tested, produced, and supported; and what is the approach to treatment of subsequent blocks?

  - If the CDD includes a firm definition of requirements to be satisfied by each block, how does the Acquisition Strategy define each block of capability and how it will be funded, developed, tested, produced, and operationally supported (i.e., incremental development)?

  - If the CDD does not allocate to specific subsequent blocks the remaining requirements that must be met to achieve full capability, how does the Acquisition Strategy define

the full capability (Block I) that the acquisition is intended to satisfy, and how does it describe the planned funding and schedule to achieve that capability (i.e., spiral development)?

- What is the management approach to be used to define the requirements for each subsequent block and the acquisition processes applicable to each block, including whether end items delivered under earlier blocks will be retrofitted with later block improvements? [3.1.1.C3]

Risk Management

3.1.1.Q23: How did the Acquisition Strategy address risk management?

- What are the four attributes of an effective Acquisition Strategy necessary to minimize program risk? *Note: realism, stability, resource balance, and flexibility. See 3.1.1.C1 for descriptions*
  - Are they present in the Acquisition Strategy?
- How were the stipulations and guidance in the Office of Management and Budget (OMB) Circular A-11, the DoD 5000 series, and the DoD Risk Management Guide followed in addressing program risk in the Acquisition Strategy?
- What statistical or other qualitative procedures were followed to "measure" program risk?
- What is the risk management structure for selecting acquisition alternatives? [3.1.1.C3]

Program Management

3.1.1.Q24: How are the following acquisition streamlining initiatives, at a minimum, applied to the program and reflected in the Acquisition Strategy?

- Integrated Product and Process Development (IPPD)
- Cost as an Independent Variable (CAIV)
- Reduction of Total Ownership Cost (R-TOC)
- Horizontal Technology Integration (HTI) [3.1.1.C3]

3.1.1.Q25: How is the planned funding approach described in the Acquisition Strategy?

- Details of advanced procurement funding?
- Transition funding and funding under an evolutionary Acquisition Strategy?
- Principal source of funds for development, production, and fielding?
- Applicable joint funding agreements?
- Highlights of the affordability studies, and known funding or affordability constraints?
- Planned annual funding totals, by appropriation, for the prior year, current year, Future Years Defense Program (FYDP) and cost to complete? [3.1.1.C3]

3.1.1.Q26: How is the concept of CAIV used in establishing the Acquisition Strategy?

- How does the Acquisition Strategy address methodologies to acquire and operate affordable DoD systems?

- Does it set aggressive, achievable cost objectives and describe how management will achieve these objectives?
- What are the cost objectives, and how are they set to balance mission needs with projected out-year resources, taking into account anticipated process improvements in both DoD and defense industries? [3.1.1.C3]

3.1.1.Q27: How is Total Ownership Cost (TOC) described in the Acquisition Strategy, primarily the PM's management of the total cost to the government over the entire life cycle of the system?

- What is the balance and perspective to the program's TOC in consideration of the performance and schedule requirements to avoid sub-optimization? [3.1.1.C3]

3.1.1.Q28: How is the program's data management system and Integrated Digital Environment (IDE) described in the strategy?

- What are the benefits of IDE? *Note: IDE allows every activity involved with the program to cost-effectively create, store, access, manipulate, and/or exchange data digitally.*
- What are the minimum requirements of the program's IDE in terms of meeting the data management needs of the support strategy, systems engineering process, M&S activities, T&E strategy, and periodic reporting requirements?
- Does the design of the IDE allow ready access to anyone with a need to know (as determined by the PM)? What are the opinions of the stakeholders on the "value" of the IDE? [3.1.1.C3]

3.1.1.Q29: What is the process to actively identify and pursue ways to reduce total ownership cost? [3.1.1.C3]

3.1.1.Q30: How does the Acquisition Strategy capture the use of Defense Contract Management Agency (DCMA) personnel at contractor facilities?

- What role has/will DCMA contract management offices play in developing and approving the program support plan to ensure agreement on contract oversight needs and perspectives?
- If the PM assigns technical representatives to a contractor's facility, has the Director, DCMA agreed in a Memorandum of Agreement (MOA)? [3.1.1.C3]

3.1.1.Q31: How does the strategy address Government Property in the Possession of Contractors (GPPC)?

- What is the process in place to ensure continued management emphasis on reducing GPPC and preventing any unnecessary additions to the GPPC? [3.1.1.C3]

3.1.1.Q32: How is streamlining/innovative acquisition addressed in the strategy?

- Has the program been tailored, and how have best practices been applied to facilitate effective and efficient program execution? [3.1.1.C3]

3.1.1.Q33: How does the Acquisition Strategy describe the PM's use of Simulation-Based Acquisition (SBA) throughout the product life cycle? *Note: The PM should use SBA and M&S*

during system design, system T&E, and system modification and upgrade. In collaboration with industry and operational users, PMs should integrate SBA/M&S into program planning activities; should plan for life cycle application, support, documentation, and reuse of models and simulations; and should integrate SBA/M&S across the functional disciplines [3.1.1.C3]

3.1.1.Q34: How does the Acquisition Strategy address key aspects, including risks, of the proposed software development approach?

- Does it state how the chosen software development approach supports the system-level Acquisition Strategy?
- What is the plan for using independent expert reviews for a software-intensive program? [3.1.1.C3]

Design Considerations

3.1.1.Q35: How does the technology portion of the strategy address the transition of critical technologies that must be applied to the developing systems, as well as the strategies to reduce technological risk?

- Is there sufficient detail to provide a strategic outline for those who develop the Systems Engineering Plan? *Examples: technology demonstration programs (TDPs), P3Is, and/or the utilization of commercial and non-developmental items (NDIs) to reduce technological risk and to reduce total ownership costs.*
- How does the technology portion of the strategy address the key aspects of the software development approach, identify the mission-critical computer resources, and identify related planning and support issues? [3.1.1.C3]

3.1.1.Q36: How does the Acquisition Strategy describe the use of open systems approach? *Note: The open systems approach should be an integral part of the overall Acquisition Strategy to enable rapid acquisition with demonstrated technology, evolutionary and conventional development, interoperability, life cycle supportability, and incremental system upgradability without major redesign during initial procurement and reprocurement of systems, subsystems, components, spares, and services, and during post-production support.*

- What is the feasibility of using widely supported commercial interface standards in developing systems? [3.1.1.C3]

3.1.1.Q37: How does the strategy describe the treatment of interoperability requirements?

- If the Acquisition Strategy involves successive blocks satisfying time-phased requirements, does this description address each block, as well as the transitions from block to block?
- How are enabling systems engineering efforts such as network analysis, interface control efforts, open systems, data management, and standardization identified and described in the Acquisition Strategy? [3.1.1.C3]

3.1.1.Q38: How does the Acquisition Strategy summarize the information technology (IT), including national security systems (NSS), infrastructure, and support considerations identified in the ICD and CDD and described in the Command, Control, Communications, Computers, and Intelligence Support Plan (C4ISP)? [3.1.1.C3]

3.1.1.Q39: How does the Acquisition Strategy provide for compliance with the procedures regarding critical program information and anti-tamper measures?

- How are the technical, schedule, cost, and funding issues associated with executing requirements for protection of critical program information and technologies identified in the Acquisition Strategy?
- What are the plans to resolve these issues? [3.1.1.C3]

3.1.1.Q40: How does the Acquisition Strategy provide for compliance with the procedures regarding information assurance? *Note: The PM should identify in the Acquisition Strategy, the technical, schedule, cost, and funding issues associated with executing requirements for information assurance, and should maintain a plan to resolve any issues that arise* [3.1.1.C3].

Support Strategy

3.1.1.Q41: How is the product support strategy for life cycle sustainment and continuous improvement of product affordability, reliability, maintainability, and supportability described in the Acquisition Strategy?

- How is the concept of performance-based logistics described in the Acquisition Strategy?
- What are the metrics to be used to measure support performance?
- How does the Acquisition Strategy address the product support integrator, from the DoD or private sector; the latter in a form of contractor logistics support (CLS)?
  - Which of the following activities - functions provided by organic organizations, private sector providers, or a partnership between organic and private sector providers - are to be coordinated by support integrators? [3.1.1.C3]

3.1.1.Q42: How does the product support strategy, as documented in the Acquisition Strategy, address actions to continually improve product affordability and reduce total ownership cost for programs in initial procurement, reprocurement, postproduction support, and field operations? [3.1.1.C3]

3.1.1.Q43: What is the source of support identified in the Acquisition Strategy?

- Is it the most effective?
- Does it optimize performance and life cycle cost (LCC), consistent with military requirements?
- Is it organic or commercial?
- How is depot maintenance addressed in the Acquisition Strategy?
- Is there an effort to reduce maintenance cost?

- If the support strategies require the employment of contractors, whether for supply or maintenance support, what are the standards and procedures for integrating CLS into the theater of operations? [3.1.1.C3]

3.1.1.Q44: How does the PM pursue human systems integration (HSI) initiatives within the strategy to optimize total system performance and minimize TOC?

- How are HIS aspects of manpower, personnel, training, safety and occupational health, habitability, human factors, and personnel survivability integrated into the acquisition process?
    - What are major elements of the training system in the support strategy? [3.1.1.C3]

3.1.1.Q45: What ESOH risks are described in the Acquisition Strategy?

- As part of the risk management strategy, how will Environmental, Safety, and Occupational Health (ESOH) hazards be prevented, where possible, and managed where they cannot be avoided? [3.1.1.C3]

3.1.1.Q46: Within the Acquisition Strategy, how does the PM consider materiel demilitarization and disposal? [3.1.1.C3]

3.1.1.Q47: What are the responsibilities of the PM in life cycle oversight? *Note: Full life cycle product support execution, resource planning responsibilities, and oversight of the fielded system's readiness, performance, and ownership costs.* [3.1.1.C3]

Business Strategy

3.1.1.Q48: As part of the Acquisition Strategy, how does the PM develop and document a business strategy that (1) describes plans to attain program goals via competition throughout all phases of the program's life cycle or (2) explains why competition is neither practicable nor in the best interests of the government? [3.1.1.C3]

3.1.1.Q49: How is competition addressed in the Acquisition Strategy?

- How does the program foster and maintain a competitive environment?
- What, if any, are the exceptional circumstances in which competition is not justified? [3.1.1.C3]

3.1.1.Q50: Does the Acquisition Strategy consider the competitive impact of exclusive teaming arrangements?

- How does the Acquisition Strategy address sub-contractor competition?
    - How does the Acquisition Strategy identify the potential industry sources to supply program needs?
    - What are some of the areas of potential vertical integration (i.e., where potential prime contractors are also potential suppliers)?
    - How does the Acquisition Strategy describe the approaches the PM will use (e.g., requiring an open systems architecture, investing in alternate technology or product

solutions, breaking out a subsystem or component, etc.) to establish or maintain access to competitive suppliers for critical areas at the system, subsystem, and component levels? [3.1.1.C3]

3.1.1.Q51: How does the Acquisition Strategy consider both international (consistent with possible information security and technology transfer restrictions) and domestic sources that can meet the need? [3.1.1.C3]

3.1.1.Q52: How does the Acquisition Strategy consider both commercial and NDI sources as the primary source of supply? What is the role of market research in determining the availability and suitability of commercial and NDIs, and to what extent do the interfaces for these items have broad market acceptance, standards-organization support, and stability?

- What is the role of commercial off-the-shelf (COTS) and NDI sources of supply to provide for the most cost-effective system throughout the system's life cycle?
- How does the PM work with the user to define and modify, as necessary, requirements to facilitate the use of COTS items and NDIs? [3.1.1.C3]

3.1.1.Q53: What is the definition of dual-use technologies?

Are dual-use technologies and component-development opportunities identified through market research and analysis? [3.1.1.C3]

3.1.1.Q54: How does the Acquisition Strategy summarize the analysis of the industrial base capability to design, develop, produce, support, and, if appropriate, restart the program for each phase with greater detail for the upcoming phase?

- Does this analysis identify the DoD investments needed to create or enhance certain industrial capabilities, and the risk of industry being unable to provide the program design or manufacturing capabilities at planned cost and schedule?
- If the analysis indicates an issue beyond the scope of the program, what steps are identified in the Acquisition Strategy to address the issue? [3.1.1.C3]

3.1.1.Q55: How does the production portion of the strategy address the contractor's design in terms of producibility, and how does it address whether timely industrial capability will exist to provide the hardware (and associated software) within the stated program goals? [3.1.1.C3]

3.1.1.Q56: How is the use of technologies developed under the Small Business Innovative Research (SBIR) program described in the Acquisition Strategy?

- What are the PM's plans to address the program's plans for funding the further development and insertion into the program of SBIR-developed technologies? [3.1.1.C3]

3.1.1.Q57: How is international cooperation described in the Acquisition Strategy?

- What is the potential for enhancing and improving the conventional forces of the NATO and the United States, including reciprocal defense trade and cooperation, and international cooperative research, development, production, and logistic support?

- Are stipulations and policies on information security and technology transfer identified and discussed in the Acquisition Strategy?
- How is international interoperability described in the Acquisition Strategy?
- Is there a project similar to the one under consideration in development or in production by one or more major allies or NATO organizations?
  - If there is such a project, is there a requirement to provide an assessment as to whether that project could satisfy, or be modified in scope to satisfy, US military requirements?
  - Is there a requirement to provide an assessment of the advantages and disadvantages, with regard to program timing, LCCs, technology sharing, standardization, and interoperability, of a cooperative program with one or more major allies or NATO organizations?
- How is the testing strategy for international programs described in the acquisition strategy?
  - For a system that has not successfully completed Initial Operational Test and Evaluation (IOT&E), is there USD(AT&L) approval prior to any foreign military sale, commitment to sell, or DoD agreement to license for export?
  - Can results of T&E of systems using approved international test operating procedures be accepted without repeating the testing? [3.1.1.C3]

3.1.1.Q58: For each major contract planned to execute the Acquisition Strategy, how does the Acquisition Strategy describe the following?

- What the basic contract buys
- How major deliverable items are defined
- The use of options, if any, and the prerequisites for exercising them
- The events established in the contract to support appropriate exit criteria for the phase or intermediate development activity [3.1.1.C3]

3.1.1.Q59: Does the Acquisition Strategy address the PM's consideration of multiyear contracting for full-rate production, and the PM's assessment of whether the production program is suited to the use of multiyear contracting based on Federal Acquisition Regulation (FAR) requirements? [3.1.1.C3]

3.1.1.Q60: What contract type(s) are identified in the Acquisition Strategy?

- Explain why the contract types are suitable, including considerations of risk assessment and reasonable risk sharing by the government and the contractor(s).
- How does the strategy explain the planned contract incentive structure, and how will the contract provide incentives for the contractor(s) to provide the contracted product or services at or below the established cost objectives?

- If more than one incentive is planned for a contract, what is the explanation of how the incentives complement each other and do not interfere with one another? [3.1.1.C3]

3.1.1.Q61: Does the Acquisition Strategy require that contractors' management information systems used in planning and controlling contract performance meet the Earned Value Management System (EVMS) guidelines set forth in American National Standards Institute (ANSI)/EIA 748-98? *Note: Further questions regarding EVMS can be found in Factor 3.3.4* [3.1.1.C3]

3.1.1.Q62: What special contract terms and conditions are identified in the Acquisition Strategy, particularly any unusual contract terms and conditions and all existing or contemplated deviations to the FAR or DFARS? [3.1.1.C3]

3.1.1.Q63: How is the use of warranties addressed in the Acquisition Strategy?

- What is the requirement for the PM to examine the value of warranties on major systems and pursue them when appropriate and cost-effective? [3.1.1.C3]

Test and Evaluation (T&E) T&E Approach

3.1.1.Q64: What key aspects of the T&E approach will require special management focus by the PM in order to reduce program risk addressed in the Acquisition Strategy? [3.1.1.C3]

References
Acquisition Strategy Guide. Defense Acquisition University, June 2003.
Defense Acquisition Guidebook (DAG). Chapter 4, "Systems Engineering." Defense Acquisition University, https://akss.dau.mil/dag/.

Factor 3.1.2 – Acceptability

Pre-Milestone A

Criteria

3.1.2.C1: Before development of a program Acquisition Strategy in the Technology Development (TD) phase, a Technology Development Strategy (TDS) is formulated during the Concept Refinement (CR) phase and approved by the MDA at Milestone A. The TDS contains the research and development strategy to be implemented—particularly in the TD phase—and the rationale for the planned acquisition approach to achieve full capability.

3.1.2.C2: The feasibility to achieve the required technological maturity is a key issue for entering Milestone A. Feasibility is confirmed during the hardware build, integration, and test activities of the TD phase and performance at Technology Readiness Level (TRL) 6 or higher has been demonstrated.

3.1.2.C3: There is an approved Initial Capabilities Document (ICD) that describes initial broad, time-phased, operational goals and requisite capabilities. The ICD is derived from integrated system architectures and functional area analyses developed and updated by the user community.

Focus Questions

[Pertinent criteria numbers follow each question]

3.1.2.Q1: How does the TDS reflect the plan to demonstrate the feasibility of developing and integrating new technologies with existing ones to form a new capability? [3.1.2.C1]

3.1.2.Q2: Is the TDS robust, and how does it address the following?

- Modular Open Systems Approach (MOSA) design for all key interfaces within the system concept
- Supportability
- Technology maturity
- Total life cycle management (hardware and software) [3.1.2.C1]

3.1.2.Q3: Is adequate funding and a realistic schedule allocated to meet the technology maturation goals of the TDS objectives?

- If time and funding are constrained, are the goals adjusted accordingly? [3.1.2.C1]

3.1.2.Q4: Explain how the current TDS objectives fully support and are traceable to the ICD. How does the TDS address all elements of the ICD? *Note: TD program plan describes the essential capabilities of the ICD that relate to the scope of the technology maturation effort, and the schedule to demonstrate selected capabilities of the concept design. The TDS management process reflects critical path planning to manage risk and assess the potential outcomes of the TD effort. The Acquisition Strategy will be adjusted as necessary to demonstrate essential capabilities of the ICD and proceed to the System Development and Demonstration (SDD) phase with an acceptable level of risk. Entrance criteria have been established as technology maturity metrics* [3.1.2.C1]

3.1.2.Q5: How does the TDS consider competition and other means to select alternatives to be considered for further development to optimize for Total Ownership Cost (TOC)? [3.1.2.C1]

3.1.2.Q6: How does the TDS address the demonstration of Technology Readiness Level (TRL) criteria for all Critical Technology components or sub-systems, so as to achieve TRL 6 before Milestone B? [3.1.2.C1]

3.1.2.Q7: How does the TDS support the TD phase? [3.1.2.C1]

3.1.2.Q8: How do technology assessments and the AoA form the basis of the TDS, and why are they essential for selection of feasible technologies for the TD phase? [3.1.2.C1]

3.1.2.Q9: How is the system integration, test, and verification process defined in the TDS?

- Does this definition include analysis, reviews, inspections, demonstrations, testing, and M&S to validate the requirements baseline?

- How does the TDS describe an iterative verification process that allocated specifications are met by lower-level components, assemblies, subsystems and then at the system level?
- Are the requirements traceable to specific test/verification events? [3.1.2.C1]

3.1.2.Q10: How will the elements of the TDS be managed, including the key decision points (e.g., Technology Readiness Assessment (TRA)) during the TD effort for assessing TRLs of the selected technologies? [3.1.2.C1]

3.1.2.Q11: What is the process for incorporating the TD results into the System Development and Demonstration (SDD) planning documentation, to include the Acquisition Strategy? [3.1.2.C1]

3.1.2.Q12: How is technology obsolescence factored into the TDS?

- Does the strategy include a process to determine when technology-refresh actions should be performed? If not, why not? [3.1.2.C1]

3.1.2.Q13: What is the explanation for how the incorporation of advanced technologies for capability improvements to the system is factored into the TDS? [3.1.2.C2]

3.1.2.Q14: Describe the continuous evolution of the capability under an evolutionary or spiral approach to incorporate deferred or evolving capability requirements into subsequent TD? [3.1.2.C2]

3.1.2.Q15: How is the approved Initial Capabilities Development Document (ICD), identified?

- How does the ICD with initial broad, time-phased, operational goals requisite capabilities, and the Analysis of Alternatives (AoA) guide the Concept Refinement (CR) phase of the acquisition lifecycle?
- What product(s) does the user community develop to support the development of the ICD?
  - What is the "quality" of these products? [3.1.2.C3]

Pre-Milestone B

Criteria

3.1.2.C4: DoD Instruction 5000.2 requires an approved Acquisition Strategy at program initiation. An Acquisition Strategy requires the concurrence of the Program Executive Officer (for programs in all acquisition categories) and the DoD Component Acquisition Executive (for Acquisition Category ID and IAM programs) prior to approval by the Milestone Decision Authority. Milestone Decision Authority approval of the Acquisition Strategy may precede a decision point; however, programs may not proceed beyond a decision point without a Milestone Decision Authority-approved strategy.

3.1.2.C5: The Acquisition Strategy and specific acquisition approaches are consistent with operational capabilities/requirements and available resources, and appropriate to fully develop a system that meets the program objectives. It meets all statutory and regulatory requirements throughout the program's life cycle. The strategy, including specific approaches, competition,

contract types, etc needs to be well documented and promulgated to all participants in the program.

- There is a sustainment plan for new systems, legacy systems, and systems being replaced.
- There is a focus on reducing total ownership cost.
- The Acquisition Strategy documents technical and sustainment performance requirements in the Acquisition Program Baseline, to include the Life Cycle Sustainment Outcome Metrics of materiel availability, materiel reliability, ownership costs, and mean down time.
- A Total Systems Approach has been established to ensure supportability considerations are included in the analysis of concepts and in trade studies.
- Performance specifications are directly traceable to the program KPPs/KSAs.
- The Depot Source of Repair (DSOR) process has been conducted and the best mix of public and private capabilities and resources has been established.
- The product support strategy is rationalized as the preferred approach based on quantitative criteria (e.g., lowest risk, best value, etc.), and a comparison of alternative approaches that verifies the selected approach as the optimal solution.
- There is an effective approach for applying Modular Open Systems Approach (MOSA).
- The maturity of the planned technology to be used in the program development is consistent.
- Program risks are identified and documented, and progress is tracked via established metrics that should be invariant with time. The end result is the overall risk of implementing the Acquisition Strategy is considered to be manageable within available time and resources.
- There is a feasible approach of using widely supported commercial interface standards in developing the system.
- The strategy ensures access to cutting-edge technologies and products from multiple suppliers.
- A balance exists among technical approach (e.g., hardware and software performance), schedule, cost, supportability, risk, and available funding.

3.1.2.C6: There is an approved Capabilities Development Document (CDD) that refines the integrated system architecture. It builds on the ICD and provides the detailed operational performance parameters necessary to design the proposed system. These parameters are stated as Objectives and Thresholds and are displayed in several program documents, including the Acquisition Program Baseline (APB); they serve as a basis for cost-schedule-performance tradeoffs. The CDD ensures that the Acquisition Strategy is well-defined and guides trade-off analyses.

Focus Questions

[Pertinent criteria numbers follow each question]

3.1.2.Q16: Who approved the Acquisition Strategy?

- When was it approved? [3.1.2.C4]

3.1.2.Q17: How is the Acquisition Strategy documented; where is it held and in what form?
[3.1.2.C4]

3.1.2.Q18: Is the Acquisition Strategy event-driven?

- What major activities has the program conducted to date?
    - Outcomes of technical reviews, test phases, independent reviews, risk reduction activities, trade studies, etc.
- What technical refreshes are planned in the SDD, PD, and O&S phases?
- Is there proprietary technology that would result in a single source of supply (prime and subcontractors) over the life of a system?
- How does the Acquisition Strategy mitigate technical risks associated with technology maturation or obsolescence?
- What is the maturity of technologies to be used?
    - When is the TRA planned to be available?
    - What are the critical technology elements (CTEs)?
    - Discuss their Technology Readiness Levels (TRLs).
    - What are the risks associated with technology and the risk closure plans?
    - What are the technology off-ramps?
- If information, equipment, software, or data are being provided to the contractor, "what" process is used to ensure these are complete, available, meet the requirements, and are supportable?
- What future increments of capability are planned?
    - What are the off-ramps for requirements and technical issues?
- What is the process that ensures the program's requirements remain stable? [3.1.2.C4]

3.1.2.Q19: How does the Acquisition Strategy meet all statutory and regulatory requirements throughout the program life cycle? [3.1.2.C5]

3.1.2.Q20: How does the Acquisition Strategy relate to the operational requirements of the system and/or system of systems? [3.1.2.C5]

3.1.2.Q21: What is the influence of the Life Cycle Sustainment Outcome Metrics of materiel availability, materiel reliability, ownership costs, and mean down time in the development of the Acquisition Strategy and the establishment of the Acquisition Program Baseline? [3.1.2.C5]

3.1.2.Q22: How are the performance specifications directly traceable to the program KPPs/KSAs?
[3.1.2.C5]

3.1.2.Q23: How does the Sustainment Plan section of the strategy provide for life cycle sustainment? [3.1.2.C5]

3.1.2.Q24: How does the Sustainment Plan provide a process to identify and pursue items/projects to lower total ownership cost? [3.1.2.C5]

3.1.2.Q25: Has a Total Systems Approach been established to ensure supportability considerations are included in the analysis of concepts and in trade studies?

- What is the "quality" of the approach? [3.1.2.C5]

3.1.2.Q26: Does the Acquisition Strategy provide a summary description of the requirements that the program is intended to satisfy?

- How does the summary address family of system or mission area requirements for interoperability? [3.1.2.C5]

3.1.2.Q27: What is the approach to using long-term Performance-Based Logistics (PBL) agreements?

- What incentives have been identified in the PBL agreements and how are they tied to performance?
- How are the incentives tied to metrics tailored by the program to reflect its Service's specific definitions and reporting processes?
- How are award and other incentive-type contracts used to facilitate future cost estimating and price analysis?
- What are the terms and conditions that implement metrics in the PBL Product Support contracts? Are they effective? [3.1.2.C5]

3.1.2.Q28: What is the process for identifying support/sustainment sources, completing the Depot Source of Repair (DSOR) analysis, and determining the best mix of public and private capabilities and resources? [3.1.2.C5]

3.1.2.Q29: How does the Acquisition Strategy describe the program's approach for applying Modular Open Systems Approach (MOSA), as characterized by the following attributes?

- Modular hardware and software design
- Incremental system improvements without total redesign
- Standard-based, robust architecture to accommodate new technology for improved capability and extended service life
- Commercially supported specifications and standards for selected interfaces, products, practices, and tools
- Planned validation of open systems implementation
- Planned migration of closed system hardware to open system design with capability upgrades
- Supportability and maintainability of the system

- Commercial-off-the-shelf (COTS) technology refreshment plans
- COTS logistics/sparing plan [3.1.2.C5]

3.1.2.Q30: Does the available funding match required performance, schedule, cost, supportability, and acceptable risk program parameters?

- How are the technical requirements executable and technical risks acceptable given any program funding and schedule constraints? [3.1.2.C5]

3.1.2.Q31: How is the approved Capabilities Development Document (CDD), identified?

- Does the CDD build on the ICD?
- How does it provide detailed operational performance parameters necessary to design the proposed system?
    - Are these parameters stated as Objectives and Thresholds?
    - How are they displayed in program documents, including the Acquisition Program Baseline (APB)?
- Was the CDD updated or appended before each decision to begin a subsequent increment of the program? [3.1.2.C6]

Pre-Milestone C

Criteria

3.1.2.C7: The Acquisition Strategy has been updated and approved to meet the Production and Deployment (PD) phase-specific requirements and program status, to include:

- Life Cycle Sustainment Outcome Metrics of materiel availability, materiel reliability, sustainability, ownership costs, and mean down time
- Program Baseline Estimates and Acquisition Unit Cost goals
- Product Support Strategy
- Acquisition Strategy objectives - extent to which the acquisition approach is achievable
- Acquisition Program Baseline (APB) criteria for performance, schedule, and cost
- All the elements that collectively fulfill the operational requirements of the system
- The plan for system life cycle sustainment consistent with operational requirements
- The plan for system life cycle sustainment includes a process to reduce total ownership cost
- System design – in terms of open systems features and commercial hardware consistent with DOD acquisition policy
- Consideration of competition and other means to manage production and sustainment costs to ensure best value for total operational costs
- The support concept incorporates performance-based logistics

- Partnering concepts are considered for all logistics functional areas, which optimize the strengths of both organic and contract resources
- The Acquisition Strategy meets all statutory and regulatory requirements throughout the program life cycle
- The Sustainment Plan section of the Acquisition Plan provides for Life Cycle Sustainment and lowering O&S cost
- Contract terms and conditions that enhance performance and cost controls
- Performance outcomes that are commensurate with the available financial resources
- System's affordability

3.1.2.C8: The Acquisition Strategy is contained in an Acquisition Strategy document that is approved by the MDA prior to Milestone C. The Acquisition Strategy and specific acquisition approaches are consistent with operational capabilities/requirements and available resources, and appropriate to fully develop a system that meets the program objectives. It meets all statutory and regulatory requirements throughout the program's life cycle. The strategy, including specific approaches, competition, contract types, etc., needs to be well documented and promulgated to all participants in the program.

3.1.2.C9: There is an approved Capability Production Document (CPD) that addresses the production attributes and quantities specific to a single increment of the acquisition program. During the SDD phase, after Critical Design Review (CDR), but prior to Milestone C, a CPD is developed as a follow on to the CDD.

Focus Questions

[Pertinent criteria numbers follow each question]

3.1.2.Q32: Who approved the Acquisition Strategy?

- When was it approved? Before Milestone C? [3.1.2.C7]

3.1.2.Q33: How is the Acquisition Strategy documented? Where is it held and in what form? [3.1.2.C7]

3.1.2.Q34: Is the Acquisition Strategy event driven?

- What major activities has the program conducted to date (e.g., outcomes of technical reviews, test phases, independent reviews, risk reduction activities, trade studies, etc.?
- What technical refreshers are planned in the PD and O&S phases?
- Is there proprietary technology that would result in a single source of supply (prime and subcontractors) over the life of a system?
- How does the Acquisition Strategy mitigate technical risks associated with technology maturation or obsolescence?
- What's the maturity of technologies to be used?

- If information, equipment, software, or data is being provided to the contractor, what process is used to ensure these are complete, available, meet the requirements, and are supportable?
- What future increments of capability are planned?
    - What are the off-ramps for requirements and technical issues?
- What is the process that ensures the program's requirements remain stable? [3.1.2.C7]

3.1.2.Q35: How does the Acquisition Strategy meet all statutory and regulatory requirements throughout the program life cycle? [3.1.2.C7]

3.1.2.Q36: How did the Acquisition Strategy change since the beginning of the SDD phase? [3.1.2.C7]

3.1.2.Q37: How has system affordability been assessed? [3.1.2.C7]

3.1.2.Q38: How has system maintainability and supportability been addressed [3.1.2.C7]

3.1.2.Q39: What are the elements of the Acquisition Strategy that will control total ownership costs?

- What is the approach taken in terms of best value to the government? [3.1.2.C7]

3.1.2.Q40: How does the sustainment plan section provide for Life Cycle Sustainment and a process to evaluate and reduce total ownership cost? [3.1.2.C8]

3.1.2.Q41: What is the influence of the Life Cycle Sustainment Outcome Metrics of materiel availability, materiel reliability, ownership costs, and mean down time in the development of the Acquisition Strategy and the establishment of the Acquisition Program Baseline? [3.1.2.C8]

3.1.2.Q42: How has the sustainment footprint optimized support resources while minimizing its "tail." [3.1.2.C8]

3.1.2.Q43: How does the Acquisition Strategy describe the plan for system life cycle sustainment consistent with operational requirements. [3.1.2.C8]

3.1.2.Q44: How does the support concept incorporate performance-based logistics? [3.1.1.C8]

3.1.2.Q45: If pertinent, how will the Acquisition Strategy satisfy operational requirements of the system and/or system of systems? [3.1.2.C8]

3.1.2.Q46: Is the maturity of the technology used in the system design an issue for the program approaching production?

- If so, what are the plans to mitigate any impacts? [3.1.2.C8]

3.1.2.Q47: What are the plans for life cycle support of software and software support systems?

- How will the software systems be supported, beginning with initial production through operational testing and deployment?
- Are software configuration control, maintenance, and upgrades consistent with computer resource and system operational requirements? [3.1.2.C8]

3.1.2.Q48: How is the approved Capability Production Document (CPD) identified?

- Does the CPD build on the CDD?

- How does the CPD address the production attributes and quantities specific to a single increment of the acquisition program?
- How does the CPD capture the results of the Critical Design Review (CDR)? [3.1.2.C9]

References
Defense Acquisition Guidebook (DAG). Chapter 4, "Systems Engineering." Defense Acquisition University, https://akss.dau.mil/dag/.
Acquisition Strategy Guide, Defense Acquisition University, June 2003.

SUB-AREA 3.2 – KNOWLEDGE-BASED DECISIONS AND MILESTONES

Description: Knowledge-based acquisition is a management approach that requires adequate knowledge at critical junctures (i.e., knowledge points) throughout the acquisition process to make informed decisions. Department of Defense (DoD) Directive 5000.1 calls for sufficient knowledge to reduce the risk associated with program initiation, system demonstration, and full-rate production. DoD Instruction 5000.2 provides a partial listing of the types of knowledge, based on demonstrated accomplishments, that enable accurate assessments of technology and design maturity, and production readiness. Implicit in this approach is the need to conduct the activities that capture relevant, product development knowledge. Such activities might cost additional time and dollars; however, knowledge provides the decision maker with higher degrees of certainty and enables the program manager to deliver timely, affordable, quality products.

The following knowledge points coincide with decisions along the acquisition framework:

- Program Initiation. Knowledge should indicate a match between the needed capability and available resources before a program starts. In this sense, resources is defined broadly, to include technology, time, and funding. Considering the knowledge associated with technology, the knowledge should be based on demonstrated accomplishments. Requiring proven technology before a program starts reduces uncertainty. Rather than address technology development and product development, the program manager and Milestone Decision Authority (MDA) can focus on product development, because they know the technology is available.
- Design Readiness Review. Knowledge should indicate that the product can be built consistent with cost, schedule, and performance parameters. This means design stability and the expectation of developing one or more workable prototypes or engineering development models.

- Production Commitment. Based on the demonstrated performance and reliability of prototypes or engineering development models, knowledge prior to the production commitment should indicate the product is producible and meets performance criteria.
- Full-Rate Production Decision. Based on the results of testing initial production articles and refining manufacturing processes and support activities, knowledge prior to committing to full-rate production should indicate the product is operationally capable; lethal and survivable; reliable; supportable; and producible within cost, schedule, and quality targets.

Scope: The assessment of this sub-area deals with the adequacy of the Acquisition Strategy to document the ground rules and assumptions that preceded and then lead to program initiation; its quality as a guide and its effectiveness in documenting program progress through periodic updates, and therefore provide a "top shelf" audit trail; and its service as a standard by which program progress can be measured.

Perspective: PMs provide knowledge about key aspects of a system at key points in the acquisition process. PMs reduce technology risk, demonstrate technologies in a relevant environment, and identify technology alternatives, prior to program initiation. They reduce integration risk and demonstrate product design prior to the Design Readiness Review. Finally, PMs reduce manufacturing risk and demonstrate producibility prior to full-rate production. A knowledge-based approach to system development efforts enables decision makers to be reasonably certain at critical junctures or "knowledge points" in the acquisition life cycle that the system products are more likely to meet established cost, schedule, and performance baselines. A knowledge-based approach therefore provides them with information needed to make sound investment decisions.

If the knowledge attained at each juncture does not confirm the business case on which the initial investment was originally justified, the project should not go forward and additional resources should not be committed. Product development efforts that do not follow a knowledge-based approach can be frequently characterized by poor cost, schedule, and performance outcomes. Milestone decision authorities use entrance and exit/success criteria to establish gates and goals for programs during an acquisition phase.
- Entrance Criteria: Each phase has defined entrance criteria that are based on the definition and validation of needed capabilities, technology maturity, system design maturation, and funding. Major decision points (e.g. MS B, C) mark the entrance into succeeding phases, with specific decision points tailored on a program-by-program basis and supported by technical and programmatic reviews.

- Exit/Success Criteria: System-specific exit criteria normally track progress in important technical, schedule, or management risk areas. Unless waived or modified by the MDA, exit criteria must be substantially satisfied for the program to continue with additional activities within an acquisition phase or to proceed into the next acquisition phase (depending on the decision with which they are associated). MDAs use exit criteria, when appropriate, to establish goals for Acquisition Category I and Acquisition Category IA programs in each acquisition phase. At each milestone decision point and review, the program manager develops and proposes exit/success criteria appropriate to the next phase or effort of the program. Exit/success criteria are program-specific accomplishments that program managers must satisfactorily demonstrate before a program can progress further in the current acquisition phase or transition to the next acquisition phase. By satisfying the exit criteria, the program manager demonstrates to the MDA that a program is on schedule to achieve its final program goals. The exit/success criteria are approved by the MDA and published in the Acquisition Decision Memorandum (ADM).
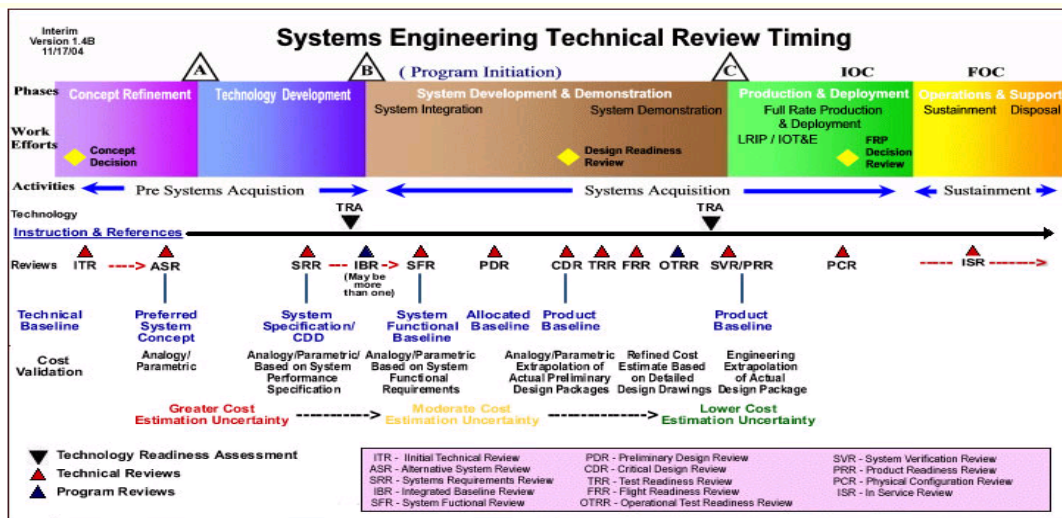
Source: NAVAIR SETR

Figure 3-1 Reviews and Milestones

Factor 3.2.1 – Statutory and Regulatory Compliance and Guidance

Pre-Milestone A

Criteria
3.2.1.C1: The statutory and regulatory report requirements for initiating the Technology Development (TD) phase are complete and are consistent with the end results of the Concept

Refinement (CR) phase (or exit/success criteria if established). *Note: The MDAs may tailor regulatory program information to fit the particular conditions of an individual program*

3.2.1.C2: The Acquisition Decision Memorandum (ADM) documents MDA approval of the Analysis of Alternatives (AoA) plan, sets a date for the Milestone B review, and establishes the exit (success) criteria for the TD phase and entrance criteria for the System Development and Demonstration (SDD) phase.

3.2.1.C3: Source selection results have considered all known environmental statutes and regulations imposed on the contractor (federal, state, and local) under full disclosure, and considered the cost implications to be consistent with the funding profile to execute the TD phase of the program.

Focus Questions

[Pertinent criteria numbers follow each question]

3.2.1.Q1: Does the PMO have a clear and concise understanding of all DoD and Service-level policies and statutes that the program must comply with? [3.2.1.C1]

3.2.1.Q2: Have the following statutory information requirements been met? Who is the approval authority and what is the approval date? *Note: See DAG for applicable statutes for each information requirement.*

- Consideration of Technology Issues
- Market Research
- Clinger-Cohen Act (CCA) Certification *Note: Required for MAIS programs only at Milestone A and for program initiation for ships*
- Registration of Mission-critical and Mission-essential Information Systems (*ships only)*
- Programmatic Environment Safety and Occupational Health Evaluation (PESCHE) *(ships only)*
- Selected Acquisition Report (SAR) *(ships only)*
- Independent Cost Estimate (ICE) and Manpower Estimate *(ships only)*
- Selected Acquisition Report (SAR) *Note: Required for MDAP programs only at Milestone A*
- Industrial Capabilities (Acquisition Strategy) *(ships only)*
- Core Logistics Analysis/Source of Repair Analysis (Acquisition Strategy) *(ships only)*
- Competition Analysis (Depot-level Maintenance $3M rule) (Acquisition Strategy) *(ships only)*
- Technology Development Strategy (TDS)
- Acquisition Program Baseline (APB) *(ships only)*
- Cooperative Opportunities (Acquisition Strategy) *(ships only)*
- Financial Management Enterprise Architecture Certification *Note: MAIS programs only.* [3.2.1.C1]

3.2.1.Q3: Have the following regulatory information requirements been met? Who is the approval authority and what is the approval date? *Note: See DAG for applicable sources for each information requirement.*

- Initial Capabilities Document (ICD)
- Capabilities Development Document (CDD) *(ships only)*
- Acquisition Strategy *(ships only)*
- Analysis of Alternatives (AoA)
- System Threat Assessment *Note: Validated by DIA for ACAT 1D programs; ships only*
- Technology Readiness Assessment (TRA) *(ships only)*
- Independent Technology Assessment *Note: ACAT 1D programs only; if required by the DUSD (S&T)*
- Command, Control, Communications, Computers, and Intelligence Support Plan (C4ISP) (Acquisition Strategy) *(ships only)*
- Component Cost Analysis *Note: Mandatory for MAIS programs; as requested for MDAP programs; ships only.*
- Cost Analysis Requirements Description (CARD) *(ships only)*
- Test and Evaluation Strategy (TES)
- Acquisition Decision Memorandum (ADM)
- Program Protection Plan (PPP) *Note: For programs with critical technology information; also summarized in the Acquisition Strategy; ships only*
- Exit (Success) Criteria
- Earned Value Management Systems (EVMS) Planning *Note: For RDT&E programs greater than $73M and procurement or O&M programs greater than $315M (in FY00 $C)* [3.2.1.C1]

3.2.1.Q4: Did the MDA tailor any regulatory information requirements in preparation for Milestone A? If the answer is yes, then how were the requirements modified? [3.2.1.C1]

3.2.1.Q5: What are the Service-specific regulatory requirements for the program?

- Are they in conflict with higher level (e.g., DoD) regulations?
- What are the impacts of any conflict to the program?
- How have these conflicts been resolved? If not, were the conflicts addressed at the OIPT level before the MDR? Were the appropriate waivers obtained to establish the official baseline under which the program is executed? [3.2.1.C1]

3.2.1.Q6: Does the PM and/or contractor have a library with all applicable government and contractor's references, compliance documents, and standards being applied to the program? [3.2.1.C1 and 3.2.1.C3]

3.2.1.Q7: When was the ADM signed? Who signed it? [3.2.1.C2]

3.2.1.Q8: What are the specific sustainment entrance and exit (success) criteria submitted as part of the ADM to the Milestone Decision Authority (MDA) for approval? [3.2.1.C2]

3.2.1.Q9: To what extent do planning for and execution of the TD phase, with the use of developmental and industrial facilities, comply with all federal, state, and local regulations and statutes for environmental and safety compliance? [3.2.1.C3]

Pre-Milestone B

Criteria

3.2.1.C4: The statutory and regulatory report requirements for initiating the System Development and Demonstration (SDD) phase are complete and are consistent with the end results (exit/success criteria) of the TD phase. *Note: The MDAs may tailor regulatory program information to fit the particular conditions of an individual program*

3.2.1.C5: The Acquisition Decision Memorandum (ADM) documents MDA approval of the program into the SDD phase, sets a date for the Milestone C review, and establishes the exit (success) criteria for the SDD phase and entrance criteria for the Production and Deployment (PD) phase.

3.2.1.C6: Source selection results have considered all known environmental statutes and regulations imposed on the contractor (federal, state, and local) under full disclosure, and considered the cost implications to be consistent with the funding profile to execute the SDD phase of the program.

Focus Questions

[Pertinent criteria numbers follow each question]

3.2.1.Q10: Does the PMO have a clear and concise understanding of all DoD and Service-level policies and statutes that the program must comply with? [3.2.1.C4]

3.2.1.Q11: Have the following statutory information requirements been met? Who is the approval authority and what is the approval date? *Note: See DAG for applicable statutes for each information requirement.*

- Consideration of technology issues
- Market research
- Clinger-Cohen Act (CCA) compliance *Note: Applies to all IT including NSS.*
- Registration of mission-critical and mission-essential information systems
- Benefit analysis and determination (Acquisition Strategy)
- Spectrum certification compliance. *Note: Applies to all systems/equipment that utilize the electromagnetic spectrum*
- Live Fire Waiver and Alternate LFT&E Plan. *Note: MDAP programs only*
- Selected Acquisition Report (SAR). *Note: MDAP programs only*

- Industrial capabilities (Acquisition Strategy)
- Competition analysis (depot-level maintenance $3M rule) (Acquisition Strategy)
- Technology Development Strategy (TDS)
- Acquisition Program Baseline (APB)
- Cooperative opportunities (Acquisition Strategy)
- Clinger-Cohen Act Certification. *Note: MAIS programs only*
- Financial Management Enterprise Architecture Certification. *Note: MAIS programs only* [3.2.1.C4]

3.2.1.Q12: Have the following regulatory information requirements been met? Who is the approval authority and what is the approval date? *Note: See DAG for applicable sources for each information requirement.*

- Initial Capabilities Document (ICD)
- Capabilities Development Document (CDD)
- Acquisition Strategy
- Analysis of Alternatives (AoA) *Note: Updated as needed*
- System Threat Assessment *Note: Validated by DIA for ACAT 1D programs*
- Technology Readiness Assessment (TRA) *[ships only]*
- Independent Technology Assessment *Note: ACAT 1D programs only; if required by the DUSD (S&T)*
- Command, Control, Communications, Computers, and Intelligence Support Plan (C4ISP) (Acquisition Strategy)
- Component Cost Analysis *Note: Mandatory for MAIS programs; as requested for MDAP programs*
- Cost Analysis Requirements Description (CARD)
- Test and Evaluation Master Plan (TEMP)
- Operational Test Agency Report of OT&E results, as applicable
- Acquisition Decision Memorandum (ADM)
- Program Protection Plan (PPP) *Note: For programs with critical technology information; also summarized in the Acquisition Strategy*
- Exit (Success) Criteria
- Earned Value Management Systems (EVMS) Planning *Note: RDT&E programs greater than $73M and procurement or O&M programs greater than $315M (in FY00 $C)* [3.2.1.C4]

3.2.1.Q13: Did the MDA tailor any regulatory information requirements tailored in preparation for Milestone B? If the answer is yes, then how were the requirements modified? [3.2.1.C4]

3.2.1.Q14: What are the Service-specific regulatory requirements for the program?

- Are they in conflict with higher level (e.g., DoD) regulations?

- What are the impacts of any conflict to the program?
- How have these conflicts been resolved? If not, were the conflicts addressed at the OIPT level before the MDR? [3.2.1.C4]

3.2.1.Q15: How are the statutory and regulatory report requirements imposed on the program factored in to the Integrated Master Plan/Integrated Master Schedule (IMP/IMS)?

- Are they consistent with the exit criteria specified for the current phase of the program? [3.1.2.C4]

3.2.1.Q16: When was the ADM signed? Who signed it? [3.2.1.C5]

3.2.1.Q17: What are the specific sustainment entrance and exit (success) criteria submitted as part of the ADM to the MDA for approval? [3.2.1.C5]

3.2.1.Q18: Have the source selection results considered all known environmental statutes and regulations imposed on the contractor (federal, state, and local) under full disclosure, and considered the cost implications to be consistent with the funding profile to execute the current phase of the program? [3.2.1.C6]

3.2.1.Q19: To what extent does planning for and execution of the SDD, with the use of developmental and industrial facilities, comply with all federal, state, and local regulations and statutes for environmental and safety compliance? [3.2.1.C6]

Pre-Milestone C

Criteria

3.2.1.C7: The program has completed the statutory and regulatory report requirements for initiating the Production and Deployment (PD) phase, and the requirements are consistent with the end results (exit/success criteria) of the SDD phase. *Note: The MDAs may tailor regulatory program information to fit the particular conditions of an individual program.*

3.2.1.C8: The Acquisition Decision Memorandum (ADM) documents MDA approval of the program into the PD phase, sets a date for the full-rate production (FRP) review, and establishes the exit (success) criteria for the PD phase.

3.2.1.C9: Source selection results have considered all known environmental statutes and regulations imposed on the contractor (federal, state, and local) under full disclosure, and have considered the cost implications to be consistent with the funding profile to execute the PD phase of the program.

Focus Questions

[Pertinent criteria numbers follow each question]

3.2.1.Q20: Does the PMO have a clear and concise understanding of all DoD and Service-level policies and statutes that the program must comply with? [3.2.1.C7]

3.2.1.Q21: Have the following statutory information requirements been met? Who is the approval authority and what is the approval date? *Note: See DAG for applicable statutes for each information requirement*

- Consideration of technology issues
- Clinger-Cohen Act (CCA) compliance. *Note: all IT including NSS and if milestone is equivalent to a FRP decision*
- Registration of mission-critical and mission-essential information systems. *Note: if milestone is equivalent to a FRP decision*
- Benefit Analysis and Determination (Acquisition Strategy). *Note: If no Milestone B*
- Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE), including National Environmental Policy Act
- Spectrum Certification Compliance. *Note: Applies to all systems/equipment that utilize the electromagnetic spectrum and if there is no Milestone B*
- Selected Acquisition Report (SAR). *Note: MDAP programs only; within the first quarter following Milestone C*
- Industrial capabilities (Acquisition Strategy)
- Independent Cost Estimate (ICE) and Manpower Estimate. *Note: MDAP programs only*
- Core Logistics Analysis/Source of Repair Analysis (Acquisition Strategy). *Note: If there was no Milestone B*
- Competition Analysis (Depot-level Maintenance $3M rule) (Acquisition Strategy). *Note: If there was no Milestone B*
- Technology Development Strategy (TDS)
- Acquisition Program Baseline (APB)
- Cooperative opportunities (Acquisition Strategy)
- Clinger-Cohen Act certification. *Note: MAIS programs only*
- Financial Management Enterprise Architecture certification *Note: MAIS programs only* [3.2.1.C7]

3.2.1.Q22: Have the following regulatory information requirements been met? Who is the approval authority and what is the approval date? *Note: See DAG for applicable sources for each information requirement*

- Initial Capabilities Document (ICD). *Note: if Milestone C is program initiation*
- Capability Production Document (CPD)
- Acquisition Strategy
- Analysis of Alternatives (AoA). *Note: Updated as needed*
- System Threat Assessment. *Note: Validated by DIA for ACAT 1D programs*
- Technology Readiness Assessment (TRA)

- Command, Control, Communications, Computers, and Intelligence Support Plan (C4ISP) (Acquisition Strategy)
- Affordability assessment
- Component Cost Analysis. *Note: Mandatory for MAIS programs; as requested for MDAP programs*
- Cost Analysis Requirements Description (CARD)
- Test and Evaluation Master Plan (TEMP). *Note: Update as necessary*
- Operational Test Agency Report of OT&E results, as applicable
- Program Protection Plan (PPP) (Acquisition Strategy). *Note: For programs with critical technology information; also includes Anti-Tamper Annex*
- Acquisition Decision Memorandum (ADM)
- Program Protection Plan (PPP). *Note: for programs with critical technology information; also summarized in the Acquisition Strategy*
- Exit (success) criteria
- Defense Acquisition Executive Summary (DAES) [3.2.1.C7]

3.2.1.Q23: Were any regulatory information requirements tailored by the MDA in preparation for Milestone C? If the answer is yes, then how were the requirements modified? [3.2.1.C7]

3.2.1.Q24: What are the Service-specific regulatory requirements for the program?

- Are they in conflict with higher level (e.g., DoD) regulations?
- What are the impacts of any conflict to the program?
- How have these conflicts been resolved? If not, were the conflicts addressed at the OIPT level before the MDR? [3.2.1.C7]

3.2.1.Q25: When was the ADM signed? Who signed it? [3.2.1.C8]

3.2.1.Q26: What are the specific entrance and exit (success) criteria submitted as part of the ADM to the MDA for approval? [3.2.1.C8]

3.2.1.Q27: Have the source selection results considered all known environmental statutes and regulations imposed on the contractor (federal, state, and local) under full disclosure, and considered the cost implications to be consistent with the funding profile to execute the current phase of the program? [3.2.1.C9]

3.2.1.Q28: To what extent does planning for and execution of the SDD, with the use of developmental and industrial facilities, comply with all Federal, State, and Local Regulations and Statutes for environmental and safety compliance? [3.2.1.C9]

References

Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.
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Factor 3.2.2 – Entrance and Exit/Success Criteria

Pre-Milestone A

Criteria

3.2.2.C1: Entrance Criteria into the CR phase – there is a validated Initial Capabilities Document (ICD) and an approved plan for conducting an Analysis of Alternatives (AoA) for the selected concept approved in the ICD.

3.2.2.C2: Entrance Criteria into the TD phase – there is an approved Technology Development Strategy (TDS) and an initial concept has been selected.

3.2.2.C3: Entrance Criteria into reviews, technical and programmatic (i.e., Initial Technical Review (ITR), Alternate System Review (ASR), System Requirements Review (SRR), Integrated Baseline Review (IBR), and Technology Readiness Assessment (TRA)), conducted in support of specific decision points in the CR and TD phases, have been successfully met.

3.2.2.C4: Exit/Success Criteria from CR phase – documented system and program capability requirements that balance capability, life cycle cost, and supportability. The initial Acquisition Strategy, including the high-level product support strategy, is defined.

3.2.2.C5: Exit/Success Criteria from CR phase – all reviews, technical and programmatic (i.e., ITR and ASR), in support of specific decision points have been successfully conducted with valid documentation, data and analyses.

Focus Questions

[Pertinent criteria numbers follow each question]

3.2.2.Q1: How did the ICD document the lessons learned and cost drivers of current systems, and/or constraints that impact the supportability-related design requirements of the planned system? [3.2.2.C1]

3.2.2.Q2: Was the critical performance-sustainment link emphasized in the ICD? Were desired user capabilities defined in terms not only of objective metrics (e.g. speed, lethality) of performance to meet mission requirements, but also the full range of operational requirements (logistics footprint, supportability criteria) to sustain the mission over the long term? [3.2.2.C1]

3.2.2.Q3: Did the AoA consider, among other factors – affordability, technology maturity, and responsiveness? [3.2.2.C1]

3.2.2.Q4: Are the risks for TD known and manageable? [3.2.2.C2 and 3.2.2.C5]

3.2.2.Q5: Is the TD work effort executable within the existing budget? [3.2.2.C2 and 3.2.2.C5]

3.2.2.Q6: Did the MDA approve the selection of a preferred strategy resulting from the AoA and the associated TDS? *Note: The ICD, AoA, and TDS are all key documents for entry into Technology Development Phase at Milestone A* [3.2.2.C2]

3.2.2.Q7: What are the Technology Readiness Levels of the system, subsystems, or components? *Note: System ≥ 4; subsystems ≥ 6, and components ≥ 8* [3.2.2.C2]

3.2.2.Q8: In preparation for the ITR, were independent subject matter experts (SMEs) available for the review of each of the identified cost drivers?

- Were these SMEs drawn from the correct technical competencies that specialize in each of the areas addressed in the Cost Analysis Requirements Description (CARD)-like document? [3.2.2.C3]

3.2.2.Q9: In preparation for the ASR, what alternative systems were evaluated during the CR phase?

- Do the stakeholders have an understanding of available system concepts to meet capabilities described in the ICD and the affordability, operational effectiveness, and technology risks inherent in each alternative concept? [3.2.2.C3]

3.2.2.Q10: In preparation for the SRR, are all system requirements and performance requirements derived from the ICD or draft Capabilities Development Document (CDD) defined and consistent with cost (program budget), schedule (program schedule), risk, and other system constraints? [3.2.2.C3]

3.2.2.Q11: In preparation for the SRR, have Computer Software Configuration Item (CSCI) requirements and operational concept been identified? [3.2.2.C3]

3.2.2.Q12: In preparation for the IBR:

- Is the technical scope of work fully included and consistent with authorizing documents?
- Are key project schedule milestones identified, and do supporting schedules reflect a logical flow to accomplish the work?
- Are resources (budgets, facilities, personnel, skills, etc.) available and adequate for the assigned tasks?
- Are tasks planned, and can they be measured objectively relative to the technical progress?
- Is the rationale underlying the Program Measurement Baseline reasonable?
- Do management processes support successful execution of the project? [3.2.2.C3]

3.2.2.Q13: In preparation for the TRA, have all Critical Technology Elements (CTEs) been identified (e.g., specific technologies on which a system depends to meet system operational threshold requirements in development, production, and operation, and whether the technology or its application is either new or novel)? [3.2.2.C3]

3.2.2.Q14: How were the initial concepts refined and the TDS developed in the CR phase? [3.2.2.C4]

3.2.2.Q15: How did the execution of the pre-acquisition CR phase influence the supportability and affordability of weapon systems? *Note: By balancing threat scenarios, technology opportunities, and operational capabilities* [3.2.2.C4]

3.2.2.Q16: Did the following information and documents result from the systems engineering (SE) process during the CR phase? What was the quality of each product?

- Preliminary System Specification
- Test and Evaluation Strategy
- Systems Engineering Plan
- Systems Safety Analyses
- Support and Maintenance Concepts and Technologies
- Inputs to the draft Capability Development Document
- Inputs to TDS
- Inputs to AoA
- Inputs to Cost and Manpower Estimate [3.3.3.C4]

3.2.2.Q17: What were the results of the PM's assessment of the selected concept and technology with regard to their ability to facilitate the use of embedded diagnostics, prognostics, and similar maintenance enablers? [3.2.2.C4]

3.2.2.Q18: Is the program schedule executable (technical/cost risks)? [3.2.2.C4]

3.2.2.Q19: As a result of the ITR, is the program's technical baseline sufficiently rigorous to support a valid cost estimate (with acceptable cost risk) and to enable an independent assessment of that estimate by cost, technical, and subject matter experts? [3.2.2.C5]

3.2.2.Q20: Is the program, as captured in the CARD-like document, executable? Is the program schedule executable (technical/cost risks)? [3.2.2.C5]

3.2.2.Q21: As a result of the ASR, does the resulting set of requirements agree with the customer needs and expectations, and can the system under review proceed into the TD phase? [3.2.2.C5]

3.2.2.Q22: As a result of the ASR, are the system software scope and complexity sufficiently understood and addressed in the planning for the TD phase to enable an acceptable/manageable level of software technical risk? [3.2.2.C5]

3.2.2.Q23: As a result of the ASR, has a preliminary system specification, consistent with technology maturity and the proposed program cost and schedule, captured the system technical baseline? [3.2.2.C5]

Pre-Milestone B

Criteria

3.2.2.C6: Entrance Criteria into the System Development and Demonstration (SDD) phase: Program is fully funded, as defined as inclusion of the dollars and manpower needed for all current

and future efforts to carry out the acquisition and support strategies. Program has all documentation required for entrance into SDD.

3.2.2.C7: Entrance Criteria into technical and programmatic reviews (e.g., IBR, SRR, System Functional Review (SFR), Software Specification Review (SSR), Preliminary Design Review (PDR), Design Readiness Review (DRR), Critical Design Review (CDR), Test Readiness Review (TRR), System Verification Review (SVR), Production Readiness Review (PRR), and TRA), in support of specific decision points conducted during the SDD phase, have been successfully met.

3.2.2.C8: Exit/Success Criteria from TD phase: Successful development, maturation, and evaluation of the technologies needed for the capability under consideration. The maturation of the required technologies is consistent with the prescribed Technology Readiness Levels (TRLs).

3.2.2.C9: Exit/Success Criteria for technical and programmatic reviews conducted during TD phase (i.e., SRR, IBR and TRA), in support of decision points were successfully conducted with valid documentation, data, and analyses.

Focus Questions

[Pertinent criteria numbers follow each question]

3.2.2.Q24: Is the program fully funded – defined as the inclusion of the dollars and manpower needed for all current and future efforts to carry out the acquisition and support strategies? [3.2.2.C6]

3.2.2.Q25: As a result of the CR and TD phases, what key performance and related support parameters (availability, reliability, maintainability, interoperability, manpower, and deployment footprint – the overall capability of the system to perform and endure in the required mission operational environment) were identified for inclusion in the CDD? [3.2.2.C6]

3.2.2.Q26: Are all test facilities and resources (including testers, lab test stations, hardware, and software) ready and available to support operational testing within the defined schedule? [3.2.2.C6]

3.2.2.Q27: What are the Technology Readiness Levels of the system, subsystems, or components? *Note: System $\geq$ 6; subsystems $\geq$ 8, and components $\geq$ 9* [3.2.2.C6]

3.2.2.Q28: In preparation for the IBR, is there a plan that identifies key responsibilities, required technical expertise, training, review dates, scope, documentation needs, disposition of findings, and procedures for risk identification, documentation, and incorporation into the project Risk Management Plan (RMP)? [3.2.2.C7]

3.2.2.Q29: In preparation for the IBR, are the following documents and information present and usable, and activities accomplished?

- A contract that includes provisions for EVMS and for conducting an IBR
- An experienced multifunctional team assembled
- A PMB that reflects the entire scope of work documented at the appropriate level of detail
- A first Cost Performance Report (CPR)

- Identification of the PM's expectations and assumptions
- Identification of the risks associated with technical, schedule, cost resources, or management processes
- Training of the IBR team
- Definition of the functional, performance, and physical attributes of the items below system level and to allocate them to the physical elements that will perform the functions [3.2.2.C7]

3.2.2.Q30: In preparation for the IBR, were the following documents provided by the contractor to the government for review?

- Statement of Work (SOW)
- Contractor Work Breakdown Structure WBS
- Contractor WBS (CWBS) Dictionary
- Control Account Plans (CAPs)
- Variance Thresholds for reporting
- Undistributed budget logs
- Earned value methods
- Organizational breakdown structure (OBS)
- Work Authorization Documents (WADs)
- Integrated Master Schedule
- Management Reserve Logs
- Responsibility Assignment Matrix (RAM)
- Earned value measurement criteria [3.2.2.C7]

3.2.2.Q31: Can the PM describe the purpose of the SRR? *Note: The SRR ensures consistency between the system requirements and the preferred system solution and available technologies. It ensures that the system requirements have been completely and properly identified and that there is a mutual understanding between the government and contractor. The SRR is intended to confirm that the user's requirements have been translated into system-specific technological requirements, that critical technologies are identified, required technology demonstrations are planned, risks are well understood, and mitigation plans are in place [3.2.2.C7]*

3.2.2.Q32: In preparation for the SRR, were the following actions completed?

- Successful completion of all post-award activities
- Published agenda (several weeks prior to the conference – to permit sufficient time for government preparation
- Draft system specification and any initial draft performance item specifications
- Functional analysis (top level block diagrams)
- Feasibility analysis (results of technology assessments and trade studies to justify system design approach)

- System maintenance concept
- Significant system design criteria (e.g., reliability, maintainability, affordability, logistics requirements)
- Systems engineering planning
- TEMP
- Draft top-level Technical Performance Measurement; and system design documentation (e.g., layout drawings, conceptual design drawings, and selected supplier components data) [3.2.2.C7]

3.2.2.Q33: In preparation for the SFR, were the following activities/actions completed or documents/information available?

- Functional analysis and allocation of requirements to items below system level
- Draft item performance and some item detail specifications
- Design data refining the overall system
- Verification that the risks associated with the system design are acceptable levels for engineering development
- Verification that the design selections have been optimized through appropriate trade study analysis
- Supporting analyses (e.g., logistics, human systems integration (HSI), etc.), and plans are identified and completed where appropriate
- Technical Performance Measurement (TPM) data and analysis
- Plans for evolutionary design and development are in place and the system design is modular and open
- Verification that the system specification reflects requirements that will meet user expectations [3.2.2.C7]

3.2.2.Q34: In preparation for the SSR, were the following activities/actions completed or documents/information available?

- Successful completion of all actions related to the SRR
- Finalized Computer Software Configuration Item (CSCI) requirements and operational concept
- Sufficiently defined CSCI requirements to enable an evaluation of the contractor's responsiveness to and interpretation of the system, segment, or prime item level requirements
- Draft system specification reflecting the operational requirements [3.2.2.C7]

3.2.2.Q35: In preparation for the PDR, were the following activities/actions completed or documents/information available?

- Successful completion of all action items related to the SRR

- Subsystem requirements
- Subsystem preliminary design, results of peer reviews
- Satisfactory plans for development and testing
- ~15% of production drawings are released
- Item performance specifications
- Draft item detail, process and material specifications
- Design data defining major subsystems, equipment, software, and other system elements
- Analyses, reports, "ility" analyses, trade studies, logistics support analysis data, and design documentation
- TPM data and analysis
- Engineering breadboards, laboratory models, test models, mockups, and prototypes used to support the design
- Supplier data describing specific components
- Design reliability
- Design maintainability
- Equipment and part standardization
- Value engineering
- Test results
- Spares and government-furnished property (GFP)
- Technical manuals [3.2.2.C7]

3.2.2.Q36: In preparation for the DDR, is the design of sufficient maturity to determine whether a program should enter System Development and Demonstration phase? [3.2.2.C7]

3.2.2.Q37: In preparation for the CDR, were the following activities/actions completed or documents/information available?

- Successful completion of all action items related to the previous conference (PDR).
- Published agenda (several days prior to the conference).
- Acceptance of all applicable CDRLs.
- See the contract for specific criteria that may be unique to the program
- Draft Production Baseline ("Build To" documentation)
- Determine if the system design documentation (Product Baseline, including Item Details
- Specs, Material Specs, Process Specs) is satisfactory to start initial manufacturing
- Test plans are reviewed to assess if test efforts are developing sufficiently to indicate the Test Readiness Review will be successful
- Product Baseline captured in the detailed design documentation
- ~75% to 90% of (manufacturing quality) product drawings and associated instructions are complete.

- 100% of all airworthiness critical component (critical safety items and critical application items) drawings are complete [3.2.2.C7]

3.2.2.Q38: In preparation for the TRR, were the following activities/actions completed or documents/information available?

- Test objectives and scope approved
- Test methods and procedures approved
- Compliance with safety requirements
- Confirmation that required test resources have been properly identified and coordinated in support of planned tests
- Traceability of planned tests to program requirements and user needs is established
- All applicable documentation completed and controlled (e.g., requirements, design, test procedures, version description document)
- Methods for documenting and disposition of test anomalies approved
- Requirements being tested are identified
- Traceability of test requirements to the specifications established
- All CSCI and HWCI level test procedures completed
- Objectives of each test identified
- Methods for documenting and disposition test anomalies acceptable. [3.2.2.C7]

3.2.2.Q39: In preparation for the SVR, were the following activities/actions completed or documents/information available?

- Functional and allocated baselines
- Readiness issues for continuing design, continuing verifications, production, training, deployment, operations, support, and disposal resolved
- Verification comprehensive and complete
- Configuration audits, including completion of all change actions, completed for all CIs
- Risk management planning updated for production
- Systems Engineering planning updated for production
- Critical achievements, success criteria, and metrics established for production
- Test procedures and results completed
- Preproduction and production test results completed [3.2.2.C7]

3.2.2.Q40: In preparation for the PRR, were the following activities/actions completed or documents/information available?

- Preliminary steps taken well in advance of the PRR to ensure timely availability of the information to be evaluated

- The contractor of a prime contract for system development and demonstration of the system; and of contracts for major government-furnished components of the system, has provided appropriate assistance for the PRR
- The developer's design complete
- Production planning documentation, existing and planned facilities, tools, tooling and test equipment, manufacturing methods and controls, material and manpower resources, production engineering, quality control and assurance provisions, production management organizations, and controls over major subcontractors completed
- Contractor's organization and plans for managing the production effort defined [3.2.2.C7]

3.2.2.Q41: In preparation for the TRA, have the following been provided or are they available for the assessment?

- Program WBS of the entire system available
- CTEs identified
- A conceptual or established baseline design configuration approved
- An objective scoring of the levels of technology maturity for each CTE by subject matter experts completed [3.2.2.C7]

3.2.2.Q42: How was technology risk reduced in the TD phase?

- How did the PM determine the appropriate set of technologies to be integrated into a full system?
- Is the maturity of the selected technologies consistent with the prescribed TRLs? [3.2.2.C8]

3.2.2.Q43: Did the assessment and demonstration of technology risk include those related to supportability? [3.2.2.C8]

3.2.2.Q44: Are the risks known and manageable within the cost estimate? [3.2.2.C8]

3.2.2.Q45: Were needed technologies demonstrated in a relevant environment, to include the demonstration of key supportability-related characteristics of the end item as well as new technologies required to reduce logistics footprint and cost-effectively support the system? [3.2.2.C8]

- 3.2.2.Q46: Can the system requirements, as disclosed, satisfy the ICD or draft Capabilities Development Document (CDD)? [3.2.2.C8]

3.2.2.Q47: Did the following information and documents result from the systems engineering (SE) process during the TD phase? What was the quality of each product?

- Preliminary System Specification
- Life-Fire T&E Waiver request
- Test and Evaluation Strategy
- Risk Assessment

- Systems Engineering Plan

- Programmatic Environment Safety and Occupational Health Evaluation (PESHE)

- NEPA Compliance Schedule

- Program Protection Plan

- Technology Readiness Assessment

- Validated System Support and Maintenance Objectives and Requirements

- Footprint Reduction

- Inputs to IBR

- Inputs to Information Support Plan

- Inputs to System Threat Assessment

- Inputs to the CDD

- Inputs to the Acquisition Strategy

- Inputs to the Affordability Assessment

- Inputs to the Cost and Manpower Estimate [3.2.2.C8]

3.2.2.Q48: Did the following result from the SRR?

- An approved preliminary system performance specification

- A preliminary allocation of system requirements to hardware, human, and software subsystems

- Identification of all software components (tactical, support, deliverable, non-deliverable)

- A comprehensive risk assessment for the SDD phase

- An approved SDD SEP that addresses cost and critical path drivers

- An approved Product Support Plan with updates applicable to this phase [3.2.2.C9]

3.2.2.Q49: As a result of the SRR, can the system requirements, as disclosed, satisfy the ICD or draft CDD? [3.2.2.C9]

3.2.2.Q50: As a result of the SRR, are the system requirements sufficiently detailed and understood to enable system functional definition and functional decomposition? [3.2.2.C9]

3.2.2.Q51: As a result of the SRR, is there an approved system performance specification? [3.2.2.C9]

3.2.2.Q52: As a result of the SRR, are adequate processes and metrics in place for the program to succeed? [3.2.2.C9]

3.2.2.Q53: As a result of the SRR, is the program schedule executable (technical and/or cost risks)? [3.2.2.C9]

3.2.2.Q54: As a result of the IBR, did the contractor establish an initial system-level functional baseline? *Note: Once that baseline is established, the effort begins to define the functional, performance, and physical attributes of the items below system level and to allocate them to the physical elements that will perform the functions* [3.2.2.C9]

3.2.2.Q55: As a result of the IBR, were the following activities/actions completed or information gathered? If yes, what is the "quality" of the product?

- Technical scope of work is fully included and is consistent with authorizing documents
- Key project schedule milestones are identified and supporting schedules reflect a logical flow to accomplish the work
- Resources (budgets, facilities, personnel, skills) are available and are adequate for the assigned tasks
- Tasks are planned and can be measured objectively relative to technical progress
- Rationales underlying Program Measurement Baseline are reasonable
- Management processes support successful execution of the project [3.2.2.C9]

3.2.2.Q56: As a result of the TRA, were Critical Technology Elements (CTEs) identified through a comprehensive review using the program WBS? [3.2.2.C9]

Pre-Milestone C

Criteria

3.2.2.C10: Entrance Criteria into the Production and Deployment (PD) phase: Program is fully funded, as defined as inclusion of the dollars and manpower needed for all current and future efforts to carry out the acquisition and support strategies; has all documentation required for entrance into PD; the system design is sufficient to initiate production; system-level technical requirements have been demonstrated to be adequate for the acceptable operational capability; supportability strategy is fully defined, a Product Support Integrator (PSI) has been selected, and performance-based logistics (PBL) agreements that reflect performance, support, and funding expectations are documented and signed; and funding has been identified and dedicated to testing .

3.2.2.C11: Entrance Criteria into reviews, technical and programmatic (i.e., PRR, Functional Configuration Audit (FCA)/SVR, Physical Configuration Audit (PCA), TRR (IOT&E), FRP and supportability demonstrations, in support of specific decision points conducted during the PD phase, have been successfully met.

3.2.2.C12: Exit/Success Criteria from SDD phase – documented program capability requirements that balance capability, life cycle cost, and supportability. The system has been developed; integration and manufacturing risks have been reduced; the system is operationally supportable with particular attention to reducing the logistics footprint; human systems integration (HSI) has been implemented; the system design is producible and affordable; the system design requirements are developed down to the major subsystem level; critical program information (CPI) is protected; and system integration, interoperability, safety, and utility have been demonstrated.

Also, program and the system architectures are defined based upon the selection and integration of the mature technology suite accomplished during the CR and TD phases.

3.2.2.C13: Exit/Success Criteria for technical and programmatic reviews conducted during SDD (i.e., SRR, SFR, PDR, DRR, CDR, TRR, SVR, and PPR), in support of decision points were successfully met with valid documentation, data and analyses.

Focus Questions

[Pertinent criteria numbers follow each question]

3.2.2.Q57: Is the program fully funded through the POM and EPP years? [3.2.2.C10]

3.2.2.Q58: Are all test facilities and resources ready and available to support operational testing within the defined schedule? [3.2.2.C10]

3.2.2.Q59: What are the Technology Readiness Levels of the system, subsystems or components at Milestone C? *Note: System $\geq$ 8; subsystems $\geq$ 9, and components $\geq$ 9.* At FRP? *Note: System $\geq$ 9; subsystems $\geq$ 9, and components $\geq$ 9* [3.2.2.C10]

3.2.2.Q60: What is the Engineering and Manufacturing Level (EMRL) at Milestone-C, at FRP? *Note: EMRL – 3 and ERML – 4, respectively*

3.2.2.Q61: In preparation for the PRR, were the following activities/actions completed or documents/information available?

- Preliminary steps taken well in advance of the PRR to ensure timely availability of the information to be evaluated
- The contractor of a prime contract for system development and demonstration of the system; and of contracts for major government-furnished components of the system shall be required to provide appropriate assistance for the PRR
- The developer's complete design
- Production planning documentation, existing and planned facilities, tools, tooling and test equipment, manufacturing methods and controls, materiel and manpower resources, production engineering, quality control and assurance provisions, production management organizations, and controls over major subcontractors
- Contractor's organization and plans for managing the production effort
- Product design is low risk from the standpoint of producibility and has stabilized.
- Verification of the design has been accomplished, including qualification of subsystems and components as appropriate, and demonstration of performance and R&M characteristics
- A critical design review has been accomplished and discrepancies resolved
- The design is in consonance with the operational, maintenance, and support concepts, including meeting inter-service and foreign interoperability requirements

- The technical data package will permit competitive acquisition and domestic and foreign co-production, where appropriate
- Production cost projections have been made and are well supported
- Plant capacity is adequate for the required production rate, taking into consideration other production efforts
- Contractor and government-owned facilities, production equipment, special tooling, and special test equipment have been identified in terms of specifications and quantity. Acquisition and installation plans meet program requirements.
- Skilled production manpower will be available in sufficient numbers for the planned term of production. Necessary personnel training and certification are programmed
- Production schedules are compatible with end item delivery requirements
- There is demonstrated aggressiveness in applying value engineering and in seeking cost reduction improvements
- Alternative production approaches are available to meet contingency needs.
- Drawings, standards, and shop instructions are sufficiently explicit for correct interpretation by manufacturing personnel. Configuration management is adequate to ensure configuration identification, control, and status accounting during product
- Provisions have been made for determining producibility and cost impacts of engineering changes introduced during production
- A production manager has been assigned the authority and responsibility for manufacture and delivery of the system, and the functional elements and organizational staff have been identified. Policies and procedures have been documented
- A complete and accurate bill of materials has been prepared. "Make-or-buy" determinations have been made for all significant elements of the system and are supported by sound justifications
- Long lead-time materials identified, and action initiated for advance procurement where appropriate. Sole source items are identified, and continuity of supply is ensured
- Government-furnished material or equipment (GFM/GFE) identified and fully integrated into program and production plans, including associated lead-time and schedule requirements.
- The contractor's quality program is in accordance with the contract requirements and the quality plan is appropriate for the production program. Necessary quality control procedures and quality acceptance criteria established.
- Capacity exists to manufacture initial and replenishment spares, including contingencies for high usage items during initial deployment
- Training aids, simulators, and other devices for operator and maintenance personnel have been developed and can be produced to support the system deployment schedule.

- Operator and repair manuals have been developed and will be available to support the training and fielding schedule [3.2.2.C11]

3.2.2.Q62: In preparation for the FCA(s)/SVR, were the following activities/actions completed or documents/information available?

- Functional and allocated baselines
- Readiness issues for continuing design, continuing verifications, production, training, deployment, operations, support, and disposal have been resolved
- Verification is comprehensive and complete
- Configuration audits, including completion of all change actions, have been completed for all CIs
- Risk management planning has been updated for production
- Systems Engineering planning is updated for production
- Critical achievements, success criteria, and metrics have been established for production
- Test procedures and results
- Preproduction and production test results [3.2.2.C11]

3.2.2.Q63: Can the PM describe the purpose of the PCA? *Note: The PCA establishes the product baseline as reflected in an early production CI. PCAs are conducted at the component, subsystem, and segment levels. A system-level PCA is conducted after a full set of production-representative CIs has been baselined. The PCAs verify that the production models and the supporting Technical Data Package (TDP) (functional and allocated configuration documentation) match or that corrective actions (e.g., ECPs) have been initiated* [3.2.2.C11]

3.2.2.Q64: In preparation for the PCA(s), were the following activities/actions completed or documents/information available?

- Technical data package that describes the product baseline, including:
    - The subsystem and CI PCAs have been successfully completed
    - The integrated decision database is valid and represents the product
    - All items have been published
    - Changes to previous baselines have been completed
    - Testing deficiencies have been resolved and appropriate changes implemented
    - System processes are current and can be executed [3.2.2.C11]

3.2.2.Q65: Into IOT&E, has the system demonstrated sufficient technical maturity in regard to Critical Technical Parameters (CTPs), including interoperability, documented in the Test and Evaluation Master Plan (TEMP)? [3.2.2.C11]

3.2.2.Q66: In preparation for the supportability demonstrations, were the following activities/actions completed or documents/information available?

- A test plan, or for smaller equipment, a test procedure

- Test Objectives, Test Approach, Ground Rules, Equipment to be Tested, Team Members, Schedule, Data to be Recorded, Special Rules/Criteria, Test Equipment, Induced Failures, etc. *Note: Test objectives should include, at a minimum, measurable pass/fail criteria and specify the confidence level desired from the overall test*
- Test director
- Trained maintainers
- Candidate fault list
- Production-representative equipment
- List of contractor-furnished equipment and tools
- List of government-provided equipment, tools, and information
- Validated training material
- Contractor-validated technical manuals
- Material Release to use military maintainers [3.2.2.C11]

3.2.2.Q67: Were the following criteria to enter into FRP met?

- An MDAP may not proceed beyond LRIP without approval of the MDA.
- Demonstrated control of the manufacturing process and acceptable reliability
- The collection of statistical process control data, and the demonstrated control and capability of other critical processes.
- Completion of IOT&E, submission of the Beyond LRIP Report for DOT&E Oversight
- Programs, and submission of the LFT&E Report (where applicable) to Congress, to the Secretary of Defense, and to the USD(AT&L) [3.2.2.C11]

3.2.2.Q68: Were the following key logistics information/activities updated/completed during SDD?

- Updated support strategy, sustainment funding requirements, key logistics
- parameters, and logistics testing criteria
  - As required by statute, an annual determination of the distribution of maintenance workloads
  - Updated support strategy within the ASR
  - Updated logistics criteria and parameters with the APB
  - Logistics and overall sustainment requirements as referenced in the CPD
  - Logistics parameters and test points in the TEMP
  - Acceptable performance in development, test and evaluation, and operational assessment, to include:
    - o Mature software capability
    - o Acceptable interoperability
    - o Acceptable operational supportability [3.2.2.C12]

3.2.2.Q69: Did the following information and documents result from the systems engineering process during the SDD phase? What was the quality of each product?

- Initial Product Baseline
- Test Reports
- TEMP
- Elements of Product Support
- Risk Assessment
- Technology Readiness Assessment
- Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE)
- Systems Engineering Plan
- NEPA Compliance Schedule
- Program Protection Plan
- Validated System Support and Maintenance Objectives and Requirements
- Footprint Reduction
- Inputs to IBR
- Inputs to Information Support Plan
- Inputs to System Threat Assessment
- Inputs to the Capability Production Document (CPD)
- Inputs to Cost and Manpower Estimate [3.2.2.C12]

3.2.2.Q70: Were the user's capabilities refined into actionable, and measurable system performance and supportability requirements? [3.2.2.C12]

3.2.2.Q71: Did the program meet the Manufacturing Readiness Level (MRL) of 9 prior to the FRP decision? *Note: MRL 9: system, component or item previously produced or in production. Or, the system, component or item is in LRIP. Ready for FRP* [3.2.2.C12]

3.2.2.Q72: Were the following activities from the SRR completed: published minutes to include list of attendees; completion of all action items; and concurrence from the government/contractor IPT members that all issues were addressed? [3.2.2.C13]

3.2.2.Q73: Were the following questions answered/information gathered from the results of the SFR?

- Can the system functional requirements, as disclosed, satisfy the CDD?
- Are the system requirements sufficiently detailed and understood to enable system design to proceed?
- Are adequate processes and metrics in place for the program to succeed?
- Are the risks known and manageable for development?
- Is the program schedule executable (technical and/or cost risks)?
- Is the program properly staffed?

- Is the program with the functional baseline executable within the existing budget?
- Is the updated CARD consistent with the approved functional baseline?
- Has the system Functional Baseline been established to enable preliminary design to proceed with proper configuration management?
- Is the software functionality in the approved functional baseline consistent with the updated software metrics and resource-loaded schedule? [3.2.2.C13]

3.2.2.Q74: Were the following activities from the PDR completed?

- Successful completion of all action items related to SSR
- Agenda published several days prior to the conference
- All applicable CDRLs accepted
- An established system allocated baseline
- An updated risk assessment for SDD
- An updated CARD based on the system allocated baseline
- An updated program schedule including system and software critical paths
- An approved Product Support Plan with updates applicable to SDD [3.2.2.C13]

3.2.2.Q75: Were the following questions answered/information gathered from the results of the PDR?

- Does the status of the technical effort and design indicate operational test success (operationally effective and suitable)?
- Can the preliminary design, as disclosed, satisfy the CDD or draft Capability Production Document (CPD)?
- Has the system allocated baseline been established and documented to enable detailed design to proceed with proper configuration management?
- Are adequate processes and metrics in place for the program to succeed?
- Have human integration design factors been reviewed and included, where needed, in the overall system design?
- Are the risks known and manageable for development testing and operational testing?
- Is the program executable (technical/cost risks)?
- Is the program properly staffed?
- Is the program executable with the existing budget and with the approved system allocated baseline?
- Does the updated cost estimate fit within the existing budget?
- Is the preliminary design producible within the production budget?
- Is the updated CARD consistent with the approved allocated baseline? [3.2.2.C13]

3.2.2.Q76: As a result of the DDR, is there evidence of design maturity to demonstrate the ability of the system to operate in a useful way consistent with the approved Key Performance Parameters (KPPs)? [3.2.2.C13]

3.2.2.Q77: Were the following activities from the CDR completed?

- "Frozen" design
- Acceptance of published minutes to include list of attendees.
- Completion of all action items assigned to the contractor
- Acceptance of any CDRLs due at the CDR.
- Concurrence from the government/contractor IPT members that all issues in the conference agenda have been addressed.
- Contractor sets product baseline
- An established system product baseline
- An updated risk assessment for SDD
- An updated CARD based on the system product baseline
- An approved Product Support Plan with updates applicable to the SDD phase [3.2.2.C13]

3.2.2.Q78: Were the following questions answered/information gathered from the results of the CDR?

- Does the status of the technical effort and design indicate operational test success (operationally effective and suitable)?
- Does the detailed design, as disclosed, satisfy the CDD or draft CPD?
- Has the system product baseline been established and documented to enable hardware fabrication and software coding to proceed with proper configuration management?
- Has the detailed design satisfied Human Systems Integration (HIS) requirements?
- Are adequate processes and metrics in place for the program to succeed?
- Are the risks known and manageable for developmental and operational testing?
- Is the program executable (technical/cost risks)?
- Is the program properly staffed?
- Is the program executable with the existing budget and with the approved product baseline?
- Are all the Critical Safety Items and Critical Application Items identified?
- Does the updated cost estimate fit within the existing budget?
- Is the software functionality in the approved product baseline consistent with the updated software metrics and resource-loaded schedule?
- Have key product characteristics having the most impact on system performance, assembly, cost, reliability, or safety been identified?

- Have the critical manufacturing processes that affect the key characteristics been identified and their capability to meet design tolerances determined?
- Have process control plans been developed for critical manufacturing processes? [3.2.2.C13]

3.2.2.Q79: Were the following activities from the TRR completed?

- Government approval to start testing.
- Software and hardware test descriptions and procedures defined, verified and baselined
- Planned testing is consistent with defined incremental approach including regression testing
- All test facilities and resources (including testers, (lab test stations, hardware, and software are ready and available to support software and hardware testing within the defined schedule
- The software and hardware being tested and the entire test environment are configuration controlled as applicable
- All lower level software and hardware testing has been successfully completed and documented
- Software and hardware metrics show readiness for testing
- Software and hardware problem report system is defined and implemented
- Software and hardware test baseline is established and controlled
- Software and hardware development estimates are updated
- Requirements that cannot be adequately tested at the CSCI and HWCI level (and thus require testing at the subsystem or system levels) are identified [3.2.2.C13]

3.2.2.Q80: Were the following questions answered/information gathered from the results of the TRR?

- Completed and approved test plans for the system under test
- Completed identification and coordination of required test resources
- The judgment that previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests
- Identified risk acceptable to the program leadership [3.2.2.C13]

3.2.2.Q81: Were the following questions answered/information gathered from the results of the PRR?

- Has the system product baseline been established and documented to enable hardware fabrication and software coding to proceed with proper configuration control?
- Are adequate processes and metrics in place for the program to succeed?
- Are the risks known and manageable?
- Is the program schedule executable (technical/cost risks)?

- Is the program properly staffed?
- Is the detailed design producible within the production budget? [3.2.2.C13]

3.2.2.Q82: Were the following key logistics criteria met during PD phase and prior to FRP decision?

- Mission capabilities: Reviewed and modified as final testing and configuration decisions were made. Emphasis is on the capability of the sustainment strategy to meet overall mission capability requirements
- Reliability: Mission and logistics reliability clearly meet desired metric targets while supporting the achievement of overall system performance objectives.
- Maintainability: The effective operation of diagnostics, prognostics, and performance-based maintenance arrangements are in place or in transition, meeting previously specified objectives
- Manpower and Personnel: Validated goals for both organic and contractor manpower requirements
- Final refinement of life cycle costs validated
- Cost as an Independent Variable (Performance-Support-Cost Trade-Offs)
- COTS Technology and Standards Evolution and COTS Products Market Surveillance (Technology Refreshment) [3.2.2.C13]

3.2.2.Q83: Did the PM place emphasis on implementing the product support capability to meet established warfighting capabilities? [3.2.2.C12]

References

Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.
Technical Reviews. Continuous Learning Course CLE 003. Defense Acquisition University.
USN Systems Engineering Technical Review Site, http://www.navair.navy.mil/kms/41g/.
Work Breakdown Structures for Defense Materiel Items. DoD Handbook, MIL-HDB-881A. Washington, DC: January 1998.

Factor 3.2.3 – Certifications

Pre-Milestone A

Criteria

3.2.3.C1: The program investigates and plans for the needed certifications and time lines for their completion. *Note: Examples of Certifications include: Spectrum, Airworthiness, DITSCAP, Joint Interoperability, Transportability, Clinger-Cohen, Weapon Systems Explosive Safety Review Board*

3.2.3.C2: The program understands and communicates how the certification processes is integrated with the program's design, development, and test approach.

Focus Questions:

[Pertinent criteria numbers follow each question]

3.2.3.Q1: Does the program manager have a listing of anticipated certification requirements with their time lines for initiation and completion, for the program life cycle? [3.2.3.C1]

3.2.3.Q2: Who is responsible for ensuring each certification is issued? [3.2.3.C1]

3.2.3.Q3: What activities are required to obtain the certifications? [3.2.3.C1 and 3.2.3.C2]

3.2.3.Q4: Can the program describe when all applicable certifications are required? [3.2.3.C2]

3.2.3.Q5: How much time is allotted to obtain the certifications prior to the need dates? [3.2.3.C2]

Pre–MS B and Pre-Milestone C

Criteria

3.2.3.C3: All MAIS programs must receive an updated Clinger-Cohen Certification for MS B; MDAP or other non-MAIS Mission Essential or Mission Critical IT Systems require Component "CIO Confirmation" letter of Clinger-Cohen Act (CCA) compliance.

3.2.3.C4: Spectrum Certification:

3.2.3.C4a: Spectrum Supportability Determination (reference DoDD 4650.1): Components must submit requests for Spectrum Supportability Assessment from MCEB as early as possible prior to the development or procurement of any spectrum dependent equipment or system, and fully address MCEB guidance and recommendations.

3.2.3.C4b: No spectrum-dependent systems being developed shall proceed into the System Development and Demonstration (SDD) phase without such a spectrum supportability determination unless specific authorization to proceed is granted by the USD(AT&L), or has a waiver been granted by ASD(NII).

3.2.3.C4c: No spectrum-dependent system can proceed into the Production and Deployment (PD) phase without such a spectrum supportability determination unless specific authorization to proceed is granted by the USD(AT&L), or has a waiver been granted by ASD(NII).

3.2.3.C4d: No spectrum-dependent "off-the-shelf" or other non-developmental system can be purchased or procured without such a spectrum supportability determination.

3.2.3.C4e: Programs may not procure or purchase off-the-shelf or other non-developmental spectrum-dependent systems without first requesting spectrum supportability guidance from the Military Communications-Electronics Board (pursuant to DODI 5100.35).

3.2.3.C5: DIACAP/DITSCAP - Defense Information Technology Systems/Information Assurance Certification and Accreditation - All IT and NSS must undergo Accreditation by DAA and Certification (for implementation) by CA to implement IA controls and security mechanisms as agreed by the PM, User Rep, CA and DAA in the System Security Authorization Agreement in

accordance with procedures established in DoD 8510.1M (DITSCAP Manual) as amended in CIO memo dated July 6, 2006, Interim DoD IA C&A Guidance (DIACAP).

3.2.3.C6: Joint J-6 System Validation - Required for IT or NSS with Joint Interest/Joint Integration/ACAT I. Granted upon completion of both the I&S Certification and the Joint System Interoperability Test Certification and expires 3 years from the date of the Test Certification or when subsequent program modifications change components of the net-ready KPP (NR-KPP) or supportability aspects of the system.

3.2.3.C7: Interoperability and Supportability Certification. Joint Staff/J-6 will perform IT and NSS interoperability and supportability certifications on all CDDs and CPDs designated as JROC Interest or Joint Integration.

3.2.3.C7a: Certification will include evaluation of compliance with the DoD Net-Centric Data Strategy through collaboration with the communities of interest that apply to these capabilities.

3.2.3.C7b: Joint Staff/J-6 will be the lead for validating the NR-KPP and will resolve all issues associated with the NR-KPP.

3.2.3.C8: Joint Interoperability Test Certification is provided by the JITC upon completion of testing and is valid for 3 years from the date of the certification or when subsequent program modifications change components of the NR-KPP or supportability aspects of the system.

3.2.3.C9: Munitions Insensitivity Certifications - requirement removed by CJCS I3170.01F

3.2.3.C10: Threat Validation and Intelligence Certification. All programs designated Joint Interest, or Joint Integration potential designators (JPDs) by J-8 undergo intelligence certification if they produce, consume, process, or handle intelligence, IAW CJCSI 3312.01 Series, to (a) prevent fielding of programs and capabilities that are unsupportable by intelligence architecture (Service and/or national); (b) prevent technological or scientific surprise from adversarial capabilities; and, (c) support intelligence architecture development through the earliest possible identification of likely or possible shortfalls in intelligence support availability.

3.2.3.C10a: Capability Document sponsor seek intelligence certification for its program from the Joint Staff Intelligence Capability Certification Office (J2S-4/IRCO), unless a waiver is requested and provided by IRCO.

3.2.3.C10b: ASD(NII) will initiate the staffing of all ACAT I and OSD-designated special interest ISPs through the Joint C4I Program Assessment Tool-Empowered (JCPAT-E), in accordance with DODI 4630.8 (reference h). This includes a requirement for J-2 and DIA review.

3.2.3.C11: OT&E Readiness Certification: The MDA or designee ensures that IOT&E entrance criteria, to be used to determine IOT&E readiness certification in support of each planned operational test, are developed and documented in the TEMP.

Focus Questions

[Pertinent criteria numbers follow each question]

3.2.3.Q6: Has the program office provided a CCA Confirmation letter or CCA Certification letter, or indicated pending status? [3.2.3.C3]

3.2.3.Q7: Has a Spectrum Supportability Assessment been completed? Has a determination been made? [3.2.3.C4]

3.2.3.Q8: If a spectrum supportability determination has not been made, has specific authorization to proceed into SDD been granted by the USD(AT&L), or has a waiver been granted by ASD(NII)? [3.2.3.C4]

3.2.3.Q9: Has the program provided a copy of the DD 1494 Spectrum Certification. [3.2.3.C4]

3.2.3.Q10: Did J-6 grant an Interoperability and Supportability Certification? [3.2.3.C6]

3.2.3.Q11: If NR-KPP applies to program, has KIP compliance been verified by the J-6 interoperability and supportability certification? [3.2.3.C7]

3.2.3.Q12: How is JITC interoperability testing planned in the TEMP? [3.2.3.C8]

3.2.3.Q13: If the program involves an IT or NSS system, was IA compliance confirmed by J-6 interoperability and supportability certification? [3.2.3.C6]

3.2.3.Q14: How does Security Testing and planning for an Interim Authorization to Operate (IATO) or ATO planned in the System Security Authorization Agreement (SSAA) align with the TEMP and the overall program schedule? [3.2.3.C5]

3.2.3.Q15: Does the program produce, consume, or handle intelligence information? Has J2S2-4 reviewed applicable capabilities documents, and have they granted Intelligence Certification? [3.2.3.C10]

3.2.3.Q16: Has DIA reviewed the ISP and provided threat validation? [3.2.3.C10]

3.2.3.Q17: Has the MDA, or designated office, certified IOT&E Readiness? [3.2.3.C11]

References

Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.
DoD Architecture Framework Working Group. DoD Architecture Framework, Version 1.0, August 2003.
Technical Reviews. Continuous Learning Course CLE 003. Defense Acquisition University.
USN Systems Engineering Technical Review Site, http://www.navair.navy.mil/kms/41g/#.

SUB-AREA 3.3 – PROGRAM AND PROJECT MANAGEMENT

Description: Program/Project Management is the process whereby a single leader exercises centralized authority and responsibility for planning, organizing, staffing, controlling, and leading the combined efforts of participating/assigned civilian and military personnel and organizations,

for the management of a specific defense acquisition program or programs, through development, production, deployment, operations, support, and disposal. Program management must first take into account diverse interests and points of view. Second, it facilitates tailoring the management system and techniques to the uniqueness of the program. Third, it represents the integration of a complex system of differing but related functional disciplines, such as business, cost estimating, and financial management; logistics; systems engineering; information technology; test and evaluation; production, quality, and manufacturing management; contracting; and others, that must work together to achieve program goals.

Scope: This assessment includes all aspects of program/project management involved in the accomplishment of the program's objectives, including the entire system life cycle (design to disposal) and supportability, life cycle costs, performance, and schedule.

Perspective: Program management provides for a single point of contact, the program manager, who is the major force for directing the system through its evolution, including design, development, production, deployment, operations and support, and disposal. The program manager, while perhaps being unable to control the external environment, has management authority over business and technical aspects of a specific program. The program manager has only one responsibility—managing the program—and accountability is clear.

The Defense industry typically follows a management process similar to that used by DoD. Often contractors will staff and operate their program office to parallel that of the government program they support.

Integrated product and process development is a management process that integrates all activities from the concept of a new defense system through the entire life cycle, using multidisciplinary teams, called Integrated Product Teams (IPTs).

An IPT is composed of representatives from all appropriate functional disciplines working together with a team leader to facilitate management of acquisition programs. Integrated product teams exist at the oversight and review levels, as well as at the program office level. Program office level integrated product teams may be structured around the major design aspects of the system under development, such as an "engine Integrated Product Team," or processes like a "test Integrated Product Team." Following contract award, program-level IPTs often include contractor participation.

The DoD has recognized the importance of integrated product teams as a means to aid the program manager, and as a way to streamline the decision process. By working as part of cross-functional teams, issues can be identified and resolved more quickly, and stakeholder involvement in the overall success of the program can be maximized. In this way the program manager capitalizes on the strengths of all the stakeholders in the defense acquisition system.

Factor 3.3.1 – Program Plan/Schedule

Pre-Milestone A

Criteria

3.3.1.C1: The Integrated Master Plan (IMP) is an event-driven plan that documents the significant accomplishments necessary to complete the work and ties each accomplishment to a key program event that forms the foundation of the Integrated Master schedule (IMS). *Note: The IMP Events are not tied to calendar dates; each event is completed when its supporting Accomplishments are completed and as evidenced by the Criteria completion supporting each of those Accomplishments.*

 3.3.1.C1a: The IMP is used as a tool in the development of the overall program structure and organization, and to monitor program progress.

- During source selection, the IMP is used to evaluate the offeror's proposed approach, management, and planning capability, and to assess the risk associated with the phase of the program.
- After contract award, the IMP provides the baseline for key events, serves as a control mechanism, and is the basis for incentives.

3.3.1.C1b: The IMP has the following attributes:

- Expands and complements Design Requirements and the SOW in a WBS format
- Linked to Risk Mitigation Plan; level of detail consistent with risk and complexity
- Provides for Evaluation of Program Maturity
- Linked to Technical Performance Measures
- Integrates Functional Activities
- Incorporates major subcontractor IMP
- Provides insight into the overall effort

3.3.1.C2: The Integrated Master Schedule (IMS) is an integrated and networked multi-layered schedule of program tasks required to complete the work effort captured in a related IMP. The IMS should include all IMP events and accomplishments and support each accomplishment

closure criteria. It provides detailed insight into program planning through support to the initial risk assessment and as a tracking and statusing tool during program execution. *Note: It is a top level tool to show performance-oriented progress during program execution and is linked to WBS, work packages, and incentives*

3.3.1.C2a: The IMS has the following attributes:

- Maintains consistency with the IMP
- Illustrates the relationship among events, accomplishments, criteria and tasks
- Indicates the start and completion dates and duration for each event, accomplishment, criteria and task
- Provides for the critical path analysis
- Provides the ability to sort schedules multiple ways (e.g., by event, by IPT, by WBS, by EVMS, by SOW, or by CWBS)
- Provides schedule updates on a regular basis that indicates completed actions, schedule slips, and rescheduled actions and includes the previous schedule for reference
- Provides the capability for the government, contractor, or support contractors to perform "what if" schedule exercises without modifying the master program schedule
- Maintains consistency with the work package definitions and the EVMS
- Is traceable between the WBS items supported by each IMS task
- Is vertically and horizontally traceable to the cost and schedule reporting instruments (e.g., Contract Performance Report)

3.3.1.C3: There is a Numbering System (NS) for the IMP (and IMS) for ease in referencing the contents of the IMP, and to facilitate the traceability of the IMP and IMS to other management and structure tools (e.g., Contractor WBS (CWBS) and EVMS).

3.3.1.C4: The IMP and IMS together, provide a systematic approach to program planning and scheduling. The IMP and IMS clearly demonstrate that the program can be executed within schedule constraints and with acceptable schedule risk. The IMP and IMS provide tools for improved day-to-day program execution and for improved program insight by both government program office personnel and contractor personnel. Together, they ensure a mutual understanding of what is required to successfully plan and execute a program. *Note: While these two products (IMP and IMS) are inherently related, they are two separate products. In general, the IMP can be thought of as the top-down planning tool and the IMS as the bottom-up execution tool for a program. Therefore, the IMS is directly traceable to the IMP.*

3.3.1.C5: The implementation of the IMP and IMS is an integral part of the Integrated Product and Process Development (IPPD) framework for the work effort. The IMP and IMS are written to align with the IPPD framework in which the IMP and IMS set forth the necessary activities to be performed by all functional disciplines. The IMP and IMS clearly communicate the expectations of the program team, and provide traceability to the management and execution of the program by

IPTs. They also provide traceability to the Program WBS, the program's Contract Work Break-down Structure (CWBS), the SOW, Systems Engineering, Risk Management, and the EVMS, which together define the products and key processes associated with program success and are the basis of IPT-generated cost estimates and cost reporting. Both the IMP and IMS are consistent with the contractor's management and scheduling system structure and format.

- *Work Breakdown Structure (WBS)* – The event-oriented IMP/IMS and product-oriented WBS have good traceability since they provide two separate but inter-related views of the same program content. The IMP and IMS provide traceability to the CWBS by including the applicable WBS element in a separate text field or other reference at the IMS task level where the work is accomplished and earned value taken. All CWBS elements are related to each criterion in the IMP.
- *Earned Value Management System (EVMS)* – An IMS has been prepared whenever EVM compliance is required (in accordance with DoDI 5000.2) and to provide traceability between the two documents. *Note: The EVMS and IMS provide different "looks" at the program. When analyzed together, the EVMS and IMS give a better overall view of the likelihood the program will meets its goals.*

	Purpose	Characteristics
IMS	• Communicate **plan to execute** the program • **Provide a day-to-day tool** for management and tracking • **Forecast schedule impacts** using critical path analysis • **Forecast schedule completion**	• **Event-based**, activity relationship driven structure (superset of IMP) • Follows **systems engineering** process flow over entire program • Identify **schedule slack** (~management reserve) and **critical path**
EVMS	• Communicate **performance against a** defined schedule and cost **plan** (baseline) • **Measure, report** work package plan vs "actuals" -- in dollars • **Forecast EAC** by extrapolating SPI/CPI	• Detailed near term **work packages**, broader planning packages for later periods • Product oriented **WBS structure**; no schedule relationships defined • Allows for **cost management reserve**, but not schedule

Figure 3-2 Purposes and Characteristics of the IMS and EVMS

- *Integrated Baseline Review (IBR)* – The IMS facilitates the conduct of a successful IBR, in which it is verified there is sound basis for cost and schedule execution of program objectives, program risks are addressed and the contractor has performance plans and underlying management control systems to assess the realism of the performance measurement baseline providing the required baselines.
- *Systems Engineering Plan (SEP)* – The IMP and IMS supports the sound technical approach documented in the SEP. The IMP demonstrates the contractual commitment to

the elements of major technical reviews and their entry and exit (success) criteria. The SEP and IMS demonstrate that Cost, Schedule and Performance are inter-related within the program. *Note: Because the basic tasks within the IMS track the systematic flow of the engineering process, there should be a relationship between the SEP and the IMS. These processes, tools, and documents should be understood, linked, and tailored for an individual program's execution needs and management reporting requirements*

- *Program risk management* – The IMS provides the link between the individual risk mitigation plans and the day-to-day execution of the program schedule. There is a Risk ID filter column in the IMS that incorporates each risk mitigation task as an IMS task. As a result, the PM has ongoing access to risk mitigation progress by filtering on each of the respective Risk ID numbers.

3.3.1.C6: During program planning, the government created a top level program schedule or Roadmap which provides a capstone program summary allowing insight into the government's program planning and approval process. This initial Roadmap, along with other program documentation, provides the basis for an initial set of expectations for the program with the warfighter who will use the delivered product. The Roadmap:

- Is prepared by the government program office early in the program planning phase in conjunction with any other supporting or associated government program offices
- Is focused on and conveys the "big picture" of the program objectives, capabilities evolution, summary schedule, and any major program constraints
- Supports initial and subsequent budget submissions and provides the basis for developing a sound position on funding cuts or increases throughout the program life
- Contains key events and shows critical schedule interfaces (e.g., IOC and FOC) with all supporting programs and activities (for example, other Services, DARPA, and other agencies) and their supporting contracts
- Is reviewed regularly by the primary program team and supporting program teams to assess progress toward accomplishing key event and schedule interfaces
- Helps detect disconnects early, and thus provide sufficient lead-time and a planning tool to help address them
- Is able to be traced to the major events of the proposal and, upon contract award, trace to the IMP/IMS
- Is kept current

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.1.Q1: How has the program manager used the event-driven schedules and the participation of all stakeholders to ensure that all tasks are accomplished in a rational and logical order?

- How does this enable continuous communication with customers?
- What is the process for maintaining and updating program planning activities?
- Who has the authority to change the planning process? [3.2.3.C1a]

3.3.1.Q2: What are the necessary input conditions to complete each identified major task?

- Has any major task been declared complete without all required input conditions and component tasks being satisfied? If so, why? [3.2.3.C1a]

3.3.1.Q3: How are all tasks integrated properly? [3.3.1.C1a]

3.3.1.Q4: Is the program management process based on significant events in the acquisition life cycle or on arbitrary calendar events? If based on arbitrary calendar events, why? [3.3.1.C1a]

3.3.1.Q5: What is the format of the IMP? *Note: The specific format for the IMP is not critical; however, it usually reflects an Event/Accomplishment/Criteria hierarchical structure–a format that greatly facilitates the tracking and execution of the program* [3.3.1.C1b]

3.3.1.Q6: What is the purpose of the preliminary IMP at this phase of the program?

- How does it provide an understanding of the scope of work required and the likely structure of the program?
- How is the likely progression of work through the Technology Development (TD) and subsequent phases depicted in the IMP?
- What are the dependencies, which may be performed by different organizations, as identified in the IMP? [3.3.1.C1b]

3.3.1.Q7: For competitive programs, has the offeror submitted an IMP with its proposal in response to the Request for Proposal (RFP)?

- Does the IMP submitted by the offeror reflect his understanding of and approach to fulfilling the government's requirements?
    - What program information in the RFP and other pertinent documents, did the offeror use in the development of the IMP and IMS? Note: At a minimum, the offeror should have reviewed the following documents for data and information in the development of the IMP and IMS: drafts of Section M (Evaluation Criteria), Section L (Instructions to Offerors), Section B (Supplies or Services and Price/Costs), and Section F (Deliveries or Performance), the CDRL (DD Form 1423) and the government Roadmap
- Was the successful offeror's IMP included in the resulting contract for use in the execution of the program?
- How has the PM used the IMP in competitive source selection and/or in sole source negotiations?
- How did the PM communicate the planned Acquisition Strategy and overall evaluation philosophy to the offerors prior to the development of the IMP and IMS?
- When were the drafts of Section M (Evaluation Criteria) and Section L (Instructions to Offerors) provided to industry?

- Was it in sufficient time to permit the maximum amount of information exchange between offeror and procuring organization? If not, why not?
- How does the information and stipulations in Section M of the RFP define how proposals will be evaluated?
    - How are the fundamental program questions addressed?
        o If the program plans/schedule is followed, will the program meet requirements?
        o How risky is the plan/schedule?
- How does Section M recognize the need to verify whether the IMP and IMS are consistent with other RFP requirements, reflect a comprehensive, complete, realistic, and reasonable approach to the program, and provide clarity and usability during program execution?
- For a government-executed program (e.g., a government lab project), did the government team tailor program guidance to its in-house IMP and IMS development? [3.3.1.C1a]

3.3.1.Q8: What infrastructure and process for managing the IMP and IMS throughout the life of the contract has the contractor established after contract award?

- Who are the members of the scheduling team and training schedulers, planners, and Control Account Managers (CAMs)? [3.3.1.C1b]

3.3.1.Q9 What are the in place processes to manage the Technology Development (TD) phase effort and control changes to the plan? [3.3.1.C1b]

3.3.1.Q10: How does the IMP and IMS provide a control mechanism to:

- Identify and assess actual progress versus the planned progress?
- Monitor the program critical path and analyze workarounds for problem areas?
- Assess program maturity?
- Assess the status of identified risk areas when risk management and risk mitigation tasks are included in the IMP/IMS?
- Assess the progress on selected TPMs and KPPs?
- Provide complementary program progress assessment along with EVMS?
- Provide an objective, quantitative basis for the contractor Performance Assessment Rating (CPAR) and/or Award Fee?
- Provide better insight into potential follow-on efforts ("What If's") that were not part of the original contract award? [3.3.1.C1b]

3.3.1.Q11: How does the IMS define the critical path and schedule variances?

- How is it linked to the EVMS?
- How are subcontractors' activities and all external dependencies included in the monitoring of critical path deviations? [3.3.1.C2]

3.3.1.Q12: How is the IMS an extension of the information contained within the IMP?

- How are the tasks and subtasks subordinate to the criteria reflected in the IMS? [3.3.1.C2a]

3.3.1.Q13: What is the process to develop the IMS?

- What are the starting points used in the development of the IMS? *Note: The IMS begins as an IMP with dates–the starting points are the events, accomplishments, and criteria that make up the plan.*

- What are the expected start and stop dates for each criterion in the plan? [3.3.1.C2a]

- 3.3.1.Q14: How did the offeror use the IMS tasks in the development of the basis of estimate (BOE) in the cost volume?

- How are they the basis of the EVMS work packages?

- How does the IMS submitted by the offeror describe a realistic and supportable schedule illustrating the plan to meet all program requirements? [3.3.1.C2a]

3.3.1Q15: Does the IMS include all program activities?

- Are critical path events clearly annotated and technical risk areas highlighted? [3.3.1.C2a]

3.3.1.Q16: How are demonstration events to support verification of critical technology reflected on the IMS? [3.3.1.C2a]

3.3.1.Q17: What were the results of the Critical Path Analysis?

- What tasks, or sets of tasks, were identified as being more difficult or costly to complete? *Note: As many of the tasks are inter-related and as work products typically require the completion of all lower level tasks before the higher-level work product can be completed, the early identification of critical tasks is essential for ensuring that schedule and cost goals are maintained for the program* [3.3.1.C2a]

3.3.1.Q18: What are the critical path and risk areas associated with the transition to the System Development and Demonstration (SDD) phase? [3.3.1.C2a]

3.3.1.Q19: How will variances from the critical path be analyzed and communicated to all stakeholders? [3.3.1.C2a]

3.3.1.Q20: How do the TD contract funding and schedule accommodate anticipated technology development lead times? [3.3.1.C2a]

3.3.1.Q21: How are programs with high risk shown in the IMS in order to give the visibility to manage and control risk? [3.3.1.C2a]

3.3.1.Q22: How does the numbering system established by the contractor assist in integrating the EVMS and IMS systems? [3.3.1.C3]

3.3.1.Q23: What are the program Events, Accomplishments, and Criteria as defined in the IMP? From what sources where the event definitions obtained? *Note: Refer to page 24 in the Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide, Version 9, dated 21 October 2005 for what defines an event* [3.3.1.C2a]

3.3.1.Q24: What is the numbering system used in the IMP and IMS? *Note: An example is below. Another numbering scheme uses alpha and numeric digits. An overall single numbering system which includes the IMP reference, the IMS reference, and the WBS as well as other parameters may also be used* [3.3.1.C3]

Table 3-1 IMP and IMS Numbering System Example

Activity Number	Activities		
A	**IMP Event**		
A01		**IMP Accomplishment**	
A01a			**IMP Criteria**
A01a01-n			**IMP Task**
A	**PDR Completed**		
A01		**Requirements Analysis Completed**	
A01a		**Avionics Requirements Analysis**	
A01a01			**Perform Avionics Requirements Analysis**
A01a02			**Develop Avionics Draft Specification**
A01a03			**Coordinate Avionics Draft Specification for Review**
A01a04			**Publish Avionics Specification**

3.3.1Q25: Does the management team has sufficient insight into subcontractors' programs to manage changes to TD phase plans? Why? [3.3.1.C4]

3.3.1.Q26: How is the prime contractor involved in and cognizant of its subcontractors' planning processes? [3.3.1.C4]

3.3.1.Q27: How are program strategies (e.g., AS, TDS, TES) and plans (IMP, SEP, TEMP, RMP, ISP) compatible, consistent and aligned in the IMP and IMS? [3.3.1.C4]

3.3.1.Q28: How is the IMS based on the IMP? [3.3.1.C4]

- Identify all of the Events, Accomplishments, Criteria, Tasks and Subtasks.

3.3.1.Q29: What is the traceability between the event-oriented IMP/IMS and the product-oriented WBS?

- What is the traceability between CWBS elements and each criterion in the IMP? [3.3.1.C4]

3.3.1.Q30: How does the IMP and IMS support the sound technical approach documented in the SEP? [3.3.1.C4]

3.3.1.Q31: Can the PM/contractor describe the makeup of the risk ID filter column in the IMS? Its purpose? [3.3.1.C4]

3.3.1.Q32: How does the program ensure that all key strategies and top-level plans remain consistent and aligned (i.e., coordinated) with the IMP/IMS?

- Are the type and number of technical reviews correct in each appropriate plan?
- Does the IMS capture both the government SEP and the prime contractor's SEMP/SEP activities, events, and milestones?
- Are the scheduled interfaces w FoS/SoS correctly captured in the IMS, SEP, TEMP, and other related plans?
- Did the plans adequately address or reference all key processes (e.g., Requirements, Risk Management, V&V, Monitoring & Control, Continuous process improvement, etc.)? [3.3.1.C5]

3.3.1.Q33: How is the SEP updated and used by the Technical Leads and PM to manage the technical aspects/efforts of the program?

- Was the SEP prepared in time to support RFPs?
- Was the SEP updated after contract award to document the major events, revisions, slips in the schedule, technology immaturity, etc. that have occurred? *Note: The SEP is the PM's overarching technical management tool that reflects both government and contractor activities, roles, and responsibilities. It is a living dynamic plan, updated as necessary* [3.3.1.C5]

3.3.1.Q34: Explain the relationship between the TD schedule and the EVMS schedules. [3.3.1.C5]

3.3.1.Q35: How does the Government Roadmap Schedule capture the plan for executing the Acquisition Strategy, including incremental approaches? [3.3.1.C6]

3.3.1.Q36: How does the Government Roadmap Schedule capture the plan for executing the evolutionary acquisition (EA) strategy, with either a spiral or incremental development process?

- How is the Government Roadmap impacted by an EA environment?
  - What additional details in the Pre-Milestone B period must be included in the Government Roadmap in order to establish a good foundation for an executable incremental capability delivery plan?
  - What are the differences in each increment's overlapping, due to concurrent development of the incremental program (e.g., PDR for one increment, CDR for an earlier one)? [3.3.1.C6]

3.3.1.Q37: What is the format of the Government Roadmap Schedule?

- How are critical activities and interfaces shown across the entire program, as well as critical dates that are dictated by higher authority? [3.3.1.C6]

Pre-Milestone B

Criteria

3.3.1.C7: The program has appropriate development activities planned and scheduled, e.g. Integrated Master Plan/Integrated Master Schedule (IMP/IMS), and implements these activities to execute the program. These planned and scheduled activities include completion criteria. Program funding and schedules are sufficient to accommodate technical complexity and identified program risks. Sufficient resources are allocated and available to the program to successfully develop the system within the program baseline.

 3.3.1.C8: The program is following the program management plans in executing the program. The program has accomplished/is accomplishing the planned activities with minimal schedule impact and is proceeding to execute within the program baselines. Schedule performance is reported through an Earned Value Management System (EVMS).

3.3.1.C9: The development and test schedules are event driven and guided by the use of success criteria. The Integrated Master Plan identifies interim DT&E measures as addressed in the TEMP. The test schedules are reasonable, accommodate all required testing, and include a test, analyze, and fix methodology.

3.3.1.C10: The program funding is based on a Contractor Work Breakdown Structure (CWBS) with well-defined work packages, schedules, and performance criteria.

3.3.1.C11: The program has an appropriate process in place to manage a program plan and control changes to the plan. This process includes having sufficient insight into subcontractor status to make realistic changes to the program plan.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.1.Q38: What are the top-level integrated program plans and schedules that define and schedule the appropriate development activities to execute the program?

- How are these plans and schedules used to manage the program?
- How does the PM use the Integrated Master Schedule (or equivalent) to identify a critical path?
- How does the PM use the Integrated Master Schedule to reflect the known technical risks in the program? [3.3.1.C7]

3.3.1.Q39: How is work defined and resources allocated to the program to execute the development effort within the program baselines? [3.3.1.C7]

3.3.1.Q40: How does the PM perform strategic planning on the program? [3.3.1.C7]

3.3.1.Q41: What was the method used to allocate times for the scheduled activities, e.g., systems engineering analyses, detailed design, component testing, etc.? [3.3.1.C8]

3.3.1.Q42: What are the completion criteria and DT&E interim test measures for the planned and scheduled activities? [3.3.1.C8]

3.3.1.Q43: What is the evidence that the PM is implementing the program management plans in executing the program? Is the program on schedule to complete within the program baselines/ expectations? [3.3.1.C8]

3.3.1.Q44: Describe the process for subcontract performance tracking and the schedule performance status of each. [3.3.1.C8]

3.3.1.Q45: How are the development and test schedules event driven?

3.3.1.Q46: What success criteria that compose the metrics for schedules? [3.3.1.C8]

3.3.1.Q47: Are the test schedules reasonable? [3.3.1.C9]

3.3.1.Q48: How do the test schedules accommodate the "test, analyze, and fix" philosophy? [3.3.1.C9]

3.3.1.Q49: What is the time frame for preparing draft tactics, techniques, and procedures or CONOPS and demonstrating them in a systems integration laboratory (SIL) or intended environment in the SDD phase? [3.3.1.C9]

3.3.1.Q50: How is the program funding based on the CWBS?

- Are there well-defined work packages, schedules, and performance criteria? [3.3.1.C10].

3.3.1.Q51: What is the process for keeping the project/program planning activities current? Who has the authority to change the planning process? [3.3.1.C11]

3.3.1.Q52: As a stakeholder in successful performance of subcontractors, how is the prime contractor involved in/cognizant of its major subcontractors' re-planning processes? [3.3.1.C11]

Pre-Milestone C

Criteria

3.3.1.C12: The program master schedule provides a current representation of all program activities. Performance to the critical path is annotated and highlights technical risk areas at least weekly. Transition to production-related activities is assessed for possible impact to the critical path.

3.3.1.C13: Schedule variances have been assessed and workarounds are reasonable and executable to support the production schedule. The performance variance of the current program to the critical path, including development subcontractor's activities, highlights the risk areas and whether they are relevant to transitioning the program to production. The IMS integrated master schedule and the EVMS schedules are consistent and directly linked.

3.3.1.C14: Allocation of funding is reasonable and is based on experience and sound estimating/modeling methods.

3.3.1.C15: The program has an appropriate process in place to manage a program plan and control changes to the plan, including planning for transition to and execution of production.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.1.Q53: What is the history of actual schedule performance to the current contract schedule? [3.3.1.C12]

3.3.1.Q54: What are the critical path and risk areas associated with the transition to production? [3.3.1.C12 and 3.3.1.C13]

3.3.1.Q55: What is the relationship between the IMS and the EVMS schedules? [3.3.1.C13]

3.3.1.Q56: What are the activities associated with the transition from development to production? [3.3.1.C13]

3.3.1.Q57: Are there any schedule variances? If so, how do they impact the start of production? [3.3.1.C13]

3.3.1.Q58: How will the production contract funding and schedule accommodate the known program risks and production start-up issues that will likely occur during contract execution? [3.3.1.C14]

3.3.1.Q59: How will financial resources be allocated to the production program by fiscal year to accommodate the learning curve associated with the transition to production and ramp-up in production rates?

- What was the methodology used to arrive at the planned allocation? [3.3.1.C14]

3.3.1.Q60: What is the process for maintaining/updating program planning activities?

- Who has the authority to change the planning process? [3.3.1.C15]

References

Defense Acquisition Guidebook (DAG). Chapter 4, "Systems Engineering." Defense Acquisition University, https://akss.dau.mil/dag/.

Earned Value Management System Acceptance Guide. Arlington, VA: National Defense Industrial Association, November 2006.

Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide. Washington, DC: Department of Defense, October 21, 2005.

Integrated Master Plan and Schedule Guide. AFMC Pamphlet 63-5, 2005.

Integrating Risk Management with Earned Value Management. Arlington, VA: National Defense Industrial Association.

Scheduling Guide for program managers. Defense Acquisition University, October 2001.

Factor 3.3.2 – Work Breakdown Structure (WBS)

Pre-Milestone A

Criteria

3.3.2.C1: The WBS provides a consistent and visible framework for defense materiel items and contracts within a program by defining the logical relationship among all program elements to a specific level (typically Level 3) of indenture that does not constrain the contractor's ability to define or manage the program and resources.

3.3.2.C2: The preliminary Program WBS (PWBS) is of sufficient detail to guide early development of the program's life cycle; e.g., generation of initial cost estimates and program plans; support of contracting and reporting; and creation of a program schedule.

3.3.2.C3: There is a balance between the program definition aspects of the WBS with its data-generating aspects. *Note: Using available data to build historic files to aid in the future development of similar defense materiel items is a very valuable resource. The primary purpose of the WBS is to define the program's structure and the need for data should not distort or hinder the program definition.*

3.3.2.C4: The initial WBS dictionary is based on the generic definitions in MIL-HDBK-881A, Appendices A through I.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.2.Q1: How does the WBS provide a basis for effective communication throughout the Technology Development (TD) phase by being the common link unifying planning, scheduling, cost estimating, budgeting, contracting, configuration management (CM), and performance-reporting disciplines?

- What is the purpose of the WBS?
- How does the WBS relate to the product structure and schedule?
- How does the WBS provide the basis for all program activities? Do these include the program and technical planning, schedule definition, CM, risk management, cost estimates, status reporting, etc.? [3.3.2.C1]

3.3.2.Q2: For a joint and/or System of Systems (SoS) program, does the WBS identify and describe the "parent-child" type relationship? *Note: Understanding the parent-child type relationship of various related programs and contracts and their impact on the WBS is important in the ever-increasing integrated and joint program environment. Often, individually base-lined programs and their various prime or GFE elements are actually part of a SoS approach. The overall parent*

program - the SoS or joint program, needs to be identified with the various child programs. Each child program would develop a stand-alone WBS structure [3.3.2.C1]

3.3.2.Q3: Is the preliminary PWBS based on the most current results of the Analysis of Material Approaches and the Analysis of Alternatives? If not, why not? [3.3.2.C2]

3.3.2.Q4: What is the traceability among mission requirements, the materiel approach or combination of approaches to provide the desired capability or capabilities, and the WBS? [3.3.2.C2]

3.3.2.Q5: Is there uniformity and consistency of approach in defining the elements and top levels of the PWBS? *Note: Benefit of uniformity in the generation of work breakdown structures and their application to management practices will be realized in improved communication throughout the acquisition process* [3.3.2.C1 and 3.3.2.C2]

3.3.2.Q6: Is there a viable "balance" between the program definition aspects of the WBS and its data-generating aspects? [3.3.2.C3]

3.3.2.Q7: What generic definition of the WBS elements is used in the PWBS? Note: See Appendices A through I, MIL-HDBK-881A, dated 30 July 2005 [3.3.2.C4]

3.3.2.Q8: What is the purpose of the WBS dictionary? *Note: The dictionary shows the hierarchical relationship of the elements and describes each WBS element and the resources and processes required to produce it. It also provides a link to the detailed technical definition documents. The PMO/contractor team should routinely revise the WBS dictionary to incorporate changes and should reflect the current status of the program throughout its life [3.3.2.C4]*

Pre-Milestone B

Criteria

3.3.2.C5: The WBS provides a consistent and visible framework for defense materiel items and contracts within a program by defining the logical relationship among all program elements to a specific level (typically Level 3) of indenture that does not constrain the contractor's ability to define or manage the program and resources.

3.3.2.C6: The PWBS provides a framework for specifying program objectives. It defines the program in terms of hierarchically related, product-oriented elements and includes "other government" elements (i.e., program office operations, manpower, government-furnished equipment (GFE), government testing). Each element provides logical summary levels for assessing technical accomplishments, supporting the required event-based technical reviews, and for measuring cost and schedule performance. *Note: It incorporates the preliminary PWBS as modified (adding tasks or reassigning personnel) as more is learned about the system.   The PWBS will evolve through iterative analysis of the program objective, functional design criteria, program scope, technical performance requirements, and other technical documentation.*

3.3.2.C7: There continues to be a balance between the program definition aspects of the WBS and its data-generating aspects. *Note: Using available data to build historic files to aid in the future development of similar defense materiel items is a very valuable resource. The primary purpose of the WBS is to define the program's structure and the need for data should not distort or hinder the program definition.*

3.3.2.C8: The PWBS was approved as part of the Cost and Software Data Reporting (CSDR) plan. *Note: The CSDR describes the PWBS to be used and defines the approach the government activity plans to use for collecting data*

3.3.2.C9: The Contract WBS (CWBS) is the complete WBS as included in the DoD-approved PWBS extended to the agreed-to contract reporting level and any discretionary extensions to lower levels for reporting or other purposes. It adequately defines the lower level components of what is to be procured and includes all the product elements (hardware, software, data, or services), which are defined by the contractor. *Note: The comprehensive CWBS forms the framework for the contractor's management control system*

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.2.Q9: How does the WBS provide a basis for effective communication throughout the System Design and Development (SDD) phase by being the common link unifying planning, scheduling, cost estimating, budgeting, contracting, configuration management (CM), and performance reporting disciplines?

- What is the purpose of the WBS?
- How does the WBS relate to the product structure and schedule?
- How does the WBS provide the basis for all program activities? Do these include the program and technical planning, schedule definition, CM, risk management, cost estimates, status reporting, etc.? [3.3.2.C5]

3.3.2.Q10: How does the IPT at each WBS level scrub and endorse the risk mitigations of lower levels? *Note: It is important to mitigate risk where possible before passing it up to the next WBS level* [3.3.2.C5, 3.3.2.C6 and 3.3.2.C9]

3.3.2.Q11: How were the PWBS and the CWBS developed and maintained based on the systems engineering function? [3.3.2.C5, 3.3.2.C6 and 3.3.2.C9]

3.3.2.C12: Is the PWBS product-oriented?

- Do its elements represent identifiable work products, whether they are equipment, data, or related service products?

3.3.2.Q13: Are the top three levels in each WBS correctly specified? *Note: If the government considers some program elements to be high cost or high risk, the system may be defined to a lower level of the WBS; this is reasonable if the product-oriented logical extension is maintained.*

The contractor should extend all other elements to the level and form based on the way the system is developed, produced, or managed [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q14: How was the PWBS used in the development of the solicitation ? *Note: The WBS used for a solicitation is structured by selecting appropriate elements from the approved PWBS. The CLINs, configuration items, contract SOW tasks, contract specifications, and contractor responses will be expressed in terms of the WBS to enhance its effectiveness in satisfying the objectives of the particular acquisition. While the relationship of the CWBS elements to the SOW and the CLINs should be clearly traceable, there may not be a one-to-one relationship, nor is it required* [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q15: If the PWBS has been revised, what is the traceability to the approved version? [3.3.2.C6]

3.3.2.Q16: Is the CWBS product-oriented and logical?

- How is it used in the development of the Integrated Master Plan (IMP), Integrated Master Schedule (IMS), Risk Management Plan, Contract Performance Report (CPR), and Contractor Cost Data Report (CCDR), as applicable? How was it used? *Note: The WBS provides a common thread for the Earned Value Management System (EVMS) and the IMS, allowing consistency in understanding program cost and schedule performance. The CWBS includes the breakdown of work into small enough entities that can be analyzed and assessed. As part of EVMS, the CWBS elements provide a structure for collecting costs assessing performance. The IMS is a time-phased schedule that serves as a tool for time phasing work and assessing technical performance. Schedule activities in the IMS are traceable to the CWBS elements used in EVMS, allowing commonality for integrated program assessment of cost, schedule, technical performance, and associated risks* [3.3.2.C9]

3.3.2.Q17: Was the PWBS built by the Cost Working-Group IPT (CWIPT)? *Note: CWIPT membership shall include, but not be limited to, designated cost analysts from the OSD Cost Analysis Improvement Group (CAIG), the Defense Cost and Resource Center (RCARC), the DoD Component cost center, the DoD Component commodity command, the program office, and the representative contractors, as appropriate. In addition, the PM's Earned Value Management (EVM) and systems engineering (SE) representatives generally participate in the CWIPT process to assist in building the WBS [3.3.2.C6]*

3.3.2.Q18: Prior to RFP, were copies of DD Form 1423-1 CDRL that establishes the WBS, the WBS dictionary and the CSDR requirements in the solicitation or RFP submitted to the CAIG for review and approval? If not, why not? [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q19: Does each contract have only one PWBS and one CWBS? [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q20: Does the PWBS submitted with the Cost Analysis Requirements Description (CARD) agree with the WBS submitted as part of the program CSDR plan? [3.3.2.C6]

3.3.2.Q21: How is the WBS the "key" to program coordination? *Note: Through the Program WBS and the Contract WBS, work progress is documented as resources are allocated and expended. Performance, cost, schedule, and technical data are routinely generated for reporting purposes. The WBS is the infrastructure to summarize data for successive levels of management and provide appropriate information on projected, actual, and current status of the individual elements. When appropriately structured and used in conjunction with sound systems engineering principles, cost estimating, EVM, integrated scheduling, and risk management, the WBS allows for program status to be continuously visible so the program manager and contractor can identify, coordinate, and implement changes necessary for desired results* [3.3.2.C6]

3.3.2.Q22: Were the following timelines/milestones met in regard to WBS approval?

- The CWIPT was formally established at least 12 months before the Overarching Integrated Product Team (OIPT) milestone review or with significant lead time to adequately develop any solicitations or requests for proposals (RFPs) to industry.

- Draft CSDR plan (including WBS dictionary) as part of the draft CARD, submitted to the OSD CAIG and the DCARC 180 days before the OIPT review or 60 days before the draft solicitation to industry.

- Final CSDR plan (including WBS dictionary) as part of the final CARD, submitted to the OSD CAIG and the DCARC 45 days before the OIPT review or 60 days before the final solicitation to industry.

- CCDR reports (including the CWBS at level 3) are due within 60 days following completion of the integrated baseline review when a pre-award or post-award conference is held. If a conference is not held, the initial report is due within 180 days of contract award. [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q23: What are the architectural products documented in the PWBS and CWBS?

- Are they in accordance with the DoD Architecture Framework (DoDAF)? [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q24: How does the PWBS consider and account for life cycle logistics and Total Life Cycle Systems Management considerations?

- Are they flowed into the CWBS? [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q25: Did the contractors extend the CWBS to the appropriate lower level to provide visibility to critical requirements? [3.3.2.C9]

3.3.2.Q26 Was a preliminary CWBS included in the RFP and did the contractor submit a complete CWBS with its proposal? *Note: The proposal should be generally based on the WBS in the RFP, although contractors should be encouraged to suggest changes needed to meet an essential RFP requirement or to enhance the effectiveness of the CWBS in satisfying program objectives* [3.3.2.C9]

3.3.2.Q27: Did the contractor expand the WBS dictionary as the Contract WBS is developed? [3.3.2.C9]

3.3.2.Q28: Is all integral software summarized in a Program or Contract WBS in conjunction with the hardware it supports? *Note: This allows for effective performance measurement and management control. When needed, a contractor's management systems can use an identifier for each software element to produce summaries for software management purposes* [3.3.2.C6 and 3.3.2.C9]

Pre-Milestone C

Criteria

3.3.2.C10: The WBS provides a consistent and visible framework for defense materiel items and contracts within a program by defining the logical relationship among all program elements to a specific level (typically Level 3) of indenture that does not constrain the contractor's ability to define or manage the program and resources.

3.3.2.C11: The PWBS provides a framework for specifying program objectives. It defines the program in terms of hierarchically related, product-oriented elements and includes "other government" elements (i.e., program office operations, manpower, government-furnished equipment (GFE), government testing). Each element provides logical summary levels for assessing technical accomplishments, supporting the required event-based technical reviews, and for measuring cost and schedule performance.

3.3.2.C12: There continues to be a balance between the program definition aspects of the WBS with its data-generating aspects.

3.3.2.C13: Changes to PWBS and CWBS moved as part of the Cost and Software Data Reporting (CSDR) plan. *Note: The CSDR describes the PWBS to be used and defines the approach the government activity plans to use for collecting data*

3.3.2C14: The Contract WBS (CWBS) is the complete WBS as included in the DoD-approved PWBS extended to the agreed-to contract reporting level and any discretionary extensions to lower levels for reporting or other purposes. It adequately defines the lower level components of what is to be procured and includes all the product elements (hardware, software, data, or services), which are defined by the contractor.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.2.Q29: How does the WBS provide a basis for effective communication throughout the Production and Deployment (PD) phase by being the common link unifying planning, scheduling,

cost estimating, budgeting, contracting, configuration management (CM), and performance reporting disciplines?

- What is the purpose of the WBS?
- How does the WBS relate to the product structure and schedule?
- How does the WBS provide the basis for all program activities? Do these include the program and technical planning, schedule definition, CM, risk management, cost estimates, status reporting, etc.? [3.3.2.10]

3.3.2.Q30: How does the IPT at each WBS level scrub and endorse the risk mitigations of lower levels? *Note: It is important to mitigate risk where possible before passing it up to the next WBS level* [3.3.2.C10, 3.3.2.C11 and 3.3.2.C14]

3.3.2.Q31: How were the PWBS and the CWBS developed and maintained based on the systems engineering function? [3.3.2.C10, 3.3.2.C11 and 3.3.2.C14]

3.3.2.C32: Is the PWBS product-oriented?

- Do its elements represent identifiable work products, whether they are equipment, data, or related service products. [3.3.2.C11]

3.3.2.Q33: How was the PWBS used in the development of the solicitation ? *Note: The WBS used for a solicitation is structured by selecting appropriate elements from the approved PWBS. The CLINs, configuration items, contract SOW tasks, contract specifications, and contractor responses will be expressed in terms of the WBS to enhance its effectiveness in satisfying the objectives of the particular acquisition. While the relationship of the CWBS elements to the SOW and the CLINs should be clearly traceable, there may not be a one-to-one relationship, nor is it required [3.3.2.C11 and 3.3.2.C14]*

3.3.2.Q34: If the PWBS has been revised, what is the traceability to the approved version? [3.3.2.C11]

3.3.2.Q35: Is the CWBS product-oriented and logical?

- How is it used in the development of the Integrated Master Plan (IMP), Integrated Master Schedule (IMS), Risk Management Plan, Contract Performance Report (CPR), and Contractor Cost Data Report (CCDR), as applicable? How was it used? [3.3.2.C14]

3.3.2.Q36: Was the PWBS built by the Cost Working-Group IPT (CWIPT)? [3.3.2.C11]

3.3.2.Q37: Prior to RFP, were copies of DD Form 1423-1 CDRL that establishes the WBS, the WBS dictionary and the CSDR requirements in the solicitation or RFP submitted to the CAIG for review and approval? [3.3.2.C11 and 3.3.2.C14]

3.3.2.Q38: Does each contract have only one PWBS and one CWBS? If not, why not? [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q39: Does the PWBS submitted with the Cost Analysis Requirements Description (CARD) agree with the PWBS submitted as part of the program CSDR plan? If not, why not? [3.3.2.C11]

3.3.2.Q40: How is the WBS the "key" to program coordination? *Note: Through the Program WBS and the Contract WBS, work progress is documented as resources are allocated and expended. Performance, cost, schedule, and technical data are routinely generated for reporting purposes. The WBS is the infrastructure to summarize data for successive levels of management and provide appropriate information on projected, actual, and current status of the individual elements. When appropriately structured and used in conjunction with sound systems engineering principles, cost estimating, EVM, integrated scheduling, and risk management, the WBS allows for program status to be continuously visible so the program manager and contractor can identify, coordinate, and implement changes necessary for desired results* [3.3.2.C6]

3.3.2.Q41: Were the following timelines/milestones met in regard to WBS approval?

- The CWIPT was formally established at least 12 months before the Overarching Integrated Product Team (OIPT) milestone review or with significant lead time to adequately develop any solicitations or requests for proposals (RFPs) to industry.

- Draft CSDR plan (including WBS dictionary) as part of the draft CARD, submitted to the OSD CAIG and the DCARC 180 days before the OIPT review or 60 days before the draft solicitation to industry.

- Final CSDR plan (including WBS dictionary) as part of the final CARD, submitted to the OSD CAIG and the DCARC 45 days before the OIPT review or 60 days before the final solicitation to industry.

- CCDR reports (including the CWBS at level 3) are due within 60 days following completion of the integrated baseline review when a pre-award or post-award conference is held. If a conference is not held, the initial report is due within 180 days of contract award. [3.3.2.C6 and 3.3.2.C9]

3.3.2.Q42: Are the architectural products documented in the PWBS and CWBS in accordance with the DoD Architecture Framework (DoDAF) Version 1.0, dated 15 August 2003? [3.3.2.C11 and 3.3.2.C14]

3.3.2.Q43: Was a preliminary CWBS included in the RFP and did the contractor submit a complete CWBS with its proposal? *Note: The proposal should be generally based on the WBS in the RFP, although contractors should be encouraged to suggest changes needed to meet an essential RFP requirement or to enhance the effectiveness of the CWBS in satisfying program objectives* [3.3.2.C14]

3.3.2.Q44: Did the contractor expand the WBS dictionary as the Contract WBS is developed? [3.3.2.C14]

References

Defense Acquisition Guidebook (DAG). Chapter 4, "Systems Engineering." Defense Acquisition University, https://akss.dau.mil/dag/.

Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide. Department of Defense, October 2005.

Integrating Risk Management with Earned Value Management. National Defense Industrial Association.

Scheduling Guide for Program Managers, Defense Acquisition University, October 2001.

Work Breakdown Structures for Defense Materiel Items. Department of Defense Handbook MIL-HDB-881A, January 1998.

Factor 3.3.3 – Management Structure and Communications

Pre-Milestone A

Criteria

3.3.3.C1: The PMO is organized to execute all functions in preparation for Milestone A review and TD activities, including the plan for formation of appropriate Integrated Product Teams (IPTs) or their equivalents. Roles and responsibilities are clearly defined and consistent with achieving the TD objectives.

3.3.3.C2: The PMO organization is structured to interface closely and openly with the contractor as well as other stakeholder organizations. The PMO leverages other government organizations to benefit the TD effort.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.3.Q1: Provide organizational charts and describe how the PMO will be organized, supported and staffed to execute the TD activities.

- Describe how roles and responsibilities will be defined and assigned.
- Describe the PMO organization related to computing systems and software. [3.3.1.C1]

3.3.3.Q2: What working or ad hoc groups have been established within the PMO?

- How do they support the IPT process?
- How do they address inter-IPT dependencies? [3.3.3.C1]

3.3.3.Q3: To whom do the chief system and software architects report and what is their authority? [3.3.3.C1]

3.3.3.Q4: What level of support or interaction has the PMO secured from other program stakeholders?

- What government organizations will support the PMO IPT process? [3.3.3.C2]

Pre-Milestone B

Criteria

3.3.3.C3: The PMO is organized to execute the SDD phase. Program IPTs or equivalent are formed and will include all appropriate program stakeholders to support SDD *(ideally these IPTs are jointly formed with the contractor IPTs)*. The organization includes support from the acquisition organization infrastructure, agencies like DCMA, OSD, and from contracted support personnel, as required. The roles and responsibilities are clearly defined and consistent with achieving program objectives.

3.3.3.C4: The PMO should establish a close and open working relationship through the use of IPTs, shared electronic media, etc., with the development contractor as well as other stakeholder organizations to include sustainment, operational organizations and test and evaluation organizations. For programs that are integral to a system of systems or family of systems, communication is accomplished across their component organizations.

3.3.3.C5: The contractor development team is organized to execute the SDD phase. Program IPTs or equivalent are formed and include representatives from all appropriate stakeholders, including the PMO. The team includes support from the company infrastructure, subcontractors and contracted support personnel, as required. Roles, responsibilities, and lines of authority are clearly defined and consistent with achieving program objectives.

3.3.3.C6: The contractor program office communicates programmatic information internally and externally in a timely and accurate manner across the contract team including subcontractors. For large, geographically distributed system development, electronic database tools are used to support this communication. The participating groups and functions, including production and support functions, are tied into the communication channels and process.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.3.Q5: Provide organizational charts and describe how the PMO is organized, supported and staffed to execute the SDD phase. [3.3.3.C3]

- Use wire diagrams to show the hierarchy of organizations; identify core, matrix, and contractor support personnel
- Identify and describe how roles and responsibilities are defined.
- Describe the program office organization related to computing systems and software.

3.3.3.Q6: How does the PMO communicate with the contractor program organization and other program stakeholders, such as the operational command and the test and evaluation organizations? [3.3.3.C4]

3.3.3.Q7: Provide the contractor organizational charts, major subcontractor organizational charts, and describe how the organization is staffed to execute the program. [3.3.3.C5]

3.3.3.Q8: How does the contractor program organization leverage the Company supporting infrastructure organizations (to acquire needed company resources) in executing the program? [3.3.3.C5]

3.3.3.Q9: How are the various IPTs organized on the program, and do they have responsibility, experienced staff, and authority to make decisions?

- Are all of the IPTs operating on approved charters?
- Provide a matrix which shows the responsibilities of key personnel, including what IPTs they lead/support, to include a summary of authorities and responsibilities
- What is the alignment between IPTs and the Work Breakdown Structure? [3.3.3.C5]

3.3.3.Q10: How are the IPTs integrated in the program's Systems Engineering processes and decisions. [3.3.3.C5]

3.3.3.Q11: Describe the relationship between the contractor software development teams and Systems Engineering organization on the program. [3.3.3.C5]

3.3.3.Q12: What are the roles of the Lead Systems Engineer/Chief Engineer (LSE/CE) and Technical Authority?

- How do they interact ?
- How do they engage with the PM, PEO, and contractor?
- Who signs the Statement of Work (SOW)?
- Who has technical planning responsibility, accountability, and authority? [3.3.3.C5]

3.3.3Q13: To whom do the contractor's chief system and software architects report and what is their authority?

- Do the chief system and software architects participate in system level activities such as an engineering review board? [3.3.3.C5]

3.3.3.Q14: Explain how program related information is communicated among the program participants, including subcontractors. Explain how the communication is both timely and accurate. Describe how participating program groups and functions, including production and support functions, participate in the communication process. Identify and describe the periodic means used to communicate internally. [3.3.3.C6]

Pre-Milestone C

Criteria

3.3.3.C7: The PMO is organized to complete all acquisition functions in SDD and transition to a production program. Program IPTs (jointly formed with contractor IPTs) are in place and include contractor/subcontractor representation, and all appropriate program stakeholders. The team

includes support from the government acquisition organization infrastructure, agencies like DCMA, and from contracted support personnel, as required. The roles and responsibilities are clearly defined and consistent with achieving program objectives.

3.3.3.C8: The PMO has a close and open working relationship with the development contractor as well as other stakeholder organizations to include sustainment, operational organizations and test and evaluation organizations. Integrated data environments are ideal for active information sharing. For programs that are integral to a system of systems or family of systems, communication is accomplished across their component organizations.

3.3.3.C9: The contractor development team is organized to complete the SDD program. Experienced resources (especially management) needed to transition to a production program are part of the development team. Program IPTs include representatives from the PMO, and all appropriate stakeholders. The team includes support from the Company infrastructure, subcontractors and contracted support personnel, as required. Roles, responsibilities, and lines of authority are clearly defined and consistent with achieving program objectives.

3.3.3.C10: The contractor PM has good cooperation from the Company infrastructure in support of the program. The PM ensures close communication within the support functional areas and is able to get priority on resources as needed to execute the program. The Company has written policy that delineates how the program office is structured to ensure compatibility with the Company functional organizations.

3.3.3.C11: The PM is part of the Company management decision-making process for program-related financing and Company capital resource allocation. His position brings positive influence on Company decisions to benefit the program both in development and production planning.

3.3.3.C12: Software engineering activities are implemented following the Software Development Plan. Software engineering and hardware engineering are closely coupled early in the process, and viewed as an integrated engineering activity applied to the system development effort for management purposes.

3.3.3.C13: The contractor program office is following a "living" Production Plan for staffing and training of personnel to accommodate the transition of the manufacturing, assembly, test, etc., of the product from an engineering environment to a production environment. Key personnel from the development program are planned to remain with the program as it makes the transition.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.3.Q15: Describe the organization of the PMO as needed to complete SDD and manage the transition of the program to production. Include all management personnel in the areas of engineering, production, manufacturing, software development, integration and testing, logistics, and quality assurance.

- Use wire diagrams to show the hierarchy of organizations; identify core, matrix, and contractor support personnel
- Identify and describe how roles and responsibilities are defined.
- Describe the program office organization related to computing systems and software. [3.3.3.C7]

3.3.3.Q16: How does the PMO communicate with the contractor program organization and other program stakeholders, such as the operational command and the test and evaluation organizations? [3.3.3.C8]

3.3.3.Q17: Describe the experience of the contractor program office staff in executing the production program. Include all management personnel in the areas of engineering, manufacturing, software development, integration and testing, subcontracting, logistics, and quality assurance. [3.3.3.C9]

3.3.3.Q18: Explain how the contractor program office leverages Company resources (personnel, facilities, test equipment, etc.) to support the execution of the program. [3.3.3.C10]

3.3.3.Q19: How are the various IPTs organized on the program, and do they have responsibility, experienced staff, and authority to make decisions?

- Are all of the IPTs operating on approved charters?
- Provide a matrix showing the responsibilities of key personnel, including what IPTs they lead/support, to include a summary of authorities and responsibilities
- What is the alignment between IPTs and the Work Breakdown Structure? [3.3.3.C9]

3.3.3.Q20: Describe the Company policy that defines the program organization's lines of authority and responsibility in managing the program. [3.3.3.C9]

3.3.1.Q21: Describe the degree of authority that the PM has over budgeting, financial commitments, and allocation material resources within the Company. [3.3.3.C11]

3.3.3.Q22: Describe how the software engineering management function is integrated with the Systems Engineering function. [3.3.3.C12]

3.3.3.Q23: Describe how the contractor team will be structured or restructured to handle the transition from the system development phase to production. Identify the key personnel and functions that have the experience to manage the risks associated with a smooth transition to production. [3.3.3.C13]

3.3.3.Q24: What are the roles of the Lead Systems Engineer/Chief Engineer (LSE/CE) and Technical Authority?

- How do they interact?
- How do they engage with the PM, PEO, and contractor?
- Who signs the Statement of Work (SOW)?
- Who has technical planning responsibility, accountability, and authority? [3.3.3.C9]

3.3.3Q25: To whom do the chief system and software architects report and what is their authority?

- Do the chief system and software architects participate in system level activities such as an engineering review board? [3.3.3.C9]

Factor 3.3.4 – Management Methods, Metrics, and Techniques

Sub-Factor 3.3.4.1 - Risk Management

Pre-Milestone B and C

Note: The questions below apply primarily to pre-Milestone B and C reviews, except where a risk management plan has been used on Concept Development contracts that may be carrying over into the TD phase (Milestone A decision)

Criteria
3.3.4.1.C1: The Department of Defense (DoD) recognizes that risk management is critical to acquisition program success (see the Defense Acquisition Guidebook (DAG). The purpose of addressing risk on programs is to help ensure program cost, schedule, and performance objectives are achieved at every stage in the life cycle and to communicate to all stakeholders the process for uncovering, determining the scope of, and managing program uncertainties. Since risk can be associated with all aspects of a program, it is important to recognize that risk identification is part of the job of everyone and not just the program manager or systems engineer. That includes the test manager, financial manager, contracting officer, logistician, and every other team member.
3.3.4.1.C2: There are several notable changes of emphasis in the above guide from previous RM versions. These changes reflect lessons learned from application of risk management in DoD programs. Emphasis has been placed on:

- The role and management of future root causes,
- Distinguishing between risk management and issue management,
- Tying risk likelihood to the root cause rather than the consequence,
- Tracking the status of risk mitigation implementation versus risk tracking, and
- Focusing on event-driven technical reviews to help identify risk areas and the effectiveness of ongoing risk mitigation efforts.

3.3.4.1.C3: Risk management is a measurement process of future uncertainties in achieving program performance objectives within defined cost, schedule and performance constraints. Risk can be associated with all aspects of a program (e.g., threat, technology maturity, supplier capability, design maturation, performance against plan,) as these aspects relate across the Acquisition Strategy (AS), Work Breakdown Structure (WBS), Integrated Master Schedule (IMS), Systems Engineering Plan (SEP) and Test and Evaluation Master Plan (TEMP). Risk addresses the potential variation in the planned approach and its expected outcome.

3.3.4.1.C4: The program manager establishes and maintains a risk management, mitigation and reporting system for data collection, tracking and feedback.

3.3.4.1.C5: The program manager establishes and maintains a corrosion prevention and mitigation reporting system for data collection and feedback and uses it to address logistic considerations and readiness issues.

3.3.4.1.C6: If the program is a system of systems, the program manager should weigh the impact of significant technical risk issues on the hierarchical program(s).

3.3.4.1.C7: The contractor Developer has an active risk management plan/program that addresses production risks.

3.3.4.1.C8: Risk Management should include a process for risk identification, risk analysis, risk mitigation planning, risk mitigation plan implementation, and risk tracking.

3.3.4.1.C9: Risks that have a potential impact on cost, schedule, and technical performance goals and thresholds are formally tracked by a Risk Management Working Group or IPT or like organization.

3.3.4.1.C10: Risks generally have three basic components:

- A future root cause (yet to happen), which, if eliminated or corrected, would prevent a potential consequence from occurring,
- A probability (or likelihood) assessed at the present time of that future root cause occurring, and
- The consequence (or effect) of that future occurrence.

A future root cause is the most basic reason for the presence of a risk. Accordingly, risks should be tied to future root causes and their effects.

3.3.4.1.C11: The risk management program identifies history and status of risk management, including top active risks to complete development, testing, and transition into production.

3.3.4.1.C12: Risk analysis includes production schedule impact, including schedule concurrency.

3.3.4.1.C13: Risk analysis includes the procurement and integration of commercial off the shelf hardware and software.

3.3.4.1.C14: Risk analysis includes open system architecture.

3.3.4.1.C15: An established, documented risk management process is applied to manage program risks in an ongoing fashion across the life of the program, addressing supportability risks such as sustainment and obsolescence.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.4.1.Q1: Provide and describe your risk management plan. Include descriptions of identified risks, assessment of likelihood and consequence, other quantitative risk assessments, risk mitigation processes, and tracking risks to closure. [3.3.4.1.C1, 3.3.4.1.C2 and 3.3.4.1.C8]

3.3.4.1.Q2: "Who" is responsible to implement risk management on the program? "Who" manages the risk management program? [3.3.4.1.C1, 3.3.4.1C4 and 3.3.4.1.C9]

3.3.4.1.Q3: Identify and describe the formal tool(s) and mechanism(s) that are in place to manage the risks on this program. Illustrate the government / contractor risk management process. Show the programs risk cube and risk definitions. [3.3.4.1.C4]

3.3.4.1.Q4: "How" often are risks reviewed? How do you mitigate risks to closure? How is the risk management process integrated with the program management process? Explain how the risk management process is used to manage programmatic and technical risks. Does this process address the risk associated with schedule concurrency? [3.3.4.1.C8 and 3.3.4.1.C9]

3.3.4.1.Q5: "What" are the top five risk areas (hardware and software, technical, cost, schedule) on your program? [3.3.4.1.C11]

3.3.4.1.Q6: Describe your obsolescence and corrosion prevention risk mitigation plan and explain how the plan is reported and tracked for the life cycle of the system. [3.3.4.1.C5]

Sub-Factor 3.3.4.2 – Earned Value Management (EVM)

Pre-Milestone B, and C

Note: The questions below apply primarily to pre-Milestone B and C reviews, except where EVM has been used on Concept Development contracts that may be carrying over into the TD phase (Milestone A decision)

Criteria

3.3.4.2.C1: EVM is required on all cost or incentive type acquisition contracts, subcontracts, intra-government work agreements, and other agreements according to dollar thresholds prescribed in USD(AT&L) Policy Memorandum dated March 7, 2005. The thresholds are as follows:

- $20 million or greater – EVM implementation compliant with ANSI/EIA – 748 - A is required. No formal EVM System (EVMS) validation is required
- $50 million or greater – EVM implementation compliant with ANSI/EIA – 748 - A is required. An EVM System must be formally validated and accepted by the cognizant contracting officer
- A Contract Performance Report (CPR) and Integrated Master Schedule (IMS) are required deliverables for all contracts that are $20 million or greater that require EVM
- Less than $20 million – EVM is not required, except at the discretion of the PM

Note required clauses: {DFARS 252.234-7001 for contracts issued before March 2005; DFARS 252.242-7002 (validation) or DFARS 252.242-7005 (compliance) issued after March 2005}

3.3.4.2.C2: EVM Systems Standard ANSI/EIA – 748 – A (regulatory requirement of DoDI 5000.2) provides 32 intent guidelines in five categories that are used to verify compliance of the EVM System being used:

1. Organization – Guidelines 1-5: address integration of organizational structure
2. Planning and Budgeting – Guidelines 6-15: address scheduling of authorized work, products, milestones, technical performance goals or other indicators used to measure progress; use of time-phased budgets and work packages, control accounts, and management reserves
3. Accounting Considerations – Guidelines 16-21: address methods of cost accounting in conjunction with material accounting, WBS, and organizational elements
4. Analysis and Management Reports – Guidelines 22-27: address content and analysis of cost and schedule measures, reporting of data elements and variances versus performance baseline, and frequency of reporting
5. Revisions and Data Maintenance – Guidelines 28-32: address methods of recording, controlling, and reporting changes to: budgets and schedules, authorized work, and performance measurement baseline

3.3.4.2.C3: EVM surveillance is an effective process used to review the health of the EVM System. Surveillance ensures that company processes and procedures are being appropriately followed and that they continue to satisfy ANSI/EIA 748-A guidelines. A standard industry surveillance approach is defined in the *NDIA/PMSC Surveillance Guide.*

3.3.4.2.C4: DoD acquisition policy requires program managers to conduct Integrated Baseline Reviews (IBRs) on contracts with EVM requirements. The IBR is viewed as an iterative process that provides the forum to establish a mutual understanding of the Performance Measurement Baseline (PMB) and to identify and mitigate program risks.

- The IBR process defines the PMB and should be conducted within 6 months of contract award
- IBR team members should include all cognizant PMs, and disciplines including program, business, subcontract, and technical management expertise, capable of assessing technical, schedule, cost, resource, and management process risk areas
- Formal team training is considered essential to ensure IBR participants understand the processes used on the program and can identify and assess program risks

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.4.2.Q1: Which contractors and subcontractors on the program have an EVMS requirement for contracts?

- Which contractors and subcontractors with EVMS requirements on the program have a government/DCMA validated EVM system?
- Which contracts containing EVMS are either cost or incentive types? (If EVMS is applied on FFP, PM has to justify) [3.3.4.2.C1]

3.3.4.2.Q2: What are the EVMS reporting requirements in the contracts (e.g. CPR, Cost Schedule Status Report (C/SSR), Contract Funds Status Report (CFSR)) [3.3.4.2.C1]

- What are the current reported cost and schedule variances (including trends) on the program (prime contractor and subcontractors)?
- How are these variances being addressed within the risk management process?
- How do these variances impact the contract Management reserve funds? [3.3.4.2.C1]

3.3.4.2.Q3: How was the prime contractor's EVM System evaluated for compliance with the 32 EVMS guidelines contained in ANSI EIA 748 - A? [3.3.4.2.C2]

3.3.4.2.Q4: Has the current Contract Work Breakdown Structure (CWBS) for the program been approved by the government?

- How does the CWBS reflect the authorized work elements of the program?
- How will the CWBS be modified for the next acquisition phase of the program? [3.3.4.2.C2]

3.3.4.2.Q5: How is the CWBS integrated with the organizational structure of the program?

- Describe how this effort establishes the control accounts for performance measurement [3.3.4.2.C2]

3.3.4.2.Q6: Describe the method used to schedule authorized work, considering work task interdependencies. [3.3.4.2.C2]

3.3.4.2.Q7: "What" are the key objective measures (metrics for determining % complete of budgeted cost of work performed) within work packages that are used to measure earned value? [3.3.4.2.C2]

3.3.4.2.Q8: Describe the definitized and undefinitized work packages that make up program budget estimate.

- What is the risk of reaching an Over Target cost Baseline (OTB) when all work packages become definitized?
- What is the status of budgeted management reserve on the contract? [3.3.4.2.C2]

3.3.4.2.Q9: Identify any time-phased budgets established for work that is considered to be level of effort (impractical to measure performance). [3.3.4.2.C2]

3.3.4.2.Q10: Is the documented, government/DCMA approved EVM system under configuration control?

- What, if any changes have there been to the EVM system description since it was approved/validated by the government/DCMA?
  - How were the changes coordinated with DCMA? [3.3.4.2.C2]

3.3.4.2.Q11: Is there an established and documented plan in place for conducting periodic internal surveillance or audits of the EVMS?

- How does the plan comply with the industry standard NDIA/PMSC Surveillance Guide?
- What provisions are in the plan to conduct joint surveillance with DCMA or the customer?
- When was the last surveillance audit conducted?
    - If joint, what was the makeup of the team?
    - Did it include an audit of the accounting system?
- What do the results indicate about the reliability and accuracy of data reported to the customer? [3.3.4.2.C3]

3.3.4.2.Q12: How soon is/was an IBR scheduled/performed on the program after contract award? [3.4.4.2.C4]

3.3.4.2.Q13: What stakeholders are/were participants in the IBR planning according to their expertise (include subcontractors with EVM reporting requirements)?

- What is the extent of formal team training for the IBR team participants? [3.3.4.2.C4]

3.3.4.2.Q14: How does the IBR process address the need for follow-on IBRs relative to contract modifications or changes to the PMB? [3.3.4.2.C4]

3.3.4.2.Q15: Have there been re-programming or re-baselining efforts that have resulted in an OTB?

- How effectively did the contractor involve the PMO in these actions?
- How many program re-baselines have occurred during the current phase of the program, and at what intervals?
- Was an IBR conducted after each re-baseline and in a timely manner? [3.3.4.2.C4]

Sub-Factor 3.3.4.3 – Technical Performance Measures

Pre-Milestone B & C

Criteria

3.3.4.3.C1: Systems engineering uses technical performance measurements to balance cost, schedule, and performance throughout the life cycle. Technical performance measurements compare actual versus planned technical development and design. They also report the degree to which system requirements are met in terms of performance, cost, schedule, and progress in implementing risk handling. Performance metrics are traceable to user-defined capabilities.

3.3.4.3.C2: The health of a program is commonly gauged in terms of cost, schedule, and technical performance. In addition to the Technical Performance Measures (TPMs) that address key performance parameters (KPP), critical technical parameters (CTP), metrics are identified and used to cover other performance-related requirements/capabilities such as Developmental Test

success criteria, Operational Test entrance criteria, as well as cost and schedule performance using the Earned Value Management (EVM) system. Metrics identified are well defined, and data are readily available, collected, documented and acted upon. For those metrics not being met, a plan of action is developed.

3.3.4.3.C3: It is important that programs are able to establish an efficient data collection and management process. These data need to be well defined and readily available. The key is being able to answer the questions, "Where are you?" "How do you know?" and "Show me."

3.3.4.3.C4: Established, documented program management techniques, methods, and tools are used to manage the program.

3.3.4.3.C5: Software metrics are defined and used to manage the software development effort. These metrics are integrated with other management tools and reported to senior program management.

3.3.4.3.C6: Suitable metrics are defined and used to manage the production program.

3.3.4.3.C7: Methods exist and are used to periodically monitor the status of the program.

3.3.4.3.C8: The Government Program Office should initially approve the program metrics and then periodically, e.g., monthly, the metrics should be reported and reviewed. These metrics should include many, if not all of the following: Development status S curves; Processor throughput utilization; Processor memory utilization; Input/output utilization; Software Engineering Staffing; Software Work Packages Summary; Schedule Performance Index; Cost performance Index; Problem/Deficiencies /Discrepancies Status; Requirements Stability; Software Size; Software Reuse Status (planned versus 'actuals'); Reliability Growth Curve; Logistics Footprint Reduction; Planned Operational Effectiveness; Product Availability Predictions; O&S Cost Projections; Development Test entrance criteria and status; DAES Reporting (For MDAPS); Milestone B and C entrance criteria.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.4.3.Q1: "What" are the programs technical performance measures (TPMs)? Provide a table of your TPMs. [3.3.4.3.C1]

3.3.4.3.Q2: How is the technical baseline developed, managed, and used to control system requirements, design integration, verification, and validation? Include a discussion of metrics (e.g., technical performance measures) for the technical effort and how these metrics will be used to measure progress? [3.3.4.3.C2]

3.3.4.3.Q3: EVMS has no provision to measure quality, "what" technical performance measures are used to determine whether your % completion metrics accurately reflect quantitative technical progress and quality toward meeting your KPPs and CTPs? [3.3.4.3.C2, and 3.3.4.3.C3, 3.3.4.3.C4 and 3.3.4.3.C5]

3.3.4.3.Q4: How are your TPMs related to the KPPs and CTPs? [3.3.4.3.C2]

3.3.4.3.Q5: "What" are the contractual provisions related to meeting TPM goals and thresholds? [3.3.4.3.C2]

3.3.4.3.Q6: "How" often are TPMs reviewed? And by whom? [3.3.4.3.C8]

3.3.4.3.Q7: Describe how metrics are structured and maintained to capture and track trend data. [3.3.4.3.C7]

3.3.4.3.Q8: How will the program metrics initially be approved and then periodically reviewed by and reported to the acquisition program office. Are the metrics documented in the TEMP and Acquisition Strategy? Please explain. [3.3.4.3.C8]

3.3.4.3.Q9: How are the program metrics interrelated and integrated with program Key Performance Parameters (KPPs), Developmental Test Success Criteria, Operational Test Entrance Criteria, risk management, EVM and cost reporting? [3.3.4.3.C2]

3.3.4.3.Q10: How are program metrics, including software metrics, used to measure technical performance and to manage the program? [3.3.4.3.C5]

References

Earned Value Management. http://www.acq.osd.mil/pm/; https://acc.dau.mil/evm; www.ndia.org.

Risk Management Guide for DoD Acquisitions. 6th Ed. (Version 1.0). Office of the Deputy Under Secretary of Defense for Acquisition and Technology, Systems and Software Engineering. http://www.acq.osd.mil/sse/ed/docs/2006-RM-Guide-4Aug06-final-version.pdf.

Factor 3.3.5 – Information Management (IDE, IT, Data Rights)

Pre-Milestone B and C

Note: The questions below apply primarily to pre-Milestone B and C reviews, except where an information management system has been implemented for Concept Development contracts that may be carrying over into the TD phase (Milestone A decision). Information Assurance (IA) policy and requirements are addressed in section 4 of this document

Criteria

3.3.5.C1: Program managers should establish a data management system within the Integrated Digital Environment (IDE) that allows every activity involved with the program to cost-effectively create, store, access, manipulate, and exchange digital data. This includes, at minimum, the data management needs of the system engineering process, modeling and simulation activities, test and evaluation strategy, TEMP, and other periodic reporting requirements.

3.3.5.C2: The program Integrated Digital Environment should be part of a larger DoD IDE and it should keep pace with evolving IT and provide ready access to anyone with a need-to-know, as determined by the program manager.

3.3.5.C3: Data management defines the policies, guidance, processes and tools used to produce data and to make data discoverable, accessible, usable and trusted.

3.3.5.C4: Industry partners are strongly encouraged to develop and implement IDE solutions that best meet the needs of their preferred business model. The program IDE should take maximum advantage of and have minimum impact on existing industry IDE.

3.3.5.C5: New contracts should require the contractor to provide on-line access to certain programmatic and technical data.

3.3.5.C6: The program manager should address the status and effectiveness of the IDE at milestone reviews and at other appropriate decision points and/or program reviews.

3.3.5.C7: The Milestone Decision Authority (MDA) shall not approve program initiation or entry into any phase that requires milestone approval for an acquisition program (at any level) until the DoD Component Chief Information Officer (CIO) confirms or certifies (for MAIS only) that their IT system is being developed in accordance with the Clinger Cohen Act (CCA).

3.3.5.C8: A financial management IT system shall be considered either mission-critical or mission essential if it meets the requirements as defined by the CCA.

3.3.5.C9: The DoD categorizes intellectual property (IP) into two main categories, most commonly referred to as "patent rights" and "technical data and computer software rights." The statutory provisions for U.S. patent law are found exclusively in Title 35 of
the U.S. Code. FAR Part 27 prescribes policies, procedures, and contract clauses pertaining to patents and directs agencies to develop coverage for rights in data and software. DFARS Part 227 provides the related policy guidance for Defense contracts. In general, under the FAR and DFARS, the government acquires certain rights (subject to negotiation) in IP that is created in the performance of work under a government contract or subcontract.

3.3.5.C10: PMs should integrate IP considerations fully into acquisition strategies for advanced technologies in order to attract commercial business to the DoD market place.

3.3.5.C11: PMs should respect and protect privately developed IP because it is valuable and critical to the financial strength of the contractor and the contractor's future success.

3.3.5.C12: Negotiate and resolve all IP issues prior to contract award by clearly identifying and distinguishing the IP deliverables from the license rights in those deliverables that do not adequately balance the interests of the government.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.5.Q1: Do you have a data management system for electronically sharing program data and information? Who maintains the programs information and content? (3.3.5.C1)

3.3.5.Q2: Who manages the data management systems? Who maintains and upgrades the system server and software? (3.3.5.C2)

3.3.5.Q3: What is the process and procedure for entering program information into the data management system? Who approves the information that will be posted by the government and contractor? (3.3.5.C3)

3.3.5.Q4: What types of program information, content and deliverables are posted to the data management system? (3.3.5.C5)

3.3.5.Q5: Do you have a classified and unclassified system? Who is the system administrator for the classified and unclassified system / network? (3.3.5.C1 and 3.3.5.C2)

3.3.5.Q6: Did your CIO confirm or certify that your IT system is being developed in accordance with the Clinger Cohen Act (CCA)? Is your financial management system certified? (3.3.5.C5, 3.3.5.C7 and 3.3.5.C8)

3.3.5.Q7: What contracts allow for proprietary and IP deliverables? (3.3.5.C9 and 3.3.5.10)

3.3.5.Q8: What is the process and procedure for integrating contractor IP and information to the data management system for use by the project team? (3.3.5.C11 and 3.3.5.C12)

3.3.5.Q9: What IP deliverables and license rights have been identified which required contract negotiations to resolve? (3.3.5.C12)

3.3.5.Q10: How is the data management system partitioned and used by the multiple contractors and government offices? (3.3.5.C1 and 3.3.5.C2)

3.3.5.Q11: What government field activities and contractors access the data management system? (3.3.5.C1 and 3.3.5.C2)

3.3.5.Q12: How are the contractors IP rights protected? (3.3.5.C11 and 3.3.5.C12)

References

Integrating Risk Management with Earned Value Management. Arlington, VA: National Defense Industrial Association (NDIA).

NDIA Program Management Systems Committee (PMSC) ANSI/EIA-748-A Standard for Earned Value Management Systems, Intent Guide. Arlington, VA: NDIA, January 2005.

NDIA PMSC Surveillance Guide. Arlington, VA: NDIA, October 2004.

Factor 3.3.6 – Management of Dependencies and External Interfaces (FoS / SoS)

Pre-Milestone A

Criteria

3.3.6.C1: System of systems (SoS) engineering deals with planning, analyzing, organizing, and integrating the capabilities of a mix of existing and new systems into a SoS capability greater than the sum of the capabilities of the constituent parts (Defense Acquisition Guidebook, Ch. 4).

3.3.6.C2: The DoD Architecture Framework (DoDAF) shall be used as a guide for the development of SoS and FoS architectures. The DoDAF is intended to ensure that architecture descriptions can

be compared and related across programs, mission areas, and ultimately the warfare enterprise, thus enabling interoperability and net centric warfare.

3.3.6.C3: Joint capability objectives shall be translated into a high-level draft CDD for the SoS. PMs and systems engineers need to understand the core top level requirements for the SoS prior to entering the technology development phase.

3.3.6.C4: A Family of Systems (FoS) can be a subset of a SoS and typically uses a common architecture with modular or unique mission equipment packages to satisfy the program requirements. Greatest value is achieved through the broad use of commonality.

3.3.6.C5: The SoS and FoS initial capabilities document (ICD) should describe the interoperability and critical dependencies between the joint systems that currently exist and the future systems that require technology development.

3.3.6.C6: The SoS and FoS technology development strategy (TDS) should address the concept development, refinement and test strategy in the Systems Engineering Plan (SEP) and T&E Strategy (TES).

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.6.Q1: What office will or should have the Systems Engineering and Integration responsibility and funding necessary to manage and integrate the FoS and SoS segments? [3.3.6.C1]

3.3.6.Q2: Describe the *{Service Name}* core and complementary systems and the systems from other Services this program must integrate. What are the critical dependencies within these systems that compose the SoS?

- Do the OV and SV architectures reflect these critical dependencies?
- Have they been adequately captured in the technology development strategy (TDS)? [3.3.6.C1, 3.3.6.C2 and 3.3.6.C3]

3.3.6.Q3: Is the SoS clearly defined in a joint initial capabilities document (ICD)? [3.3.6.C5]

3.3.6.Q4: What are the common requirements and interfaces of the FoS? [3.3.6.C4]

3.3.6.Q5: Does the SEP and TES address the interface interdependency plans for development and test. [3.3.6.C6]

Pre-Milestone B and C

Criteria

3.3.6.C7: All programs responding to a capabilities or requirements document, regardless of acquisition category, shall apply a robust systems engineering approach that balances total system performance and total ownership costs within the family of system (FoS), and system of systems (SoS) context.

3.3.6.C8: FoS and SoS materiel solutions usually require systems delivered by multiple sponsors and materiel developers requiring non-traditional systems integration and overarching program management of individual systems.

3.3.6.C9: Three key aspects of FoS and SoS systems engineering are its governance, interoperability, and overall asset management. The PM should establish a FoS/SoS Systems Engineering and Integration lead for the program.

3.3.6.C10: The PM should develop a schedule which shows FoS/SoS dependencies and alignment of event driven technical reviews, major milestones, and test phases for individual systems within the SoS.

3.3.6.C11: The boundary and scope of the SoS is understood by the PM and system engineers and the SoS is adaptable to boundary and scope changes over time. All systems included in the SoS should be identified. Interfaces from the SoS to external systems should be defined and scoped. Specific stakeholders of the SoS and its systems should be identified, including their organization. Identification of the users for each system is key.

3.3.6.C12: In a SoS program, the technical planning process must be initiated top-down but iterated within individual systems until a consensus approach is agreed upon and resourced. Systems engineers from across the SoS must share data and plans and engage as part of a collaborative team for the SoS. It is important to recognize the value of a collaborative SE team and value of integration facilities, which promote open and active exchange and experimentation among members of the SoS SE team.

3.3.6.C13: The program should have a structured Systems Engineering Plan (SEP) and Test and Evaluation Master Plan (TEMP) to assess how well it is meeting SoS / FoS performance thresholds and user capability objectives and to provide positive feedback during the SDD phase of the program.

3.3.6.C14: The program has created measurable metrics and defined methods to collect data to measure SoS performance. These metrics and methods can be applied over the life of the SoS and leverage data from development and operational test events.

3.3.6.C15: The SoS design is agile and expandable to integrate future requirements and minimize performance impacts associated with integration issues of individual systems.

Focus Questions

[Pertinent criteria numbers follow each question]

3.3.6.Q6: Effective management and organization are critical to the synchronized and effective engineering and integration of multiple, independent programs and systems into a SoS. What is the SoS structure of authority for allocating resources to coordinate all SE activities? [3.3.6.C7]

3.3.6.Q7: Is there a designated FoS/SoS Systems Engineering and Integration Lead for the program?

- What is their authority to reallocate resources (funding and manpower) from the "fast movers" to 'slow movers' to field the capability together? [3.3.6.C8]

3.3.6.Q8: Is the SoS clearly defined in a CDD/CPD?

- Do the CDD/CPDs clearly lay-out increment or block upgrade requirements?
- Is there a commitment to maintain stable requirements within the SoS? [3.3.6.C9]

3.3.6.Q9: What are the core and complementary systems within the SoS?

- What are the critical dependencies within these systems that compose the SoS?
- What systems from the other Services must this program communicate with?
- Do the OV and SV architectures reflect these critical dependencies?
- Have they been adequately captured in the system specifications? [3.3.6.C10]

3.3.6.Q10: Describe the plan to manage the critical dependencies within the SoS.

- Explain the management system that will have to be put in place to maintain stable requirements across all segments within a system of systems, to foster "harmonious" development.
- What are the plans to conduct trade studies across the SoS?
- How is configuration management implemented across the SoS? [3.3.6.C11]

3.3.6.Q11: What office has the Systems Engineering and Integration responsibility, authority, accountability (RAA) and funding necessary to manage and integrate the systems, FoS, and SoS segments?

- Is the SE&I lead empowered to integrate the programs within the SoS, and reallocate resources (e.g. funding and manpower) within the SoS from the "fast movers" to the "slow movers" program to keep the establishment of the SoS capability on track?
- Is there adequate "white space" in the systems integration schedule?
- Is the SE&I lead synchronizing work efforts, funding, and schedules? [3.3.6.C12]

3.3.6.Q12: FoS and SoS interoperability is more than just information exchange. It not only includes a multi layer network, but individual systems, processes, procedures, organizations and missions that support the life cycle of the SoS and balanced with information assurance.

- What is the lowest risk interface to the network in the SoS?
- What is the highest risk interface?
- How do you plan to demonstrate full up interoperability prior to IOT&E? [3.3.6.C13]

3.3.6.Q13: Are requirements and schedules for all systems within the SoS being synchronized?

- Are the EVM systems for all SoS core programs linked? Is the EVM system for any of the complementary programs linked? What is the plan to maintain stable requirements within the SoS?
- What's the approach for conducting CAIV trade-off analyses at the system, FoS and SoS level? [3.3.6.C14]

3.3.6.Q14: How will FoS/SoS interfaces be managed? And what is the plan to resolve issues that cross PM, PEO, and Service lines?

- Have Interface Control Documents been identified/developed and Interface Control Working Groups been assigned?
- Provide a summary of the Memorandums of Agreement (MOAs)
- Do the MOAs include any "triggers" that require a FoS/SoS member to inform the others if there is a cost, schedule, or performance deviation?
- How are hardware and software upgrade programs for the FoS/SoS linked?
- What is your top SoS net-centric acquisition risk? [3.3.6.C14]

3.3.6.Q15: How are changes in SoS constituent systems negotiated with their PMs? [3.3.6.C14]

3.3.6.Q16: How are upgrades to the SoS managed, e.g. spin outs, increments, blocks? [3.3.6.C14]

3.3.6.Q17: What are your management metrics and leading indicators for measuring progress toward end goals (completion) for individual systems within the FoS / SoS? [3.3.6.C14].

3.3.6.Q18: Who will have the ability to keep the development of the SoS program on track?

- Discuss the management of the complementary programs and the allocation of resources (people, work and funding) to keep the program on track. [3.3.6.C15]

3.3.6.Q19: Does the TEMP reflect an appropriate level of interface testing?

- Does it call out compliance testing with interoperability standards?
- Have technical interoperability metrics been developed? (message completion rate, speed of service, etc) [3.3.6.C15]

References

Department of Defense Architecture Framework, Volume 1: Definitions, Guidelines, and Background. Washington DC: Department of Defense, November 2003.

Office of the Deputy Under Secretary of Defense for Acquisition and Technology, Systems and Software Engineering. Systems Engineering Guide for System of Systems, Version1.0. Washington, DC: Department of Defense, August 2008.

Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)). "Policy for Systems Engineering in DoD." Memorandum, Feb. 20, 2004.

SUB-AREA 3.4 – CONTRACTING

Description: As defined by the Defense Acquisition System (DAS), the acquisition of a capability may begin at any Milestone, depending on the technical opportunities available and the user needs. The approach may also include blocks of capability growth, which evolve to the full planned capability.

Contracting for goods and services is fundamental since the functions inherent in systems acquisition, such as analysis, design, development, test, production, sustainment, modification, and disposal of systems are accomplished through contracts with private industry.
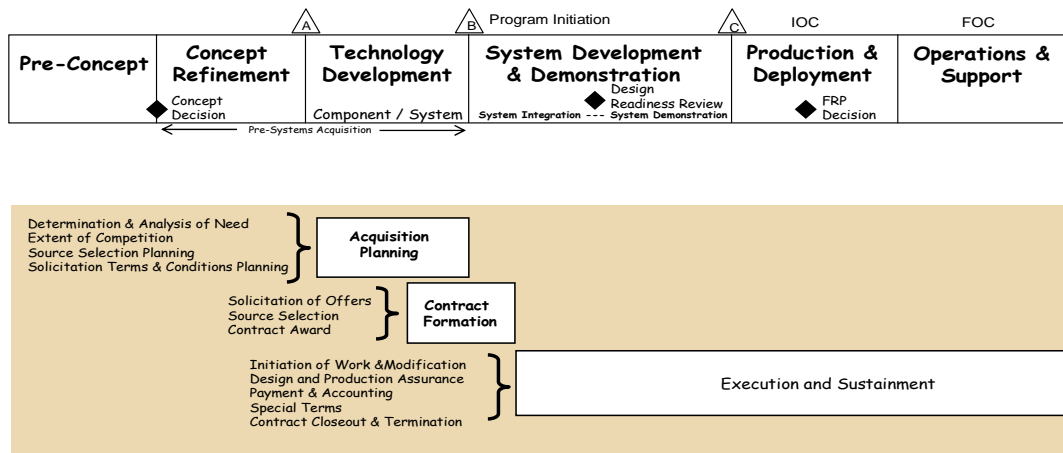
Figure 3-3 Contracting Management Process

Figure 3-3 shows the contracting management process for efforts that enter Milestone B, but the process is applicable at any entry point:

Acquisition Planning is the process of identifying and describing requirements and determining the best strategy for meeting those requirements, which is ultimately reflected in the Request for Proposal (RFP). The PMO documents the programmatic and technical requirements, develops the top level program approach and performs an initial risk assessment. The goal is to develop a program strategy, (for both the total program and any particular contract to support the overall strategy) which can be expected to reasonably meet all requirements, within program budget, at acceptable risk.

The second stage is Contract Formation, which begins with RFP issuance. However, industry efforts actually begin long before the final RFP. In the initial portion of this stage, industry leads in developing proposals in response to the RFP. In the latter portion, the lead shifts back to the government for the proposal evaluation, source selection and contract award tasks. During this stage, offerors finalize their program planning, focusing on the specific items requested in the RFP.

They develop Work Breakdown Structure (WBS) and IPT structures, present their program approach in an Integrated Management Plan (IMP) and Integrated Master Schedule (IMS), and expand the system requirements and technical requirements. Risk management plans are expanded into specific mitigation techniques and the program cost estimate is completed. Contract award ends this stage.

In Execution and Sustainment, the third stage, the focus is on program management activities in managing risk and addressing the impact of change. An integrated tool set is used in this stage to provide program insight to all levels of government and industry management. Contents of the tool set vary with the program, nevertheless includes, at a minimum, the IMS, Earned Value Management System (EVMS), and program metrics.

Scope: The assessment of this sub-area deals with the effectiveness of the contracting management process to satisfy the stakeholders in terms of cost, quality, and timeliness of the delivered product.

Perspective: Major contractors have shifted toward system integration as a business strategy and core competency. This shift has increased the already significant share of program dollars expended on subcontracts, and it is important that we refocus our attention on subcontractor performance (How is the contractor managing its subcontractors?) Subcontracting management is a concept that addresses subcontracting issues and the government's role in ensuring successful prime contractor interaction with subcontractors, in order to satisfy prime contract requirements. Subcontracting management also includes government oversight of the contractual action entered into by a prime contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services under a prime contract.

The government provides the leadership role in the acquisition planning stage; however, early industry inputs can provide critically important insights into both technical challenges and key business motivations. Industry begins working with the users in the early stages of the requirements process. Their program planning activities begin very early in the government cycle—Industry actually accomplishes a great deal of work during this Program Definition Stage and has insights that can be extremely valuable (Figure 4). Competitors have frequently accomplished the Bid/No Bid decision analysis, structured an approach and perhaps even initiated the draft proposal. Early and frequent industry involvement in the strategy formulation provides valuable insight into both the technical and business aspects of the program. Building the strategy incrementally, with ongoing industry interaction is key to a successful Program Definition Stage and a well-structured RFP.

Opportunities for miscommunication are extensive, while opportunities for program synergism through open communication are equally prevalent. This synergism through parallel development is essential for a successful program implemented in an acceptable and reasonable cycle time.

Factor 3.4.1 – Prime Contractor Management

Pre-Milestone A, Pre-Milestone B and Pre-Milestone C

Criteria

3.4.1.C1: The acquisition team has been identified and resourced with subject matter experts and managers. Though the team is tailored to meet specific program needs within the acquisition life cycle, at a minimum, it consists of: the program manager, technical experts, the contracting officer, contract specialists, logistics experts, transportation experts, configuration managers, and legal counsel.

3.4.1.C2: The PM's focus in acquisition planning is on the business and technical management and technical approaches designed to achieve program objectives within specified resource constraints and the procurement and contracting strategies necessary for implementation. Within acquisition planning, the following contracting processes and associated focus areas have been definitively addressed:

3.4.1.C2a: *Determination and Analysis of Need* - forecasting and planning of the acquisition requirements, as well as developing and updating Acquisition Plans and Authorizations, as required.

3.4.1.C2b: *Extent of Competition* – determination if available sources have the qualifications to use competition as an effective tool for driving risk out of a program and achieving performance targets within a reasonable timeframe (e.g., down-selecting strategies).

3.4.1.C2c: *Source Selection Planning* – establish criteria to determine that the selected source(s) results in the lowest Total Ownership Cost (TOC) consistent within the budget and delivery of an end item that meets the user's needs.

3.4.1.C2d: *Solicitation Terms and Conditions* – developed to minimize the risk of a solicitation not meeting performance, cost and schedule requirements.

3.4.1.C3: The Request for Proposal (RFP) clearly captures and articulates the requirements definition, any programmatic constraints, and a succinct explanation of the overall strategy and priorities in the form of guidance to the contractor.

3.4.1.C4: The focus in contract formation – the proposal preparation and evaluation period between RFP release and contract award - is primarily on the contractor's approach to effectively turn the overall programmatic and technical requirements into an executable program. Key to the

success of contract formation is the development of the program structure, the continual assessment of risks, and the refinement of the cost estimates. Within contract formation, the following areas are definitively addressed:

3.4.1.C4a: *Solicitation of Offers* – ensures that all qualified offerors are afforded the opportunity to compete for contract award necessary to meet the government requirements, through the preparation of a quality solicitation, the publication of the proposed procurement, the reception of offers and clear and direct communication with offerors to minimize the impacts of any misunderstandings.

3.4.1.C4b: *Source Selection* – select a source competitively that meets program objectives and requirements.

3.4.1.C4c: *Contract Award* – prepare and issue the contract.

3.4.1.C5: The program's third phase – execution and sustainment - is being successfully completed through insight into program progress, and the effective management of the impact of changes, whether these changes are due to contract execution or to external influences. As the program progresses, the PM makes viable and timely decisions and provides direction to accommodate changing circumstances. Focus is maintained on the risk areas most likely to impact the program. The PM uses those indicators developed in the previous stages, i.e., EVMS, IMS and appropriate metrics, for primary program insight. The following areas are definitively addressed:

3.4.1.C5a: *Initiation of Work and Modification* – plan for proper contract administration, conduct necessary post award briefings, determine the need to consent to subcontracts, implement the appropriate subcontracting requirements, and properly administer proposed modifications, options, and tasks/delivery order contract.

3.4.1.C5b: *Design and Production Assurance* – monitor the performance of the contractor against contract requirements to enable timely corrective action.

3.4.1.C5c: *Payment and Accounting* – Contracting Officer delineates the payment and accounting terms in the contract, and the Comptroller adds / subtracts accounts as required.

3.4.1.C5d: *Special Terms* – primarily dealing with property administration of the contract.

3.4.1.C5e: *Contract Closeout and Termination* - ensures equitable results for both the government and the contractor.

Focus Questions

[Pertinent criteria numbers follow each question]

3.4.1.Q1: What are the organization and skills of the acquisition team?

- What is the composition of the team?
- Is the Contracting Officer warranted? To what level? [3.4.1.C1]

3.4.1.Q2: Has a Memorandum of Agreement (MOA) been developed and signed between the PM and the Contract Administration Officer (CAO) (usually Defense Contract Management Agency (DCMA))?

- How does the MOA identify the overall DCMA/PM relationship during contract performance?
- How does the MOA address the PM's issues and concerns in the development of functional program surveillance plans (i.e., contractor cost, schedule and technical performance)? [3.4.1.C1]

Acquisition Planning

Determination and Analysis of Need

Note: Focus is on the forecasting and planning of the acquisition requirements, as well as developing and updating acquisition plans and Justifications and Authorizations, as required

3.4.1.Q3: In regard to the forecasting of requirements, to what detail has the acquisition team accomplished the following contracting functions:

- Future acquisition requirements?
- Policies and long range strategies for enhancing competition, minimizing costs, reducing lead times, etc.?
- Organization of the acquisition team to meet the anticipated, aggregate requirements?
- The consolidation and forecasting of requirements that are likely to be incorporated in purchase requests during the next several fiscal years?
- Economic order quantities and a tentative schedule of purchases? [3.4.1.C2a]

3.4.1.Q4: In regard to the forecasting of requirements, to what detail has the acquisition team accomplished the following programmatic functions:

- Preparation of program plans, cost estimates, and schedules and the determination of priorities, to include:
  – Program needs (i.e., technical objectives)?
  – The identification and sequencing of tasks to accomplish overall objectives for each sub-objective?
  – The identification of sub-objectives and related responsibilities for each task?
  – Resources needed?
  – Length of time for each objective?
- Identification of systems, subsystems, equipment, and components required by program phase? *Note: Included are items for Joint Programs, Foreign Military Sales, developmental testing, Commercial Off the Shelf/Non Developmental Items (COTS/NDI) assessment, training, integration testing, qualification testing, options, etc, as applicable. The following were should be considered:*

- Prototype units

- Pre-production units

- Low/Full-Rate production units

- Spares

- Test equipment/tooling, software, government-furnished property (GFP), etc., required by program phase?

- Services required by program phase:
    - Hardware/software design/development/support?
    - Systems integration?
    - Production?
    - Depot/maintenance?

- The identification of documentation and data requirements:
    - Specifications?
    - Design analyses and test reports?
    - Technical Data Rights? [3.4.1.C2a]

3.4.1.Q5: In regard to contract planning, to what detail has the acquisition team accomplished the following contracting functions:

- Procurement related data from program and project planning and Pre-Procurement Planning Conferences, including:
    - Supplies and services to be procured?
    - Acquisition histories on needed supplies and services
    - Findings of market research?
    - Decisions on whether to use pre-solicitation notices, conferences, et al.?
    - Alternative techniques to enhance competition and breakeven points?
    - Program baselines (milestones, cost, and performance)?

- The review and organization of all elements required for plans, such as: sources, competition, source selection procedures, contracting considerations, budgeting and funding, small business opportunities and patent rights, product descriptions, priorities, allocations and allotments, contractor versus government performance, management information requirements, make or buy, test and evaluation, logistics considerations, GFP, government-furnished information, environmental considerations, security considerations, and milestones?

- Concurrence and approvals from:
    - Contracting Officer?
    - Competition Advocate?
    - Legal, finance, and other supporting offices?

- Contract type appropriate for the program requirements such as fixed price, cost reimbursement, incentive, indefinite delivery, time and material/labor hour, basic agreements/basic ordering, and letter?
- Preparation and process of the Justification & Approval (J&A) or Determination and Findings?
- Plan of action and milestones for significant actions through contract award, including assembly of the solicitation package and status meetings?
- Selection of technique(s) for testing and improving the government's description of required supplies and services? These include:
  - Design competition (contract for specification and prototype development)
  - Industry panels to assist in specification development
  - Solicitations for information or planning purpose
  - Pre-solicitation notices
  - Pre-solicitation conferences [3.4.1.C2a]

3.4.1.Q6: In regard to contract planning, to what detail has the acquisition team accomplished the following programmatic functions:

- Identification of the technical actions required to successfully complete program and procurement milestones?
- Identification of the overall procurement requirements and associated program budget?
- Program and the constraints placed on the procurement?
- Market research results, including previous procurements, related programs, and historical problems as they affect technical issues?
- Identification of sources, budgeting and funding, product descriptions, priorities, allocations, and allotments, contractor versus government performance, management information requirements, make or buy, test and evaluation, logistics considerations, GFP, government-furnished information, environmental considerations, security considerations, and milestones?
- Deliverable Quantities/Options – the identification of procurement requirements, including options, breakout considerations, and Foreign Military Sales?
- Preparation of the contract line item structure and data requirements?
- Plan for the requirements for the contract Statement of Objectives/Statement of Work (SOO/SOW)/Specification/Contract Data Requirements List (CDRL), including Risk Management, Systems Engineering, Configuration Management, Technical Data Package, Logistics Support, Program/Design Reviews, IPTs Implementation, Acceptance Requirements, and Schedule?
- Acquisition approach/requirements:

- Warranty requirements?
- Requirements for Contract Administration Office (CAO) MOA and/or Letter of Delegation?
- Requirements for Sections L and M of the solicitation?
- Contract cost, schedule and performance reporting requirements?
- Significant actions, including status meetings, through contract award, and a plan for completion?
- Technical evaluation/response to Contracting Officer regarding offeror comments and pre-award inquiries? [3.4.1.C2a]

3.4.1.Q7: In regard to purchase requests, to what detail has the acquisition team accomplished the following contracting functions:

- Review of the Purchase Requests (PR) for completeness and adequacy?
- Establishment and maintenance of the contract file?
- Control data on the acquisition?
- Contract Clauses, to include Federal Acquisition (FAR)/Defense FAR Supplement (DFARS) clauses that are applicable to the program, including consideration of: Acquisition Streamlining, Competition requirements, Correction of Deficiencies, Materials and Workmanship, Warranty, Inspection/Delivery Requirements, and Data Rights?
- Synopsis for the Commerce Business Daily? [3.4.1.C2a]

3.4.1.Q8: In regards to PR, to what extent has the acquisition team accomplished the following programmatic functions:

- Section B: Supplies and Services Line Items?
- Section C: SOO/SOW, Specification, Technical Data Package?
- Section D: Packaging and Marking?
- Section E: Inspection and Acceptance?
- Section F: Period of Performance or Delivery?
- Section G: Contract Administration Data?
- Section H: Special Contract Requirements?
- Section I: Contract Clauses?
- Section L: Instruction to Offerors?
- Section M: Evaluation Factors for Award?
- Funding Citation?
- Any applicable justifications and/or waivers? [3.4.1.C2a]

3.4.1.Q9: In regard to government-furnished property (GFP), to what extent has the acquisition team accomplished the following contracting functions:

- Preparation of any necessary justifications/certifications and/or Determinations and Findings?
- Determination if GFP contracts are available to purchase the items? [3.4.1.C2a]

3.4.1.Q10: In regard to GFP, to what extent has the acquisition team accomplished the following programmatic functions:

- Trade studies to establish the requirement for furnishing GFP or use of DoD supply sources by the contractor?
- GFP requirements and their availability? *Note: Determine if coordination is required with another PM, Service, or Agency to procure the GFP and provide notification for their advance planning. Identify the configuration, quantity and timing of the GFP that must be supplied to the prime contractor.*
- The provision of the supporting rationale as appropriate, or establish alternate requirements? [3.4.1.C2a]

3.4.1.Q11: In regard to services contracts, to what extent has the acquisition team screened PRs for requests to acquire personal services or advisory and assistance services? [3.4.1.C2a] *Note: Determine if there is sufficient justification, approvals, and legal authority to make such acquisitions. Where applicable, request Wage Determinations for incorporation into the solicitation*

3.4.1.Q12: In regard to services contracts, to what extent has the acquisition team prepared the following:

- SOW?
- Period of performance?
- Deliverables?
- Sections L and M of the RFP? [3.4.1.C2a]

3.4.1.Q13: Is there sufficient funding to commit prior to solicitation release?

- Is there enough funding to support the technical requirements? [3.4.1.C2a]

3.4.1.Q14: In regard to market research, to what extent has the acquisition team accomplished the following contracting functions:

- Obtained data from acquisition histories and other DoD sources?
- Collected and compiled additional market information?
- Determined whether and how to initiate exchange of information with prospective offerors prior to soliciting? Coordinated and participated in early exchanges?
- Estimated the proper price level or value of the supplies or services to be purchased? [3.4.1.C2a]

3.4.1.Q15: In regard to market research, to what extent has the acquisition team accomplished the following programmatic functions:

- Conduct of trade studies to evaluate alternatives and associated risks? [3.4.1.C2a]   Note: As part of the trade study, consider producibility, supportability, reliability, cost and schedule as well as performance
- Whether COTS/NDI is applicable?

Extent of Competition

Note: Focus is on determining if the qualifications of available sources are sufficient to meet program needs

3.4.1.Q16: In regard to sources, to what extent has the acquisition team accomplished the following contracting functions:

- Availability of qualified sources?
- Determination if the source can meet the need?
- For commercial sources, review of acquisition histories, conduct of market research, and preparation of source lists of identified sources?
- Verification that a Qualified Bidders List, Qualified Manufacturers List, or Qualified Parts List (QBL/QML/QPL) applies to the procurement?
- Determination from market research whether unlisted firms or products may be able to meet the minimum functional need? [3.4.1.C2b]

3.4.1.Q17: In regard to sources, to what extent has the acquisition team accomplished the following programmatic functions:

- The establishment of technical requirements (e.g., Performance, Interchangeability, Quality, Maintenance Concept, Technical/Logistics Documentation) for evaluating potential sources? *Note: If schedules and technical requirements restrict competition, data must be available to justify the restriction*
- Determination whether qualifications of outside vendors and products not on the QBL/ QML/QPL meet the minimum functional need? [3.4.1.C2b]

3.4.1.Q18: In regard to competition requirements, to what extent has the acquisition team accomplished the following contracting functions:

- Determination that a set-aside is appropriate or if a competition should be limited to establish or maintain an industrial base?
- Determination whether full and open competition can be obtained. If not, determine whether to solicit from a limited number of sources or from a sole source?
- Identification of any international agreement that restricts competition?
- Preparation of the justification for other than full and open competition?
- Clearances/approvals from the Competition Advocate and/or other responsible officials?
- Preparation of a synopsis? [3.4.1.C2b]

3.4.1.Q19: In regard to competition requirements, to what extent has the acquisition team accomplished the following programmatic functions:

- Preparation of supporting justification (e.g., lead time requirement, standardization program, limited rights in data, industrial base mobilization, and an essential engineering, development, or research capability) if recommending other than full and open competition?
- Production competition, with associated risks, below the end-item, such as:
  - Subcontract competition?
  - Component/subsystem breakout?
- Assessment of past performance histories of potential suppliers? [3.4.1./C2b]

Source Selection Planning
Note: Objective is to establish criteria to determine that the selected source(s) results in the lowest expected Total Ownership Cost consistent with the PM's budget and delivery of an end item that meets the user's needs

3.4.1.Q20: In regard to source selection planning, to what extent has the acquisition team accomplished the following contracting functions:

- Determination whether to solicit for lease, purchase, or both?
- Identification of applicable factors, such as multiple award, Buy American, energy efficiency, transportation, TOC for solicitation, multiyear options, reverse auction, and Cost as an Independent Variable (CAIV)?
- Selection of non-price evaluation factors (if any) for award and determination how the government will apply the factors (e.g., as go/no-go or rating factors) to screen out high risk bids or proposals? *Note: Determine whether to award to the Lowest Priced, technically acceptable proposal or through a trade-off analysis. Organize and brief the source selection team. The higher the business and technical risk, the greater the emphasis on factors other than price*
- Determination of the method of procurement or purchasing (sealed bid, two-step sealed bid, competitive proposals) and soliciting quotes/proposals? [3.4.1.C2c]

3.4.1.Q21: In regard to source selection planning, to what extent has the acquisition team accomplished the following programmatic functions:

- Determination of the product's expected life and life cycle cost, considering factors such as:
  - Potential obsolescence?
  - Maintenance and repair?
  - Operation?
  - Spares?

- Training?
- The establishment of technical criteria for non-price related factors and their relative importance?
- Determination of the product's expected quality and life cycle cost?
- Establishment of the technical requirements for evaluating performance, interchangeability, interoperability, quality, maintenance concept, technical/logistics documentation, and skills?
- Establishment of technical criteria for non-price related factors and their relative importance?
- Evaluation of past performance, personnel qualifications, products proposed by a vendor with different characteristics other than price, and technical realism of proposed resources?
- Performance of technical/non-price factor trade-off analyses and determine the best value or minimum technical requirements for award?
- The review of acquisition history and market research and recommend procurement methods? *Note: For selections based on oral presentations, develop sample technical tasks and evaluation criteria for oral presentations* [3.4.1.C2c]

Solicitation Terms and Conditions (Planning)
Note: Objective is to minimize the risk of a solicitation not meeting performance, cost and schedule requirements
3.4.1.Q22: In regard to solicitation terms and conditions (planning), to what extent has the acquisition team accomplished the following contracting functions:
- Identification of the type of contractual pricing arrangements (e.g., fixed price award fee, cost plus award fee) that will best mitigate and apportion expected risks?
- Use of Incentive Contracts that include definitive, measurable incentives?
- Determination of the appropriate method to solicit for currently unfunded requirements? *Note: Alternatives include blanket purchase agreements, options, and indefinite delivery types of contracts*
- Determination if buyer financing should be used as an evaluation factor, and what type of government financing is available (e.g., progress payments, advance payments, performance based payments, etc.)?
- Whether bonds are required or necessary to protect the government from market risks?
- The method of payment (i.e., impact card, electronic funds transfer, etc.)? [3.4.1.C2d]
3.4.1.Q23: In regard to solicitation terms and conditions (planning), to what extent has the acquisition team accomplished the following programmatic functions:
- Provision of input on program technical risk?

- Identification of program requirements?

- Provision of technical support as required to the contracting team?

- Determination of the product's expected life and life cycle cost, considering factors such as:
    - Potential obsolescence?
    - Maintenance and repair?
    - Operation?
    - Spares?
    - Training?

- The establishment of technical criteria for non-price related factors and their relative importance?

- Determination of the product's expected quality and life cycle cost?

- Establishment of the technical requirements for evaluating performance, interchangeability, interoperability, quality, maintenance concept, technical/logistics documentation, and skills?

- Establishment of technical criteria for non-price related factors and their relative importance?

- Evaluation of past performance, personnel qualifications, products proposed by a vendor with different characteristics other than price, and technical realism of proposed resources?

- Performance of technical/non-price factor trade-off analyses and determine the best value or minimum technical requirements for award?

- The review of acquisition history and market research and recommend procurement methods? *Note: For selections based on oral presentations, develop sample technical tasks and evaluation criteria for oral presentations* [3.4.1.C2d]

Request for Proposal

3.4.1.Q24: How does the Request for Proposal (RFP) clearly capture and articulate the requirements definition, any programmatic constraints, and a succinct explanation of the overall strategy and priorities? [3.4.1.C3]

3.4.1.Q25: Are the following two categories of documentation included in the RFP? If not, PMO should provide explanation.

- Program Documents: Government Roadmap Schedule, Incentive Plan, Government SEP, ISP, TRA, TES/TEMP, and preliminary SPS - may be attached to the RFP or available in a "Bidders Library;" ICD, CDD, other JCIDS documents, COTS/GOTS data, FoS/SoS interface data, and reports from previous phases of the program - typically included in the Offeror's Library. *Note #1: These documents provide background on the program and describe the government's management and technical approach to the system acquisition.*

Note #2: Several of these documents are required for Milestone B and are described in the DAG Chapter 4

- RFP Documents: A typical RFP includes a model contract with any special clauses (e.g., CLINs, SOO or SOW, CDRL), Preliminary WBS, Evaluation Factors (Section M), and Instructions to Offerors (Section L). *Note: The RFP (with the program documents referenced in the RFP) defines the program and sets the basis for the contract* [3.4.1.C3]

3.4.1.Q26: How does Section C (includes Description/Specification/SOO or SOW) of the RFP describe the products to be delivered or the work to be performed under the contract?

- Does it include the government's SOO (or SOW) and preliminary system performance specification? [3.4.1.C3]

3.4.1.Q27: What is listed under Section J (List of Attachments)? *Note: Initial IMP, Top Level Program Schedule, Government SEP, CDRLs, and Contract Security Classification Specification (DD Form 254) [3.4.1.C3]*

3.4.1.Q28: In the preparation of the RFP, was Section M (Evaluation Factors) defined before Section L (Instructions to Offerors)?

- How is Section M of the RFP structured to address only those elements determined to be discriminators in the source selection to select the best proposal with acceptable program risk?
  - Are the evaluation factors measurable?
  - Relevant to the program?
  - Traceable, with expected differentiation among the offers?
  - Under the offeror's control?
- Does Section M contain any evaluation factors or subfactors for which there is not a corresponding request for proposal information in Section L? [3.4.1.C3]

3.4.1.Q29: How does Section L of the RFP instruct the offerors on how to structure their proposal and what should be included in each proposal section?

- How does it clearly identify the structure and composition of each volume and section of the proposal? How does it track to the evaluation factors in Section M? [3.4.1.C3]

Contract Formation

Solicitation of Offers

3.4.1.Q30: In regard to the preparation of the solicitation, to what extent has the acquisition team accomplished the following contracting functions:

- Identification, completion and incorporation of FAR clauses and provisions into the Invitation for Bids (IFB), Request for Quote (RFQ), or Request for Proposal (RFP)?
- Identification of customary commercial terms and conditions and the determination of which to incorporate?

- The assembly of the IFB/RFQ/RFP?
- Made the solicitation available to all parties? [3.4.1.C4a]

3.4.1.Q31: In regard to the preparation of the solicitation, to what extent has the acquisition team accomplished the following programmatic functions:

- Review of requirements documents that authorize the program and define its basic objectives?
- Use of market research to determine whether COTS/NDIs are available to meet program requirements?
- Identification of all organizations and persons who will participate in preparing the SOW, and the determination of the participants' areas of responsibility?
- Preparation of the SOW covering all of the Work Breakdown Structure (WBS) work elements included in the RFP/contract?
- For each WBS work element, the identification of tasks that define the scope of the work effort to satisfy the minimal needs of the program and to identify required data deliverables?
- That only those tasks which add value to the product, whether a management system or technical requirement, are included in the SOW? [3.4.1.C4a]

3.4.1.Q32: In regard to the preparation of the specification, to what extent has the acquisition team ensured that the specification:

- States the actual minimum functional need?
- Encompasses all available products or services that can meet the actual minimum functional need (eliminates any nonessential preferences that may thwart full and open competition)?
- Is stated in terms that the market can satisfy? [3.4.1.C4a]

3.4.1.Q33: In regard to the preparation of the specification, to what extent has the acquisition team accomplished the following programmatic functions?

- Selection of the appropriate non-government specification, military specification, or other applicable specifications?
- Ensures that technical performance requirements are properly contained in the system specification and not in the SOW?
- Review of the requirement documents that authorize the program and define its basic objectives?
- Ensures that the specifications are consistent with the SOW? [3.4.1.C4a]

3.4.1.Q34: In regard to the preparation of Section L, to what extent has the acquisition team ensured:

- That standard FAR required provisions advising the offerors of statutory and DoD requirements are included?
- That formatting information is provided (organizational requirements, volumes, page limitations, cost instructions, etc.)?
- Consistency with the rest of the RFP, such as tasking established in the SOW, evaluation criteria in Section M, and Special Provisions in Section H? [3.4.1.C4a]

3.4.1.Q35: In regard to the preparation of Section L, to what extent has the acquisition team identified contractor critical design, test, and manufacturing technical requirements, such as:
- Critical design processes?
- Design analyses?
- Variability reduction program?
- Cpk requirements?
- Critical production processes?
- Special test equipment?
- Special test requirements?
- Reliability prediction and growth requirements?
- Risk management programs (design, test and manufacturing)? [3.4.1.C4a]

3.4.1.Q36: In regard to the preparation of Section M, to what extent has the acquisition team ensured:
- Evaluation factors/sub-factors are related to the program objectives and reflect the minimum material requirements of the solicitation?
- Consistency with the rest of the RFP, such as tasking established in the SOW, criteria in Section L, and Special Provisions in Section H? [3.4.1.C4a]

3.4.1.Q37: In regard to the preparation of Section M, to what extent has the acquisition team accomplished the following programmatic functions?
- Description of the relative weights of the technical performance factors developed in Section L?
- Ensured that the factors/sub-factors match exactly the factors/sub-factors approved in the Source Selection Plan (SSP)? [3.4.1.C4a]

3.4.1.Q38: In regard to the preparation of CDRLs/DIDs, to what extent has the acquisition team accomplished the following contracting functions:
- Ensured that approved Data Item Descriptions (DIDs) are referenced with the CDRLs?
- Reviewed all CDRLs to determine if reports are necessary and if the number of reports is appropriate? [3.4.1.C4a]

3.4.1.Q39: In regard to the preparation of CDRLs/DIDS, to what extent has the acquisition team accomplished the following programmatic functions?

- Identification, justification, and support of the need for the deliverable data on the contract at a data call?
- Ensured data requirements are based on the Acquisition Strategy? *Note: Data requirements should only be acquired for two purposes:*
    - Information feedback from the contractor for program management, control, and decision making (e.g., cost performance).
    - Information needed to manage, operate, and support the system, depending on the weapon system support concept (e.g., specifications, technical manuals, engineering drawings, etc.) [3.4.1.C4a]

3.4.1.Q40: In regard to the preparation of the Incentive/Award Fee stipulations, to what extent has the acquisition team accomplished the following contracting functions:

- Tailoring of the contract performance elements (e.g., areas of critical program risk) selected for incentive/award fees to key events, then assigning them to appropriate evaluation periods? *Note: The results become the basis of the RFI from potential offerors, as contained in the Instructions to Offerors, without having to ask for extraneous detail. A well thought out list of critical risk areas provides an excellent roadmap for the solicitation* [3.4.1.C4a]
- Ensured that incentive/award fee contracts that are based on contractor process improvements, have some objective measurements to use as a basis for evaluation and incentive/award fee percentage calculation? *Note: The PM should provide the contractor regular, structured feedback to preclude great disparity between what the contractor expects as an incentive/award fee payment and what the government actually pays*
- Contract types (e.g., cost plus or fixed price) are commensurate with the risk associated with each acquisition phase? [3.4.1.C4a]

3.4.1.Q41: In regard to the preparation of the Incentive/Award Fee stipulations, to what extent has the acquisition team accomplished the following programmatic functions?

- The analysis of the SOW and attendant requirements to determine which contract performance requirements should be subject to award or incentive fees? *Note: As a general rule, historically high-risk processes and processes involved with new technologies are usually good candidates for consideration as incentive/award fee elements*
- Specification of the measurable criteria against which contractor performance will be measured?
- Description of the general procedures that will be used to determine the earned incentive/award fee for each evaluation period?
- Consideration of independent labs or facilities to technically support incentive/award fee evaluations?

- From the total incentive/award fee amount to be made available, the specification of evaluation periods and the corresponding amount of award fee available each period?

3.4.1.Q42: In regard to the preparation of the warranty stipulations, to what extent has the acquisition team accomplished the following contracting functions:

- Development of contractual language to implement the warranty?
- The conduct of a warranty cost/benefit analysis? [3.4.1.C4a]

3.4.1.Q43: In regard to the preparation of the warranty stipulations, to what extent has the acquisition team accomplished the following programmatic functions?

- The assessment of warranty conditions for COTS/NDI products?
- Development of warranty terms based on the objectives and circumstances of the acquisition, considering planned operational, maintenance and supply concepts?
- The conduct of a warranty cost/benefit analysis? [3.4.1.C4a]

3.4.1.Q44: To what extent has the acquisition team prepared and publicized in the Commerce Business Daily (CBD)? [3.4.1.C4a]

3.4.1.Q45: To what extent has the acquisition team accomplished the programmatic function of providing technical inputs for preparing and publicizing in the CBD? [3.4.1.C4a]

3.4.1.Q46: To what extent has the acquisition team conducted pre-award inquiries, to include:

- Answering questions about the solicitation?
- Processing Freedom of Information Act (FOIA) requests? [3.4.1.C4a]

3.4.1.Q47: To what extent has the acquisition team accomplished the programmatic function of providing technical responses, when requested, to pre-award inquiries? [3.4.1.C4a]

3.4.1.Q48: To what extent has the acquisition team conducted Prequote/Prebid/Preproposal Conferences, to include providing offerors a public forum to review and question the solicitation, and brief the solicitation? [3.4.1.C4a]

3.4.1.Q49: To what extent has the acquisition team accomplished the programmatic function of providing technical support to Prequote/Prebid/Preproposal Conferences? [3.4.1.C4a]

3.4.1.Q50: To what extent has the acquisition team accomplished the contracting function of determining if there is a need to amend or cancel a solicitation? [3.4.1.C4a]

3.4.1.Q51: To what extent has the acquisition team accomplished the programmatic function of providing technical justification for amendment or cancellation of a solicitation? 3.4.1.C4a]

Source Selection

3.4.1.Q52: To what extent has the acquisition team processed and accepted offers?

- How were offers submitted in response to the solicitation, controlled?
- How was the acceptance period for the offers identified?
- How were delayed offers and late offers provided for? [3.4.1.C4b]

3.4.1.Q53: In terms of proposal price and responsiveness, what were the results of the price reasonableness analysis?

- How was it reasonable?
- How as it responsive to the proposal?
- Was the proposal technically qualified? Why or why not? [3.4.1.C4b]

3.4.1.Q54: To what extent were Quotes and Proposals processed?

- Was the Source Selection Activity (SSA) and Source Selection Evaluation Board briefed prior to receipt of offers on rules and regulations applicable to the conduct of the evaluation process? If not, why not?
- How were proposals determined to be in the competitive range for the purpose of conducting written or oral discussions?
- How does the PM ensure that the source selection "evaluation factors for award" set forth in the Source Selection Plan (SSP) and approved by the SSA, are the same as those in Section M of the solicitation?
- How are late offers/quotes resolved?
- How are technical personnel for proposal evaluation identified and their services solicited?
- How are technical evaluators provided with complete and correct instructions on evaluating technical proposals?
- When awarding on "best value," how are evaluator ratings or scoring of technical proposals reliable and, in terms of the RFP's evaluation factors, valid?
- The Cost/Price Team, chaired by the Contracting Officer, is responsible for evaluating cost/price in order to determine whether:
  - the cost/price is reasonable?
  - the offeror has an understanding of the work?
  - the offeror has the ability to perform the contract?
- Were debriefings of unsuccessful offerors offered?
  - How were they conducted? [3.4.1.C4b]

3.4.1.Q55: To what extent were Quotes and Proposals processed by the programmatic team/functions?

- How were the technical evaluation of proposals performed?
- What were the facts and findings required in the Technical Evaluation Plan and source selection process?
- In support of the Cost/Price Team, what was the assessment of the scope (e.g., labor categories/ mix/hours, materials, etc) of the proposals relative to their respective technical approach?

- Do the findings and recommendations of the Technical Evaluation Board provide sufficient data to:
  - Determine the need for fact finding?
  - Determine the need for amending or canceling the solicitation?
  - Present and support negotiation objectives (i.e., areas of discussion)?
  - Support the Contracting Officer's determination of the competitive range?
- Provide constructive information to offerors regarding their technical proposals after award? [3.4.1.C4b]

3.4.1.Q56: To what extent were past performance, technical and non-price factors addressed applied by the acquisition team?

- How was the latest performance information in the Service's contractor performance assessment reporting system used?
- How were the findings and recommendations of technical personnel to ensure evaluation documentation, was adequate to sustain the government's position on ratings/scoring in a protest forum?
- What were the invited contractor comments?
- How were discrepancies between the contractor version of events and reported past performance information reconciled? [3.4.1.C4b]

3.4.1.Q57: To what extent were past performance, technical and non-price factors addressed by the programmatic team?

- What were the technical evaluations and recommendations on:
  - Technical rating and acceptability of each offer/quote?
  - Technical deficiencies and need for fact finding or clarifications?
  - The relative standing of the offers/quotes, including strengths and weaknesses, with the application of non-price factors?
  - Quality/reliability histories?
- How was an offeror's recent actual performance reviewed as in relevant areas to assess risk? *Note: The offeror's recent and relevant past performance (measured by such indicators as quality, timeliness, cost, schedule, operational effectiveness and suitability) may be considered in assessing the probability of successful accomplishment of the proposed effort in a timely and cost-effective manner* [3.4.1.C4b]

3.4.1.Q58: To what extent did the acquisition team conduct price analysis, negotiations, and audits?

- Prior to soliciting:
  - How was the PR estimate critiqued?
  - How was price-related information during market research collected?
  - What was the forecast for likely prices?

- How were trade-offs investigated?

- After receipt of quotes/offers:
    - How were price-related factors applied to the solicitation, offers, and/or quotes?
    - How were prices evaluated and compared?
    - What was the reasonableness of the proposed prices?
        o How were they determined?
        o Were price-related negotiation objectives for discussion with vendors developed from this reasonable analysis?.
    - How was required pricing information, audit cost, and pricing data obtained?
- How did the programmatic team support the acquisition team's conduct of price analysis, negotiations and audits, in terms of:
    - Technical inputs and analyses?
    - Fact finding/clarification/issues/recommendations?
    - Determining the best trade-offs? [3.4.1.C4b]

3.4.1.Q59: In terms of cost analysis, how were the PM's pre-negotiation positions on proposed elements of cost and profit/fee developed?

- Were the following aspects included?
    - Technical analyses
    - Identification of significant technical factors, including contingencies and assumptions that affected the contractor's proposed cost estimate
    - Should-cost analysis considering, for example, inefficient or uneconomical contractor methods and processes proposed [3.4.1.C4b]

3.4.1.Q60: What is the pre-negotiation plan that establishes objectives, priorities, and potential trade-offs for discussions with the offeror/quoter? [3.4.1.C4b]

3.4.1.Q61: What are the "make-or-buy" programs in the contractor's subcontracting plan?

- Does the contractor require the government's consent for subcontractor selection under the terms of the contract?
- Did the PM review the contractor's purchasing system?
    - What is the adequacy of the contractor's purchasing system and the contractor rating system, including the use of failure/discrepancy reporting data?
    - Were improvements to it negotiated?
    - How was implementation monitored by the government?
- What is the process for the government to monitor compliance with make-or-buy plans? [3.4.1.C4c]

3.4.1.Q62: In the preparation and issuance of the award:

- Is there sufficient funding?
- Who approved the awarding the contract?

- What was government selected outcome?
- Was the contract technical package in compliance with requirements? [3.4.1.C4c]

3.4.1.Q63: In addressing protests, were responses made in the procedures or forums in which the protest was filed? [3.4.1.C4c]

Execution and Sustainment

Initiation of Work and Modification

Note: Objective is to plan for proper contract administration, the conduct of post award briefings, the determination of the need to consent to subcontracts, the implementation of the appropriate subcontracting requirements and the proper administration of proposed modifications, options, and tasks/delivery order contracting

3.4.1.Q64: In terms of planning for contract administration, how were the following actions accomplished/executed?

- The review the contract and related acquisition histories.
    - What is the criticality of the contract?
    - What are the key milestones?
    - How was authority delegated to the Contracting Officers Representative and/or Administrative Contracting Officer?
- The definition of program roles of supporting organizations for:
    - Surveillance of contractor activities?
    - Quality assurance activities?
    - GFP?
    - Program Support Team reporting requirements? [3.4.1.C5a]

3.4.1.Q65: In terms of post award orientations, how were the following actions executed?

- Confirmation of contractor's understanding of key contract provisions and that they match the government's understanding.
- Identification of issues, such as apparent contractor interpretations of technical requirements, which may affect program risks and expectations for mitigation. [3.4.1.C5a]

3.4.1.Q66: How will the subcontractors be controlled by the prime contractor?

- Is consent to a subcontractor required?
- How were applicable subcontracting requirements and goals prescribed by FAR and other directives in the prime contract, such as small, disadvantaged, and minority business set-asides, identified and implemented?
- How were shortcomings in these requirements, such as failure to meet subcontracting goals identified?
    - What are remedies for noncompliance?
        - How will these remedies be invoked?

- Did technical SMEs participate in formal and informal design reviews and vendor conferences to evaluate the subcontractors' technical processes?
    - What were the results?
- What are the metrics and measures for rating subcontractors' processes? [3.4.1.C5a]

3.4.1.Q67: How were contract modifications addressed?

- What were the results of the review of proposed modifications against the scope of work and availability of funds?
- How were proposed modifications analyzed for technical content?
- Was the Contracting Officer consulted on all changes or additions as needed/ [3.4.1.C5a]

3.4.1.Q68: What are the option?

- Verify the validity of an option.
- Determine whether to exercise the option.
- Notify the contractor.
- Provide technical concurrence/non-concurrence for exercise of the option. [3.4.1.5a]

Design and Production Assurance

Note: Objective is to monitor the performance of the contractor against contract requirements to enable timely corrective action

3.4.1.Q69: In terms of monitoring the contractor's performance, to include the inspection and acceptance of product/service:

- What was the feedback on the contractor's performance or deliverables?
- How was evidence of actual or potential performance problems, constructive changes, or other breaches verified and documented?
- How was potential impact of technical issues on cost, schedule, and delivery, and investigate/resolve rationale for potential or actual delays determined?
- How was it determined whether to ratify constructive changes, modify the contract as required, and invoke appropriate remedies?
- How were contractual problems reported by the contractor or government resolved?
- What were the technical criteria for the quality of the product, in-process test procedures and test points, and acceptance criteria through engineering analysis?
- What inspection points were inserted at the most effective areas in production to avoid unnecessary test and inspection points?
- What was the general assessment of performance, quality, and other technical issues? [3.4.1.C5b]

3.4.1.Q70: How are the contract risks monitored by the government? Contractor?

- What is the assessment of contract risks?

- What is the risk management process to identify technical risk as well as cost, schedule, and performance risk? [3.4.1.C5b]

3.4.1.Q71: How are Engineering Change Proposals (ECPs) and alterations affecting cost and schedule addressed to ensure that adequate funding is available and that schedules imposed in the contract are not affected?

- Are the changes within the scope of the contract?
- Was pricing information to support the ECP requested from the contractor?
- After Change Control Board approval, were the following issued?
    - The change request for implementing the change
    - Contract deliverable data requirements
    - Sole source authorization if required
    - Funding documents to be used [3.4.1.C5b]

3.4.1.Q72: What is the PM's process to review requests for waivers and deviations from the contractor and field activities?

- How are they addressed to determine their impact on system reliability and performance, as well as on cost and schedule?
- How is acceptance information for waivers or deviations provided to the Contracting Officer?

3.4.1.Q73: In terms of design reviews, what are the potential impact to the contract (e.g., constructive change clauses, etc.)? [3.4.1.C5b]

3.4.1.Q74: In terms of Integrated Baseline Reviews (IBRs):

- How did the contractor address the government's intent to conduct IBRs after contract award?
- Who developed the guidelines, criteria, and processes for the IBR?
- Who lead the technical assessments during IBRs?
- Upon completion, how are the results of the IBR documented and provided to appropriate team members?
- What action plan is prepared to correct any problem areas discovered during the review?
- What is the process to track corrective actions and interfaces with the contractor during program reviews until the corrective actions are completed? [3.4.1.C5b]

3.4.1.Q75: What is the Configuration Management (CM) process?

- How does it ensure requirements of the contract are consistent with the Acquisition Strategy, such as the decision to buy data rights or other strategies to ensure that a second source can build the hardware?
- What are the hardware/software configuration baselines?

- Who approves and authenticates design disclosure documentation, and grant approval for standardization and substitutions? [3.4.1.C5b]

3.4.1.Q76: What is the potential, if any, resulting from the proposed Single Process Initiative (SPI), on contract performance, such as meeting schedule and cost?

- Should the contract be modified to reflect the cost and schedule impact. [3.4.1.C5b]

3.4.1.Q77: If there are delays during contract execution:

- Were the delays excusable according to their root cause? Was consideration for delays that are fault of the contractor negotiated with the contractor?
- For excusable delays, what were the corrective actions, such as additional time to perform or modification of the requirement that caused the delay? [3.4.1.C5b]

3.4.1.Q78: If there are "Stop Works" during contract execution:

- Determine whether to stop work: prepare and issue the stop work order. Unless the contract is terminated, resume work and modify the contract as necessary.
- Recommend stop work when contractor deficiencies are expected to result in delivery of non-conforming technical products.
- Evaluate contractor proposals to stop work for technical reasons.
- Assess the impact of stop work orders on contractor performance of the technical and programmatic requirements. [3.4.1.C5b]

3.4.1.Q79: What are the stipulations in the contract for remedies?

- How were they identified?
- Does the non-conformance have major or minor program impacts? [3.4.1.C5b]

Payment and Accounting
Note: This is a joint effort between the Contracting Officer and the Comptroller. The Contracting Officer is responsible to delineate the payment and accounting terms in the contract, while the Comptroller adds and subtracts accounts as required

3.4.1.Q80: What is the payment to which the contractor is entitled under the terms and conditions of the contract? [3.4.1.C5c]

3.4.1.Q81: Which costs were classified as unallowable? [3.4.1.C5c]

3.4.1.Q82: How were price adjustments made to the contract for economic terms and conditions, incentives, award fees, and price re-determinations? [3.4.1.C5c]

3.4.1.Q83: How does the PM monitor the contractor's accounting and cost estimating systems and assess the adequacy of those systems?

- What is the contractor's financial health? Is that information being used to protect the government's best interests?

3.4.1.Q84: Are the contractor's accounting practices in compliance with applicable cost accounting standards? [3.4.1.C5c]

Special Terms

Note: Focus is on property administration of the contract

3.4.1.Q85: How is government-furnished property (GFP) administered, controlled and dispositioned?

- What are the requirements for GFP necessary to complete the job? [3.4.1.C5d]

3.4.1.Q86: How is the contractor in compliance with contract provisions on patents, patent infringement, licensing , and government data rights that may be critical to provide life cycle support? [3.4.1.C5d]

3.4.1.Q87: Are the correct contract provisions included to require contractor compliance with contractor workplace requirements regarding labor laws, environment, security, insurance, and small, small disadvantaged, and women owned small businesses? [3.4.1.C5d]

Contract Closeout and Termination

Note: Objective is to administer contract closeout and termination with equitable results for both the government and the contractor

3.4.1.Q88: For claims referencing performance or technical objectives, did the PM provide the Contracting Officer with factory, fleet and field feedback on system performance, reliability, quality etc. to determine if the contractor has a legitimate claim? [3.4.1.C5e]

3.4.1.Q89: If required, what type of termination was implemented *Note: Contracts are terminated for convenience or for cause or default*

- What are the technical reasons for termination (e.g., deficient response to cure notice, continued failure to pass qualification tests, pursuit of alternative methods to satisfy the program needs, failure to perform)? [3.4.1.C5e]

3.4.1.Q90: For closeout of contracts, did the PM:

- Verify that the contract is physically complete?
- Obtain from both the government activities and contractor all forms, reports, and clearances required at closeout, and ensure that both the government and contractor have met all applicable terms and conditions for closeout?
- Settle all outstanding claims, issues or disputes?
- Make final payment and de-obligate funds, if any?
- Prepare contract completion documentation? [3.4.1.C5e]

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The Integrated Project Management Handbook. Dayton Aerospace, Inc. February 2002.

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Trade Studies. Continuous Learning Module CLE026. Defense Acquisition University.

Factor 3.4.2 – Subcontractor Management

Pre-Milestone A, Pre-Milestone B and Pre-Milestone C

Criteria

3.4.2.C1: *[In the event that a prime contractor plans to use the services of subcontractors]* – To ensure successful program performance, there are effective processes and procedures in place between the prime contractor and the subcontractors that identifies and resolves subcontract management issues. In addition, the government fully understands and proactively executes its role in influencing the prime contractor's interaction with its subcontractors.

3.4.2.C1a: The PMO and contractor have adequately addressed pre-award activities during the preparation of the solicitation.

- *Market Research*
  - The PMO has collected and analyzed information about capabilities within the market that will assist the PMO to determine how much competition is available among the sources; the length of time it will take to get the product or service; the amount of schedule/performance/cost risk (dependent on whether the product or service is available commercially, requires modification or must be developed, whether small businesses can do the work, etc.); and the identification of sources, their technical capabilities, estimated prices, and potential terms and conditions such as warranties, data rights, and delivery requirements.
  - The government has keen insight into the teaming arrangements between prime contractors and subcontractors and an indication of who will perform the work.
  - The Statement of Work (SOW)/Statement of Objectives (SOO) were refined with the results to maximize the benefit of competitive market forces.
- *Acquisition Plan* – Sets forth an overall plan for successfully satisfying the mission need in the most effective, economical and timely manner. During its development, the PM and Contracting officer have identified and analyzed future concepts and objectives that direct and control the overall development, production, and deployment of a system. In terms of subcontract management, the following areas have been adequately addressed:

- Sources - Includes consideration of inclusion of small business programs.
- Competition - Continuous competition is encouraged at the subcontract level. Plan addresses how subcontract competition will be sought, promoted, and sustained throughout the acquisition and addresses subcontract competition barriers.
- Make-or-Buy Plan(s) - Government has reviewed and agreed on the prime contractor's decision to do work themselves or to subcontract it.
- Analysis of the Industrial Base – PM has determined the capabilities of the national technology and industrial base to develop, produce, maintain, and support the program. This includes the availability of raw material, composite materials, components, tooling, and production test equipment that are usually procured by primes from vendors and subcontractors. Any discrepancies have been reported to high levels for resolution.
- Subcontractor Influence - If a critical or substantial amount of the work effort is to be performed by a subcontractor, then all areas of planning and strategy that are influenced by it are addressed. Note: Two examples:
    o The plan describes the test program of the contractor and the government as much as possible; this test planning addresses a critical component built by a subcontractor.
    o The plan addresses the requirements and cost for data rights. Data rights flow from the subcontractors to the prime contractors to the government.
- *Risk Management –*
    - PM is able to define subcontracting risk for major subcontractors supporting their program in terms of risk events (things that could go wrong) to a level in which an individual can comprehend the potential impact and its cause.
    - Although the government does not have privity of contract with the sub-contractor, the PM and the Contracting Officer have implement actions, processes and plans to mitigate the risk of an untimely, over-budget, and/or non-compliant delivery of a product or service. These could include the following:
        o Contract type
        o Market research
        o Evaluation criteria
        o Contract administration
        o Integrated Product Teams (IPTs)
        o Sources
        o Schedule
        o Procurement Strategy
        o Statement of Work/Statement of Objectives

- *Contract Types and Incentives* – Depending on acquisition lifecycle phase and program objectives, the government has implemented the right contract type to adjust the amount of risk passed along to the contractor. The prime contractor has allocated appropriate risks between itself and the subcontractor through an appropriate contract type. Incentives have been provided to the subcontractor to meet the government program goals.

3.4.2.C1b: The PMO and contractor have adequately addressed award activities during contract award.

- *Past Performance* – Past Performance of each major subcontractor has been appropriately weighted in comparison with other evaluation criteria in order to emphasize the importance of the prime contractor's experience with subcontract management.
- *Evaluation Criteria* – The following criteria have been adequately addressed:
  - Management capability
  - Past Performance
  - Meeting Small Business Goals
- *Small and Small Disadvantaged Business (SDB) Subcontracting Plans* –
  - The Contracting Officer has encouraged the prime contractor to subcontract with small business concerns to the maximum practicable extent possible.
  - The Contracting Officer has approved the prime contractor's subcontracting plan.
- *"Flow-down" Clauses* – Mandatory and non-mandatory clauses have been "flowed down" from the prime to subcontractor to ensure that the latter will provide adequate assistance or cooperation to enable the former to meet its contractual requirements with the government.
  Note: Examples are:
  - Mandatory –
    o Subcontractor Cost or Pricing Data
    o Subcontractor Cost or Pricing Data – Modifications
    o Audit and Records – Negotiations
  - Non-Mandatory –
    o Changes
    o Inspection of Supplies
- *Commercial Items* – To the maximum extent practicable, the subcontractor has incorporated COTS and NDI as components of items delivered to the government.
- *Certified Cost and Pricing Data* – When proposals are greater than $550,000, the subcontractor will submit certified cost and pricing data.
- *Defense Contract Management Agency (DCMA)* – The PM has established a relationship with DCMA to allow government access to prime contractor and subcontractor facilities for inspection or test.

- *Earned Value Management (EVM)* – The PM has determined that the government should perform earned value system surveillance on the subcontractor, due to one or more of the following reasons:
    - The prime contractor is unable to accomplish the required surveillance because it would jeopardize the subcontractor's competitive position or proprietary data is involved;
    - There is a business relationship between the prime contractor and subcontractor not conducive to independence and objectivity, as in the case of a parent-subsidiary or when prime contracting and subcontracting roles of the companies are frequently reversed; or,
    - The subcontractor is sole source and the subcontract costs represent a substantial part of the prime contractor costs.
- *Subcontracting with Foreign Sources* - The prime contractor has flowed-down requirements to the subcontractor (under DFARS 252.225-7004) if there is a subcontract placed with foreign sources.

3.4.2.C1c: The PMO and contractor have adequately addressed post-award activities after contract award.

- *Memorandum of Agreement (MOA)* - Explicitly defines the working relationship between the PM and DCMA (Contract Administration Officer (CAO)), to include, at a minimum:
    - The review, approval or disapproval, and maintaining surveillance of the contractor's purchasing system
    - The consent to placement of subcontracts
    - The review, evaluation, and approval of plant or division-wide small, small disadvantaged and women-owned small business master subcontracting plans
    - The obtainment of the contractor's currently approved company- or division-wide plans for small, small disadvantaged, and women-owned small business subcontracting for its commercial products; or, if there is no currently approved plan, provide assistance to the Contracting Officer in evaluating the plans for those products, including documentation of compliance with similar plans under prior contracts
- *Make-or-Buy* – The PM government has reserved the right to review and agree on the contractor's make-or-buy program when necessary to ensure negotiation of reasonable contract prices, satisfactory performance, or implementation of socioeconomic policies.
- *Consent to Subcontract* – The Contracting Officer has required consent where considered necessary to protect the government due to subcontract type, complexity, or value, or because the subcontract needs special surveillance.

- *Contractor Purchasing System Review (CPSR)* – The prime contractor's CPSR has been approved by the ACO. It provides sufficient oversight of the company's subcontracting program.
- *Privity of contract* – The PM understands the concept of "privity of contract," but has taken steps (e.g., clauses on the flow of requirements) to ensure that program goals are met.
- *Integrated Product Teams (IPTs)* – Representatives from the major subcontractors are part of the program IPTs.

Focus Questions

[Pertinent criteria numbers follow each question]

3.4.2.Q1: When competition is not planned at the prime contract level, what reason under FAR Part 6 did the PM give for using other than full and open competition?

- How long in terms of contemplated successive increments is the sole source expected to be necessary?
- When will the PM introduce competition, to include plans for bringing competitive pressure to bear on the program through competition at major subcontractor or lower tiers or through other means? [3.4.2.C1a]

3.4.2.Q2: How has the PM fostered competition at sub-tier levels, as well as at the prime level? [3.4.2.C1a and 3.4.2.C1c]

3.4.2.Q3: How does the Acquisition Strategy address areas of potential vertical integration (i.e., where potential prime contractors are also potential suppliers)? *Note: Vertical integration may be detrimental to DoD interests if a firm employs internal capabilities without consideration of, or despite the superiority of, the capabilities of outside sources* [3.4.2.C1a and 3.4.2.C1c]

3.4.2.Q4: As described in the Acquisition Strategy, what is the PM's approach (e.g., requiring an open systems architecture, investing in alternate technology or product solutions, breaking out a subsystem or component, etc.) that establishes or maintains access to competitive suppliers for critical areas at the system, subsystem, and component levels? [3.4.2.C1a]

3.4.2.Q5: What are the results of the PM's analysis of product and technology areas critical to meeting program needs?

- How does the Acquisition Strategy identify the potential industry sources to supply these needs?
- Does the prime contractor plan to provide critical product and technology areas internally, by subcontractor, or through exclusive teaming?
  - What is the PM's assessment of the possible effects of these choices on competition?
  - What are the PM's plans to mitigate any potential loss of competition due to these choices? [3.4.2.C1a]

3.4.2.Q6: As the program design evolves, what process is in place for the PM to continually analyze how the prime contractor addresses the program's critical product and technology areas in terms of competition?

- As a result of this ongoing analysis, what areas were identified where the design unnecessarily restricts subsystem or component choices?
- How does the PM challenge the contractor during requirements and design reviews to defend why planned materiel solutions for subsystem and component requirements critical to the program exclude other competitive choices? [3.4.2.C1b and 3.4.2.C1c]

3.4.2.Q7: After contract award, what process has the PM established to review and approve or disapprove the prime contractor's make-or-buy decisions?

- How does this process ensure decisions by the prime contractor have considered better technical and cost effective solutions from other vendors? [3.4.2.C1c]

3.4.2.Q8: As described in the Acquisition Strategy, how has the PM considered national policies on contracting and subcontracting with small business; small and disadvantaged business; women-owned small business; Historically Underutilized Business Zone (HUBZone) small business; and Service-Disabled, Veteran-Owned small business; and addressed considerations to secure participation of these entities at both prime and sub-tier levels? [3.4.2.C1a and 3.4.2.C1b]

3.4.2.Q9: How has the PM addressed intra-government work agreements, i.e., formal agreements, project orders, or work requests, in which one government activity agrees to perform work for another, creating a supplier/customer relationship?

3.4.2.Q10: What procedures and processes has the PM established that require contractors and subcontractors to use commercial items to the maximum extent possible?

- How are these decisions monitored by the PM and Contracting Officer? [3.4.2.C1a and 3.4.2.C1b]

3.4.2.Q11: Is/are PBL Product Support contract(s), if used, competitively sourced?

- What are the prime's plans to make maximum use of small and disadvantaged businesses as subcontractors?
- What are the performance-based contractual incentives? How are they tied to small and disadvantaged business subcontracting goals? [3.4.2.C1c]

3.4.2.Q12: As part of the EVM System Surveillance Process, how are program cost, schedule and performance risks that may be problematic to the prime contractor and subcontractor addressed during the Integrated Baseline Review (IBR)?

- How are the results of the IBR used to refine program design and structure?
- When does the prime contractor anticipate using a major subcontractor as part of the master schedule review? [3.4.2.C1b and 3.4.2.C1c]

3.4.2.Q13: Is there a requirement for subcontractors to submit an Integrated Master Schedule?
Note: The PM should obtain an IMS on all cost or incentive contracts, subcontracts,

intra-government work agreements, and other agreements valued at or greater than $20 million.

- How is the subcontractor's IMS traceable to the overall program IMS? Integrated Master Plan (IMP)? Work Breakdown Structure (WBS)? Statement of Work (SOW)? [3.4.2.C1b and 3.4.2.C1c]

3.4.2.Q14: Is Contractor Cost Data Reporting (CCDR) required of the subcontractor(s) involved with the program? *Note: CCDR is required on all major contracts and subcontracts that support Acquisition Category ID and IC programs, regardless of contract type, when the contracts are valued at more than $50 million (FY 2002 constant dollars). CCDR reporting is not required for contracts priced below $7 million. The CCDR requirement on high-risk or high-technical-interest contracts priced between $7 and $50 million is left to the discretion of the Cost Working-Level IPT* [3.4.2.C1c]

- How do the CCDR data enable reasonable cost estimates?
- At what Contract WBS level do the key subcontractors routinely report cost data?
- Is this CCDR requirement consistent with DoD guidance for addressing high-risk, high-value, or high-technical areas of interest of a program?

3.4.2.Q15: Because quality deficiencies for non commercial-off-the-shelf (COTS) products often occur in the lower tiers, at what level down its supply chain does the prime contractor have insight?

- What level of insight down their own supply chain do subcontractors have? [3.4.2.C1b and 3.4.2.C1c]

3.4.2.Q16: What are the prime contractor's approved vendor (i.e., subcontractor) lists?

- What degree of insight/oversight does the prime contractor have of the subcontractors' planned suppliers? [3.4.2.C1b and 3.4.2.C1c]

3.4.2.Q17: How has the PM informed the prime contractors of its interest in quality throughout the supply chain?

- How does the PM and Contracting Officer request and evaluate evidence of effective supply management?
  - Are any of the following characteristics of effective supply chain management not present? Why or why not?
    - o Relationships with suppliers that promote and facilitate communication to improve the effectiveness and efficiency of processes that add value;
    - o The use of supplier development programs focused on continuous improvement;
    - o Strategic partnerships with suppliers, over the product life cycle, that are based on a clear understanding of the partners' and customers' needs and expectations in order to improve the joint value proposition of all stakeholders;
    - o Processes that effectively and efficiently monitor, evaluate, verify, and improve the suppliers' ability to provide the required products with a focus on defect prevention rather than defect detection;

- o Right of access for both the prime contractor and the government to supplier facilities and documentation where applicable; and
- o Requirements for the supplier to flow down analogous quality management system provisions to its subcontractors. [3.4.2.C1c]

3.4.2.Q18: How are the PM and Contracting Officer incorporating incentives for subcontractors to provide high-quality products and services?

- What types of contract incentives has the prime contractor made available to subcontractors (e.g., increased fee; extended contract length; follow-on contracts awarded; accelerated progress payments; shared savings; and opportunities for return on investments (some of which may increase the contractor's competitiveness on other contracts))? [3.4.2.C1c}

3.4.2.Q19: How are technology development and risk reduction requirements identified in the contracts and flowed down to the development subcontractors? [3.4.2.C1b]

3.4.2.Q20: How has the prime contractor established a management process compatible with major subcontractors to provide the customer with an integrated development efforts? [3.4.2.C1]

3.4.2.Q21: Identify the types of contracts used by the prime and subcontractors, and explain how the selected approach best suits the different acquisition life cycle phases (i.e., CR, TD, SDD and PD). [3.4.1.C1a]

3.4.2.Q22: How is the contractor provided with incentives to achieve DoD-wide initiatives, such as MOSA, net-readiness, etc., during each phase of the acquisition life cycle (i.e., CR, TD, SDD, and PD)? [3.4.2.C1a]

3.4.2.Q23: What are the contractual provisions to obtain government rights to technical data?

- How are these provisions flowed down to major subcontractors? [3.4.2.C1b]

3.4.2.Q24: How have teaming agreements been documented, defined, and communicated among all relevant parties?

- What is the process for making changes to agreements, and who is involved? [3.4.2.C1a]

3.4.2.Q25: How does the contractor maintain connectivity within its management process with subcontractors and suppliers to provide compatibility in managing and reporting? [3.4.2.C1]

3.4.2.Q26: How do the prime contractor and major subcontractors utilize their infrastructure and internal processes to establish program-specific plans, such as systems engineering, software development, risk mitigation, and test and evaluation, that are required for each phase of the acquisition life cycle? [3.4.2.C1]

3.4.2.Q27: What is the process to define system performance requirements in a system specification, to baseline that specification, and appropriately delegate requirements to the subcontractors?

- For system of systems, how are the system interface control requirements delegated to the subcontractors? [3.4.2.C1b]

3.4.2.Q28: How are the contract types (e.g., cost plus or fixed price) commensurate with the program development risk at each contracting level? [3.4.2.C1a]

3.4.2.Q29: Identify and describe contractual provisions to provide incentives for program execution (including system supportability).

- How are award fees determined?
- How are award fees or other performance incentives set up with key development subcontractors? [3.4.2.C1a]

3.4.2.Q30: What are the subcontractors' quality goals?

- Are they consistent with the developer's quality requirements? [3.4.2.C1c]

3.4.2.Q31: What is the status of subcontractor and supplier management planning?

- How are audits, supplier ratings, metrics, value stream, etc., addressed in the planning? [3.4.2.C1c]
- 3.4.2.Q32: How is the past performance of the prime contractors' management of subcontracts? What is the prime contractor's technical capability to manage the planned subcontractors? [3.4.2.C1c]

3.4.2.Q32: What are the important aspects of the prime contractor's Small Disadvantaged Subcontracting Plan? [3.4.2.C1b]

3.4.2.Q33: How does the prime contractor plan to track the subcontractor's performance with EVM? [3.4.2.C1a and 3.4.2.C1c]

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DoD Guide for Integrating Systems Engineering into DoD Acquisition Contracts.

FAR 15. Contracting by Negotiation.

FAR 16. Types of Contracts.

FAR 44.4. Subcontracts for Commercial Items and Commercial Components.

FAR 52.244-6. Subcontracts for Commercial Items.

Subcontracting Management Guidebook. Defense Contract Management Agency (DCMA).

Factor 3.4.3 – Value Engineering

Pre-Milestone A

Criteria

3.4.3.C1: There is an effective Value Engineering (VE) program within the Program Management Office (PMO) that systematically and creatively applies the tenets, facets and attributes of VE to decrease system costs while improving quality, reliability, durability and effectiveness.

3.4.3.C2: There is a viable Value Engineering system plan, within the goals and stipulations of the PMO's VE program, to effectively guide the successful development of solutions that eliminate or modify any element of the program that significantly contributes to the overall cost without adding commensurate value to overall system performance or program execution.

Focus Questions
[Pertinent criteria numbers follow each question]
3.4.3.Q1: Is the PMO's VE program of sufficient quality to ensure success?
- What are the policies and responsibilities which will ensure that VE discipline is integrated into all elements of an organization?
- How does top management demonstrate its involvement to ensure implementation and continuing emphasis by middle management?
- Who is the key individual managing the VE program?
    - Is this individual well versed in VE principles, techniques and appropriate acquisition regulations?
- What training is there is to acquaint personnel with VE policies, procedures and benefits?
- What is the "cross-feed" mechanism to communicate information about successful applications to others who can benefit? [3.4.3.C1]

3.4.3.Q2: What is the general knowledge of the PMO personnel on VE and the VE process?
- When can a Value Engineering Change Proposal (VECP) be submitted?
- When in the life cycle are the greatest savings achieved?
- What FAR sections describe the stipulations of the DoD VE Program? *Note: FAR Parts 48 and 52.248* [3.4.3.C1]

3.4.3.Q3: Is there funding set aside in the program budget for the submission and review of VE Change Proposals (VECPs) as well as for testing and evaluation of submissions? [3.4.3.C1]

3.4.3.Q4: What are the areas for VE in a Performance Specification contract that are mutually beneficial for contractors to submit (and the government to accept)? *Note: Answers should include: high development and implementation costs; new/risky technologies; changes that require government test facilities; and changes that impact the acceptance of products.* [3.4.3.C1]

3.4.3.Q5: What is the goal for VE savings (i.e., what percentage of Total Obligation Authority (TOA)) for the PMO? [3.4.3.C1]

3.4.3.Q6: How does the plan identify essential functions? *Note: Function is defined as the specific purpose or use intended for something. It describes what must be done. For VE studies, function is reduced to the simplest accurate expression. An active verb and a quantifiable noun – "support weight," "transmit torque," and "conduct current" describes in terms that are quantifiable and measurable.* [3.4.3.C2]

3.4.3.Q7: How does the plan identify alternate methods to adequately satisfy those essential functions in the most cost-effective manner? [3.4.3.C2]

3.4.3.Q8: Are the following aspects of the system plan addressed as potential candidates for VE?

Note: This list is not all-inclusive.

- Performance Specifications
- Contract Requirements (Technical, Support, Data Delivery Schedules)
- Manufacturing Procedures and Processes
- Tooling
- Test Procedures/Equipment
- Installation
- Hardware (procurements, fabrication & assemblies, government furnished material)
- Maintenance (Repair Policy and Procedures)
- Repair Level/Cycle
- Equipment Requirements
- Layout/Procedures
- Operations
- Policy/Procedures
- Staffing [3.4.1.C2]

Pre-Milestone B

Criteria

3.4.3.C3: The contractor has an effective VE program that systematically and creatively applies the tenets, facets and attributes of VE to decrease system costs while improving quality, reliability, durability and effectiveness.

3.4.3.C4: There is a viable Value Engineering (VE) system plan, within the goals and stipulations of the contractor's VE program, to effectively guide the successful development of solutions that eliminate or modify any element of the program that significantly contributes to the overall cost without adding commensurate value to overall system performance or program execution.

Focus Questions

[Pertinent criteria numbers follow each question]

3.4.3.Q9: Is the contractor's VE program of sufficient quality to ensure success?

- What are the policies and responsibilities which will ensure that VE discipline is integrated into all elements of an organization?

- How does top management demonstrate involvement to ensure implementation and continuing emphasis by middle management?
- Who is the key individual managing the VE program?
    - Is the individual well versed in VE principles, techniques and appropriate acquisition regulations?
- What training is there to acquaint personnel with policies, procedures, and benefits?
- What is the "cross-feed" mechanism to communicate information about successful applications to others who can benefit? [3.4.3.C3]

3.4.3.Q10: How does the contractor's company set company or division goals for Value Engineering Change Proposals (VECPs)? [3.4.3.C3]

3.4.3.Q11: What is the general knowledge of the contractor personnel on VE and the VE process?
- Do they know when can a Value Engineering Change Proposal (VECP) be submitted?
- When in the life cycle are the greatest savings achieved?
- What FAR sections describe the stipulations of the DoD VE Program? *Note: FAR Parts 48 and 52.248* [3.4.3.C3]

3.4.3.Q12: What are the areas for VE in a Performance Specification contract that are mutually beneficial for contractors to submit (and the government to accept)? *Note: Answers should include: high development and implementation costs; new/risky technologies; changes that require government test facilities; and changes that impact the acceptance of products.* [3.4.3.C3]

3.4.3.Q13 What does the contractor understand about the stipulations involved in the submission of a VECP? *Note: To qualify as a VECP, the change must be submitted under a current contract, require a change to the contract under which it was submitted, and must provide an overall cost savings to the government after being accepted and implemented.* [3.4.3.C3]

3.4.3.Q14: How does the plan identify essential functions?
- Are they the same as the government's?
- How does the plan identify alternate methods to adequately satisfy those essential functions in the most cost-effective manner? Are they different from the government's? [3.4.3.C4]

3.4.3.Q15: Is the contractor aware of the government's VE plan for the system?
- What are the contractor's views in regard to any of the following aspects of the system as addressed as potential candidates for VE in the government's VE plan?
- Performance Specifications
- Contract Requirements (Technical, Support, Data Delivery Schedules)
- Manufacturing Procedures and Processes
- Tooling
- Test Procedures/Equipment

- Installation
- Hardware (procurements, fabrication & assemblies, government-furnished material)
- Maintenance (repair policy and procedures)
- Repair Level/Cycle
- Equipment Requirements
- Layout/Procedures
- Operations
- Policy/Procedures
- Staffing [3.4.3.C4]

3.4.3.Q16: What is the result of the meeting between the contractor's top management and key PMO personnel to agree on VECP goals and processing on major contracts and programs? [3.4.3.C4]

3.4.3.Q17: How does the contractor accommodate the requirement to allow minimal time to (1) develop a VECP, and (2) obtain internal company approval prior to submittal to the government? [3.4.3.C4]

3.4.3.Q18: How did the government and contractor, through the VE process, evaluate technologies and design concepts to ensure the most promising design concept will be selected for development and demonstration? [3.4.3.C4]

3.4.3.Q19: How does the government and contractor plan to use VE in the Systems Development and Demonstration (SDD) phase to reduce total ownership costs in O&S? [3.4.3.C4]

Pre-Milestone C

Criteria

3.4.3.C5: The system's VE plan has successfully eliminated or modified any element of the program that significantly contributes to the overall cost without adding any commensurate value to overall system performance or program execution.

Focus Questions

[Pertinent criteria numbers follow each question]

3.4.3.Q20: Are the essential functions identified in earlier phases still the same?

- Are they still aligned with the government's? [3.4.3.C5]

3.4.3.Q21: How are the alternate methods to adequately satisfy those essential functions identified in earlier phases, still the most cost-effective manner?

- Are they different from the government's? [3.4.3.C5]

3.4.3.Q22: what is the process for the contractor's top management meet with key customer personnel to agree on VECP goals and processing on major contracts and programs? [3.4.3.C5]

3.4.3.Q23: How did the government and contractor, through the VE process, analyze the essential requirements, military and technical characteristics, and the design tasks to develop possible alternatives offering improved value? *Note: Evaluating initial prototypes, design layouts, and other details during the development may provide additional opportunities to improve value. Efforts in this phase are directed toward evaluations and recommendations concerning function, cost and worth of specifications, systems, modules, assemblies, parts and components. By defining value in measurable terms, VE can produce a functional cost analysis to improve visibility of the costs directly related to detailed requirements.* [3.4.3.C5]

3.4.3.Q24: How does the government and contractor plan to use VE to evaluate manufacturing processes, methods and materials during the Production and Deployment (PD) phase? [3.4.3.C5]

References

Contractor's Guide to Value Engineering. Version 2. Department of Defense, April 2003.

Defense Acquisition Guidebook (DAG). Section 4.5.4. Defense Acquisition University, https://akss.dau.mil/dag/.

DoD Value Engineering Program web site. Institute for Defense Analysis. http://ve.ida.org/ve/ve.html.

Value Engineering Handbook. Institute for Defense Analysis, September 2006.

Value Engineering. Continuous Learning Module. CLE001. Defense Acquisition University.

4.0 TECHNICAL PROCESS

SUB-AREA 4.1 – DESIGN CONSIDERATIONS

Description: In developing weapons systems, the acquisition process examines and validates user needs, develops alternative concepts to satisfy those needs, and acts upon the selected concept to define the performance requirements that will meet desired capabilities to achieve the "best value" for the user over the entire life cycle of the system. Design considerations are central to a rigorous systems engineering process applied through each acquisition phase, which translates validated system performance requirements into a material design solution that can be built, tested, and verified.

Design considerations are addressed during the earliest phase of a program, when materiel solutions to user needs are examined in the analysis of alternative concepts. They continue during the Technology Development (TD) phase, as product critical technologies mature, and prototype products are built and tested to validate of all or part of a system concept. As a result, documented performance specifications become the baseline for the development and demonstration phase of the program. Design solutions must be documented based upon sound systems engineering practices using engineering tools to augment the technical approach. Design considerations include those attributes that must be factored into the design solution. They are emphasized in Chapter 4, Section 4.4 of the Defense Acquisition Guidebook (DAG).

Scope: Key design considerations are examined that underpin the achievement of the system's Key Performance Parameters (KPPs) as addressed in the Initial Capabilities Document (ICD), Capabilities Development Document (CDD), and Capability Production Document (CPD). The assessment of this sub-area focuses on key attributes of the system to determine the extent to which they are considered in, and influence, the system design solution. Design considerations must address factors that influence performance and life cycle cost so that performance is optimized and cost minimized.

Perspective: The program manager faces myriad considerations and management tools to translate the user's mission needs and required capabilities (regardless of phase in the acquisition cycle) into a structured system of interrelated design specifications. It is an iterative task, performed within the framework of systems engineering to achieve the "best value" for the user. The objective is to create a design that provides the required capabilities, is easily operated and maintained, and is affordable. Design considerations that affect operations and sustainment must also be

addressed early in the life cycle to optimize performance and to minimize acquisition and sustainment cost.

Factor 4.1.1 – System Assurance

Pre-Milestone A

Criteria

4.1.1.C1: The program should capture critical system assurance capabilities to reduce the risk that the system will adversely affect the enterprise (Department of Defense (DoD)). It is DoD policy to manage all interconnections of DoD information systems "to continuously minimize community risk by ensuring that the assurance of one system is not undermined by vulnerabilities of interconnected systems" (DoDD 8500.1 section 4.14).

4.1.1.C2: The program should incorporate system assurance criteria, captured in the ADM (Acquisition Decision Memorandum) before sign-off, and refined through the life cycle.

4.1.1.C3: Pending the next version of DoDI 5000.2, "3.5.2.6. A list of known or probable Critical Program Information (CPI) and potential countermeasures such as Anti-Tamper (AT) in the preferred system concept and in the critical technologies and competitive prototypes to inform program protection (DoDD 5200.39, Reference (ai)) and design integration during in the TD phase."

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.1.Q1: Are the risks and vulnerabilities this program may be subject to articulated in sufficient form early in the program?

- Does this include risk and vulnerability awareness in interconnected systems, and system assurance dependencies on those systems? [4.1.1.C1]

4.1.1.Q2: Are the system assurance requirements captured at the front of the program? (In what form, and in what program documentation?) [4.1.1.C1]

4.1.1.Q3: Are system assurance criteria, which may later develop into Key Performance Parameters (KPPs) or other requirements, captured in the ADM? [4.1.1.C2]

4.1.1.Q4: Has a list of known or probable CPI been identified? [4.1.1.C3]

Pre-Milestone B

Criteria

4.1.1.C4: Confirm that the System Requirements Review (SRR), Integrated Baseline Review (IBR), and Technology Readiness Assessments (TRAs) were successfully completed including assurance criteria noted in Milestone A. This includes review of the Acquisition Strategy and the activities supporting it.

4.1.1.C5: Ensure that an Acquisition Strategy is completed, including awareness and addressing of system assurance criteria.

4.1.1.C6: Ensure that per DoDI 5000.2, a Program Protection Plan (PPP) has been developed. Before writing the PPP, the program office must identify whether or not its program has or will have CPI as described in DoDD 5200.39 (soon to be DoDI 5200.39) and DoD 5200.1-M (soon to be DoD 5200.39). The new DoDI 5200.39 will emphasize that the CPI is not only leading edge technology, it is also any information or "elements or components of the system" that "if compromised could cause significant degradation in mission effectiveness."

4.1.1.C7: System assurance and other program protection counter measure requirements such as anti-tamper and information assurance, should be clearly stated in testable terms, (i.e., they are realistically measurable and their demonstration is not precluded due to safety constraints).

4.1.1.C8: High-level threats should be identified, especially including critical program information and associated threats.

4.1.1.C9: Security appropriate for the system information and technology being developed should be assessed and defined.

4.1.1.C10: Counter intelligence reports that will be necessary to assess the threats to the system and its development, operation, and maintenance have been defined and requested.

Focus Questions

[Pertinent criteria numbers follow each question]

4.1.1.Q5: Has a review been conducted by a cross-discipline (science and technology, counterintelligence, systems engineering) team to identify CPI and whether CPI was identified?

- If no CPI was identified, what candidates for CPI were considered and why were they determined not to be CPI?
- Were any "elements or components of the system" considered for possible CPI? [4.1.1.C6]

4.1.1.Q6: Did the SRR capture system assurance criteria?

- How did the IBR note and address system assurance criteria?
- Demonstrate how TRAs reflected and addressed system assurance criteria. [4.1.1.C4]

4.1.1.Q7: Demonstrate that the Acquisition Strategy reflects awareness of system assurance criteria, as well as plans for addressing them. [4.1.1.C5]

4.1.1.Q8: Are the system assurance requirements clearly stated in realistic, measurable terms? [4.1.1.C7]

4.1.1.Q9: Has the security necessary for the software system development and operational environments been clearly defined? [4.1.1.C9]

- What is the planned classification level and mission assurance category? [4.1.1.C9]

4.1.1.Q10: Have critical program information and technology items been identified?

- Have high-level system threats been identified?
- Has the impact of threats on the system, software and supply chain vulnerabilities been analyzed to identify risks? [4.1.1.C8]

4.1.1.Q11: Have the necessary counterintelligence threat assessments been requested? [4.1.1.C10]

Pre-Milestone C

Criteria

4.1.1.C11: The exit criteria of the Milestone Decision Authority (MDA) should include system assurance criteria. Ensure that system assurance criteria have been considered and addressed throughput development, especially including the Preliminary Design Review (PDR), Critical Design Review (CDR), and other technical reviews.

4.1.1.C12: The system assurance case should demonstrate adequate assurance throughout the program life cycle, including correspondence the customer and developer have contributed to their own, and any coordinated, assurance case.

4.1.1.C13: The system assurance case should be enabled for use by downstream teams, including operational test, deployment, maintenance, and potential system upgraders/enhancers.

4.1.1.C14: Ensure that per DoDI 5000.2 that a PPP has been developed. The PPP is not just a document stating the plan; the plan outlined in the document must be implemented before Milestone C. As described in DoDD 5200.39 (soon to be DoDI 5200.39) and DoD 5200.1-M (soon to be DoD 5200.39), the contractor must describe/reference (it is acceptable to meet this requirement by referencing a document other than a PPP) the countermeasures it is implementing (at each site where CPI is found) to protect CPI, and it must be able to demonstrate that it is implementing the countermeasures defined in the PPP.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.1.Q10: Demonstrate how system assurance criteria and requirements were reflected in program exit criteria throughout Technology Development and then System Development and

Demonstration (SDD) phases, especially including PDR, CDR, and other technical reviews. [4.1.1.C11]

4.1.1.Q11: Examine the system assurance case and appropriate supporting evidence, to ensure that the system has demonstrated adequate assurance. Examine the correspondence between assurance cases maintained separately by, or in collaboration between, the customer and developer. [4.1.1.C12]

4.1.1.Q12: Verify that the assurance case is usable by downstream consumers and contributors, and that updates to this information will also be fed back to the program office. This is part of positioning the program for maintenance, upgrade, and eventual disposition. [4.1.1.C13]

4.1.1.Q13: Demonstrate that the PPP is being implemented. Examples of evidence include (but are not limited to) training material on For Official Use Only (FOUO) document markings; logs showing when and for whom FOUO training was conducted; software development manuals stating requirement to make use of software assurance techniques, tools, and code reviews; and evidence of an Interim Authority to Operate (IATO) or Assemble to Order (ATO). [4.1.1.14]

Supplier Assurance

Criteria

4.1.1.C15: Supplier ensures that an infrastructure for safety and security is established and maintained.

4.1.1.C16: Supplier ensures safety and security risks are identified and managed.

4.1.1.C17: Supplier ensures safety and security requirements are satisfied.

4.1.1.C18: Supplier ensures that activities and products are managed to achieve safety and security requirements and objectives.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.1.Q13: How are the suppliers' ability evaluated to ensure integrity of safety and security information? [4.1.1.C15]

4.1.1.Q14: Explain how the supplier ensures business continuity. [4.1.1.C16]

4.1.1.Q15: Demonstrate that the supplier identifies and addresses safety and security risks. [4.1.1.C16]

4.1.1.Q16: Explain how suppliers are evaluated to determine whether they determine, implement, and monitor the associated risk mitigation plan. [4.1.1.C17]

4.1.1.Q17: How are suppliers evaluated to know whether they ensure safety and security assurance? [4.1.1.C18]

4.1.1.Q18: Does the supplier mandate independent safety and security reporting? [4.1.1.C17]

4.1.1.Q19: Does the supplier have a safety and security plan? [4.1.1.C18]

References

DoD 5200.1-M. Acquisition Systems Protection Program, March 1994.

DoDD 5200.39. "Security, Intelligence, and Counterintelligence Support to Acquisition Program Protection," September 1997.

DoDD 8500.1. "Information Assurance," October 2002.

DoDI 5000.2. "Operation of the Defense Acquisition System," May 12, 2003.

National Defense Industrial Association (NDIA) System Assurance Committee. Engineering for System Assurance. Arlington, VA: NDIA, 2008.

Software Assurance in Acquisition: Mitigating Risks to the Enterprise https://buildsecurityin.us-cert.gov/swa/downloads/SwA_in_Acquisition.pdf.

US DoD Software Assurance (SwA) Strategy Concept of Operations (CONOPS).

Factor 4.1.2 – Modular Open Systems Approach

Pre-Milestone A

Criteria

4.1.2.C1: Certain capabilities, requirements, and program strategies/objectives necessitate implementing open systems and developing open architectures. DoDD 5000.1 requires that a modular open systems approach (MOSA) be employed where feasible. The program should identify open architecture enabled capabilities/objectives that reflect the following MOSA objectives (see the MOSA PM Guide at (http://www.acq.osd.mil/osjtf/pmguide.html):

> *1. Facilitate a modular architecture to allow for affordable interoperability*
>
> *2. Ensure a flexible and robust system design to accommodate changing technology and requirements*
>
> *3. Facilitate integration with other systems and use of commercial products from <u>multiple sources</u> both in the initial design and in future enhancements*
>
> *4. Enable technology insertion as currently available commercial products mature and new commercial products become available in the future*

4.1.2.C2: To realize open systems benefits, programs need to continually measure their progress toward achieving MOSA-enabled capabilities/objectives. Percentage of key interfaces defined by open standards, or percentage of components/subsystems modularized (self-contained, decoupled, and encapsulated) are examples of open systems-related metrics.

4.1.2.C3: Program staff must be aware of open systems benefits, understand its concept, and know how to implement it. Staff knowledge of open systems should be evidenced by academic courses on open systems concepts, and/or relevant open architecture development and implementation experience.

4.1.2.C4: Programs should make a business/engineering case for open systems implementation. The program should assess the feasibility of developing an open architecture for the system and document the business case analysis that justifies or prohibits its development.

4.1.2.C5: Program technical planning documentation (e.g., Systems Engineering Plan (SEP)) must have adequate coverage on development of an open architecture for the system. Documented technical processes should adequately address MOSA principles and their implementation.

4.1.2.C6: The program should provide incentives to contractors for implementation of modular and open architectures. In addition, program contracts should have specific language that conveys the government's interest in MOSA and its objectives for the program (see MOSA PM Guide for examples pertaining to Request for Proposal (RFP) language).

4.1.2.C7: Program capability requirements should not call for usage of particular software or hardware products that could prohibit open systems implementation. Requirements also should not impose product or technology-specific solutions.

4.1.2.C8: Modeling and simulation (M&S) tools and products that are based on open systems architectures could more cost-effectively and easily be upgraded and integrated, and should be considered by the program.

4.1.2.C9: Most of commercial-off-the-shelf (COTS) advantages will be lost when such products use proprietary interfaces. All the COTS hardware and software products used by the program should employ open interfaces.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.2. Q1: What open architecture-enabled capabilities, strategies, and objectives is the program pursuing? [4.1.2.C1]

4.1.2. Q2: What specific measures of effectiveness (MOEs) or metrics does the program use to gauge its progress toward achieving open architecture-enabled capabilities/objectives? [4.1.2.C2]

4.1.2.Q3: What is the relevant experience and training level of the assigned program staff in open systems concepts and implementation? [4.1.2.C3]

4.1.2.Q4: What studies or analyses have been conducted to assess the market, economic, operational, and technological feasibility of using open standards for key system and subsystem interfaces? [4.1.2.C4]

4.1.2.Q5: What is the open systems technical planning approach for developing and implementing the system architecture (functional and physical)?

- Is this technical planning described in the SEP? [4.1.2.C5]
- How does the technical planning address the following key MOSA principles (MOSA PM Guide):
    - Establish an enabling environment to apply MOSA

- Employ a modular design
- Designate key interfaces
- Use open standards
- Certify conformance

4.1.2.Q6: What incentives do the program contracts offer to prime and subcontractors to develop open architectures for the selected system and subsystems? [4.1.2.C6]

4.1.2.Q7: Have program requirements been analyzed and refined as needed, to ensure that they do not impose design specific solutions?

- In the event of planning for software reuse and/or government-furnished equipment or materials, what considerations are given to the impact on the open systems approach? [4.1.2.C9]

4.1.2.Q8: What consideration is given for selection of open architecture-based M&S tools used by the program? [4.1.2.C8]

4.1.2.Q9: What consideration is given for selecting COTS hardware and software products that contain open interfaces? [4.1.2.C9]

Pre-Milestone B and Pre-Milestone C

Criteria

4.1.2.C10: Certain capabilities, requirements, and program strategies/objectives necessitate implementing open systems and developing open architectures. DoDD 5000.1 requires that a modular open systems approach be employed where feasible. The program should identify open architecture enabled capabilities/objectives that reflect the following MOSA objectives (see the MOSA PM Guide at http://www.acq.osd.mil/osjtf/pmguide.html):

1. Facilitate a modular architecture to allow for affordable interoperability

2. Ensure a flexible and robust system design to accommodate changing technology and requirements

3. Facilitate integration with other systems and use of commercial products from multiple sources both in the initial design and in future enhancements

4. Enable technology insertion as currently available commercial products mature and new commercial products become available in the future

4.1.2.C11: Programs should incorporate MOSA principles into the Acquisition Strategy to ensure access to the latest technologies and products, and to facilitate affordable and supportable system development and modernization of fielded assets. The program should plan for open systems implementation and include a summary of such planning as part of the overall Acquisition Strategy. The summary of the open systems planning should describe (1) how MOSA fits into a program's overall acquisition process and strategies for acquisition, technology development, and T&E; (2)

what steps a program will take to analyze, develop, and implement a system or a system of systems architecture based on MOSA principles; and (3) how the program intends to monitor and assess its open systems implementation progress and ensure system openness.

4.1.2.C12: To realize open systems benefits, programs need to continually measure their progress toward achieving MOSA-enabled capabilities/objectives. Percentage of key interfaces defined by open standards, or percentage of components/subsystems modularized (self-contained, decoupled, and encapsulated) are examples of open systems related metrics.

4.1.2.C13: Programs should document and track, and be able to demonstrate their success in open systems implementation.

4.1.2.C14: Program staff must be aware of open systems benefits, understand its concept, and know how to implement it. Staff knowledge of open systems should be evidenced by academic courses on open systems concepts, and/or relevant open architecture development and implementation experience.

4.1.2.C15: Programs should not blindly implement open systems. They should make a business/engineering case for open systems implementation. The program should assess the feasibility of developing an open architecture for the system and document the business case analysis that justifies or prohibits its development.

4.1.2.C16: Program technical planning documentation (e.g., SEP) must have adequate coverage on development of an open architecture for the system. Documented technical processes should adequately address MOSA principles and their implementation.

4.1.2.C17: The program should provide incentives to contractors for implementation of modular and open architectures. In addition, program contracts should have specific language that conveys the government's interest in MOSA and its objectives for the program (see MOSA PM Guide for examples pertaining to RFP language).

4.1.2.C18: Program capability requirements should not call for usage of particular software or hardware products that could prohibit open systems implementation. Requirements also should not impose product or technology-specific solutions.

4.1.2.C19: M&S tools and products that are based on open systems architectures could more cost-effectively and easily be upgraded and integrated, and should be considered by the program.

4.1.2.C20: Most of COTS advantages will be lost when such products use proprietary interfaces. All the COTS hardware and software products used by the program should employ open interfaces.

4.1.2.C21: Programs should ensure that modular design considerations (i.e., encapsulation, cohesiveness, self-containment, and loose coupling) are incorporated into the system design.

4.1.2.C22: Programs should benchmark the best industry standards for developing systems. The ISO/IEC 10746 Reference Model for Open Distributed Processing can be used as a reference model to specify the system's architecture.

4.1.2.C23: Prior to system design, the program should construct a model (e.g., reference model) to embody early system design decisions to use as a framework to depict system modules, apply standards, and identify interfaces that are key to achieving system technical and business goals.

4.1.2.C24: Programs should ensure that system components and commercial products will not require dependency on a single source of supply throughout the system life cycle (e.g., use of vendor-specific extensions that are not defined as formal options or extensions).

4.1.2.C25: The program's systems architecture should distinguish among interfaces that are between technologically stable and volatile modules, between highly reliable and more frequently failing modules, and between modules with least interoperability impact and those that pass vital interoperability information. Decision criteria such as (1) high turn-over rate of technology; (2) criticality of function; (3) ease of integration; (4) high frequency of change due to poor reliability of modules; (5) interoperability; (6) commonality and reuse; or (7) high cost; should be used as the basis for designating its key interfaces.

4.1.2.C26: The program must designate all external system interfaces as key interfaces subject to standardization.

4.1.2.C27: The program should use specific "key interface designation criteria" to identify which internal system and subsystem interfaces are key interfaces subject to standardization. The system architecture should identify all key internal system and subsystem interfaces.

4.1.2.C28: Programs should establish specific criteria for selection of standards and rank such criteria in terms of preference. The documented standards selection criteria should give preference to open interface standards.

4.1.1.C29: The use of proprietary standards for key internal and external interfaces must be appropriately justified and documented by the program. In this case, a migration plan should be established to ultimately make such key interfaces open.

4.1.2.C30: Programs must have established mechanisms to test and verify that system components and selected commercial products conform to specified open standards.

4.1.2.C31: Open standards should enable interchangeability of similar products from competitive sources, and be verified by the program.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.2.Q10: What open architecture-enabled capabilities, strategies, and objectives is the program pursuing? [4.1.2.C10]

4.1.2.Q11: How does the program's Acquisition Strategy address an open systems architecture approach with characteristics such as modularity and verifiable open interfaces? [4.1.2.C11]

4.1.2. Q12: What specific MOEs or metrics does the program use to gauge its progress toward achieving open architecture-enabled capabilities/objectives? [4.1.2.C12]

4.1.2.Q13: How are open architecture-enabled capabilities/objectives being tracked and managed by the program?

- What has their progress been as measured to date? [4.1.2.C13]

4.1.2.Q14: What is the relevant experience and training level of the assigned program staff in open systems concepts and implementation? [4.1.2.C14]

4.1.2.Q15: What studies or analyses have been conducted to assess the market, economic, operational, and technological feasibility of using open standards for key system and subsystem interfaces? [4.1.2.C15]

4.1.2.Q16: What is the open systems technical planning approach for developing and implementing the system architecture (functional and physical)?

- Is this technical planning described in the SEP? [4.1.2.C16]
- How does the technical planning address the following key MOSA principles (See MOSA PM Guide):
    - Establish an enabling environment to apply MOSA
    - Employ a modular design
    - Designate key interfaces
    - Use open standards
    - Certify conformance

4.1.2. Q17: What incentives do the program contracts offer to prime and subcontractors to develop open architectures for system and subsystems being procured? [4.1.2.C17]

4.1.2.Q18: Have program requirements been analyzed and refined as needed, to ensure that they do not impose design specific solutions?

- In the event of planning for software reuse and/or government-furnished equipment or materials, what considerations are given to their impact on the open systems approach? [4.1.2.C18]

4.1.2.Q19: What consideration is given to selection of open architecture-based M&S tools used by the program? [4.1.2.C19]

4.1.2.Q20: What consideration is given to selecting COTS hardware and software products that contain open interfaces? [4.1.2.C20]

4.1.2.Q21: How do system-level functional and performance specifications exhibit the results of a modular design approach? [4.1.2.C21]

4.1.2.Q22: What accepted industry reference model(s) does the system architecture adhere to (e.g., ISO/IEC 10746 Reference Model for Open Distributed Processing) that provides a design pattern for the development of the system? [4.1.2.C22]

4.1.2.Q23: How does the program use modeling of the system or its architecture to improve definition and verification of the system design and interfaces? [4.1.2.C23]

4.1.2.Q24: What is the process to select products to avoid utilization of proprietary or vendor-unique extensions to open interface standards? [4.1.2.C24]

4.1.2.Q25: What specific criteria have been established for designating key system and subsystem interfaces? [4.1.2.C25]

4.1.2.Q26: What external system interfaces are designated as key interfaces? [4.1.2.C26]

4.1.2.Q27: What internal system and subsystem interfaces are designated as key interfaces? [4.1.2.C27]

4.1.2.Q28: What criteria has the program established for selection of standards (open or closed) for key interfaces?

- What specific open standards are specified for key internal and external system interfaces? [4.1.2.C28]

4.1.2.Q29: Has the program justified and documented specific reasons for using closed (proprietary) standards for certain key interfaces?

- What is the plan for migrating these interfaces to open standards? [4.1.2.C29]

4.1.2.Q30: What is the plan to test and verify that products conform to open standards specified for key system and subsystem interfaces?

- How is this test plan integrated with the test and evaluation strategy for the system?
- Where is it documented? [4.1.2.C30]

4.1.2.Q31: What is the plan for interchangeability of competitive source components that conform to open interface specifications with existing system components that use the same specifications? [4.1.2.C31]

References

Defense Acquisition Guidebook (DAG). Chapter 4, "Systems Engineering," Section 4.4.1. Defense Acquisition University. https://akss.dau.mil/dag/.

MOSA Assessment (Modular Open Systems Approach (MOSA) Assessment), September 2004. www.acq.osd.mil/osjtf/html/mosa_assessment.html.

MOSA PM Guide (Program Manager's Guide: A Modular Open Systems Approach (MOSA) to Acquisition, Version 2.0), September 2004. www.acq.osd.mil/osjtf/pmguide.html.

Factor 4.1.3 – Architecture

Software Architecture Methods and Tools

Pre-Milestone A and Pre-Milestone B

Criteria

4.1.3.C1: The system architecture and subsystem architecture, including computer system and support architectures, is defined using standardized methods, such as the Department of Defense

Architecture Framework (DoDAF), and widely accepted tools sets, such as those that employ the Unified Modeling Language (UML), which meets the system requirements, including open-system requirements and benefits. Ease of change, growth, upgrade, and lifecycle support is facilitated with this architecture.

4.1.3.C2: The technical system architecture descriptions should use mandated Operational View (OV), System View (SV), and Technical View (TV) products as described in the DoDAF, and should be integral to the system design. There should be System Description Documents (SDDs) and System Capability Specifications (SCSs) that address those for the system and major subsystems.

4.1.3.C3: There should be a disciplined process to ensure that the technical system descriptions are integrated such that changes to any one that affects others is identified and tracked to conclusion.

4.1.3.C4: The program should ensure that the system is designed based on modular design principles. The interfaces are identified with application of open standards for key system interfaces where possible, and the open systems architectures address and provide benefits in the following areas:

- System performance capabilities
- Commercial-off-the-shelf (COTS) products
- System growth capability
- Obsolescence/Diminished Manufacturing Sources (DMS)
- Technology Refresh
- Interoperability
- Built-In-Test (BIT)
- Life cycle cost reduction
- Compatibility with hierarchical system(s) (for system of systems)
- Compatibility with support systems.

4.1.3.C5: The open systems architecture should provide system life cycle operational and sustainment benefits that are verifiable and add value to the system, including Reliability and Maintainability (R&M) and built-in test.

4.1.3.C6: The open architectures employed in the system should satisfy the specified performance and support requirements.

4.1.3.C7: The design architecture should evaluate all required material properties to meet design requirements, including resistance to corrosion, and minimize the use of exotic materials.

4.1.3.C8: If the system architecture is based on an open design approach, it should lead to modular design for the system.

4.1.3.C9: A Program Protection Plan is required for system security and should address protection and anti-tamper schemes for information assurance security and Cryptological Systems (should also

be summarized in the Acquisition Strategy and in the Test and Evaluation Master Plan (TEMP)).

4.1.3.C10: Architecture development should be an identifiable activity in the Work Breakdown Structure (WBS).

4.1.3.C11: Description of system components should be provided if available.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.3.Q1: Provide and describe the system architecture, subsystem architecture, and hardware/software implementation architecture. [4.1.3.C1]

4.1.3.Q2: Explain and illustrate how the technical architecture system design descriptions address the total system performance requirements to include the end item, production, and support systems. [4.1.3.C2 and C6]

4.1.3.Q3: How is a change within the technical system descriptions ensured for traceability of impact across the system? [4.1.3.C3]

4.1.3.Q3: Describe the approach to implement a design that is modular and incorporates open standards for the key interfaces implementing open systems architectures throughout the system. Describe how these resulting architectures will:

- Reduce logistics footprint
- Reduce life cycle costs and development cycle time
- Meet system performance capabilities
- Leverage off-the-shelf (OTS) products
- Provide growth capability over the life of the system
- Mitigate obsolescence/DMS
- Enable technology refresh
- Achieve interoperability
- Achieve compatibility with the hierarchical system(s) (for a system of systems)
- Achieve compatibility with support systems [4.1.3.C1, C4, and C5]

4.1.3.Q4: Identify and describe any other system operational and sustainment benefits the open architecture provides. Describe how these benefits will be verified. [4.1.3.C5 and C6]

4.1.3.Q5: Describe how the systems architectures are open. Explain how these meet the specified performance requirements. [4.1.3.C1]

4.1.3.Q6: Have all required material properties for the design been considered in material selection? Are exotic materials required in the design?

- If so, please identify. [4.1.3.C7]

4.1.3.Q7: Have reliability, maintainability, and BIT been addressed in the design? [4.1.3.C5]

4.1.3.Q8: Describe how the system architecture leads to modular design for the system. [4.1.3.C8]

4.1.3.Q9: Provide and discuss the applicability and content of the Program Protection Plan for information assurance, anti-tamper, and cryptology [4.1.3.C9]

4.1.3.Q10: Is architecture development an identifiable activity in the WBS, or is it "buried" under other activities?

- What percentage of total development budget during the System Design and Development (SDD) phase will be devoted to architecture? [4.1.3.C10]

4.1.3.Q11: What are the new processors and other major hardware components?

- How much impact on the software architecture did they have? [4.1.3.C11]

Pre-Milestone C

Criteria

4.1.3.C12: System architecture, subsystem architecture, and hardware/software implementation architecture should be defined and documented. The developer should have a documented analysis of the architecture priorities and their impact on the program's Key Performance Parameters (KPPs). Expect to see a series of diagrams. If UML is used, Use Case Diagrams (contains users and interactions with the system), Activity Diagrams (documents the process and user responsible for each activity), or Sequence Diagrams (communication between objects) should be developed.

4.1.3.C13: Technical system descriptions should address the total system to include the end item, production, and support systems.

4.1.3.C14: The system design is modular and incorporates an open architecture with the following features/capabilities:

- Optimized to reduce life cycle costs and development cycle time
- Predictions meet system performance capabilities
- Leverage OTS products
- Provide growth capability over the life of the system
- Mitigate obsolescence/DMS
- Enable technology refresh
- Predicted to achieve interoperability

Predicted to achieve compatibility with the hierarchical system(s) (for a system of systems)

4.1.3.C15: The system architecture provides operational and sustainment benefits that are verifiable and will be verified.

4.1.3.C16: The system architecture implementation will be verified against the specified performance requirements.

4.1.3.C17: Materials suitable to the operational environment will be used in the design implementation.

4.1.3.C18: Reliability, maintainability, and BIT have been addressed in the design.

4.1.3.C19: A software product baseline (in addition to the hardware baseline) must be established and documented for the product/system.

4.1.3.C20: Software support equipment required to produce and integrate the system exists.

4.1.3.C21: A documented Program Protection Plan should exist for information assurance, anti-tamper, and cryptology. The architecture should address mitigation of threats and system assurance risks.

4.1.3.C22: Architecture development should be an identifiable activity in the WBS.

4.1.3.C23: Description of system components should be provided if available.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.3.Q12: Provide and describe the system architecture, subsystem architecture, and hardware/software implementation architecture. [4.1.3.C12]

- How were the KPPs translated into architecture priorities, and where is this documented?

4.1.3.Q13: Explain and illustrate how the technical system descriptions address the total system to include the end item, production, and support systems. [4.1.3.C13]

4.1.3.Q14: Describe how the system design is modular and incorporates an open architecture. Describe how the system architectures will:

- Reduce life cycle costs and development cycle time
- Meet system performance capabilities
- Leverage OTS products
- Provide growth capability over the life of the system
- Mitigate obsolescence/DMS
- Enable technology refresh
- Achieve interoperability
- Achieve compatibility with the hierarchical system(s) (for a system of systems) [4.1.3.C14]

4.1.3.Q15: Identify and describe any other system operational and sustainment benefits the architecture provides.

- Describe how these benefits will be verified. [4.1.3.C15]

4.1.3.Q16: Describe how the system architecture will be verified against the specified performance requirements. [4.1.3.C16]

4.1.3.Q17: Are exotic materials used in the design?

- If so, please identify. [4.1.3.C17]

4.1.3.Q18: How have reliability, maintainability, and BIT been addressed in the design?

- Have they been verified? [4.1.3.C18]

4.1.3.Q19: Has the product baseline for software been established? [4.1.3.C19]

4.1.3.Q20: Describe the software support equipment required to produce and integrate the system.

- Provide the status of this equipment. [4.1.3.C20]

4.1.3.Q21: Provide and discuss the applicability and content of the Program Protection Plan for information assurance, anti-tamper, and cryptology. [4.1.3.C21]

- What threats were considered in the design of this software system?
- Explain how the design (or processes or documentation, etc.) manages, mitigates, or avoids the threats determined to be applicable for this system.

4.1.3.Q22: Is architecture development an identifiable activity in the WBS, or is it "buried" under other activities? [4.1.3.C22]

- What percentage of total development budget during SDD is devoted to architecture?

4.1.3.Q23: What are the new processors and other major hardware components?

- How much impact on the software architecture did they have? [4.1.3.C23]

References

DoDAF (DoD Architecture Framework). Volume 1: Definitions, Guidelines, and Background. Washington DC: Department of Defense, November 2003.

MOSA PM Guide (Program Manager's Guide: A Modular Open Systems Approach (MOSA) to Acquisition). Version 2.0, September 2004.

Software Technology Support Center, Hill Air Force Base. http://www.stsc.hill.af.mil/resources/tech_docs/gsam4.html

Factor 4.1.4 – Environment, Safety, and Occupational Health

Pre-Milestone A

Criteria

4.1.4.C1: In conducting system-level trade studies in this phase of the program, system safety personnel initiate top-level hazards analyses to identify environment, safety, and occupational health (ESOH) considerations and constraints. MIL-STD-882D, DoD Standard Practice for System Safety, 10 February 2000 is the overarching guide for implementing safety.

4.1.4.C2: The government team/developer managing the Concept Refinement phase should include system safety technical personnel at the outset of the program. Personnel should be fully qualified and trained in the technical aspects of system safety and human factors at the appropriate level of qualification in the safety engineering career field. They should assist in the development and refinement of the Initial Capabilities Document (ICD), draft Capabilities Development Document (CDD), and the Analysis of Alternatives (AoA) plan in identifying preliminary ESOH hazards.

4.1.4.C3: During this phase, safety personnel are integral to the systems engineering (SE) process. They should assist with evaluating user needs and analysis of operational capabilities and environmental constraints and define potential safety (ESOH) hazards. MIL-STD-882D is the Guide. Key activities include:

- Review the system threat assessment
- Identify applicable system safety (ESOH) criteria to evaluate alternate system concepts
- Develop a Preliminary Hazard List (PHL) (Milestone A exit criteria)
- Develop a strategy for integrating ESOH risk management into the Systems Engineering Plan (SEP) (Milestone A exit criteria)

4.1.4.C4: During this phase, safety personnel assist the technical team in analyzing alternative concepts. The role of safety personnel is to translate the concept-level safety criteria into functional requirements and identify verification objectives. This information is applied to each alternative concept from system to functional to component capabilities, to assess each system concept and finalize the PHL for each concept.

4.1.4.C5: An Alternative Systems Review (ASR) is conducted to report on AoA findings and select the preferred system concept. Safety should present the PHL for each system concept and recommend the System Safety (ESOH) level of effort required for the next phase of the program.

4.1.4.C6: Additional safety contributions to the products of this phase include inputs to:

- Preliminary System Specification
- Test and Evaluation (T&E) Strategy
- SEP
- Support and maintenance concepts and technologies (ID potential hazards)

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.4.Q1: To what extent have preliminary system safety hazards analyses (ESOH) been completed and documented for each of the alternative concepts being considered?

- What is the schedule for completing the analyses for each of the concepts?
- Has the government team established a system safety program approach in accordance with MIL-STD-882D? [4.1.4.C1]

4.1.4.Q2: Is the government team/developer staffed with qualified safety personnel to manage and conduct this phase of the program?

- What is the experience and qualifications of the safety personnel?
- Who provided the technical support to assist with the development of the ICD, CDD, and AoA plan?
    - What was the basis (what trade studies/analyses) of the safety considerations that were included to address the concept approach?

- What ESOH-related requirements are documented in these plans? [4.1.4.C2]

4.1.4.Q3: During this phase, what process was used to define the safety criteria needed to evaluate each of proposed concepts under consideration?

- Was the threat assessment factored into the initial assessment? [4.1.4.C3]

4.1.4.Q4: What were the safety criteria for each concept and how were they factored into the trade studies/analyses?

- Was a PHL documented for each concept evaluation?
- What were the results of the AoA for each of the concepts evaluated?
- What was the basis for selection of the preferred concept from a safety perspective?
- What safety-critical requirements were incorporated in the Technology Development Strategy (TDS) for the next phase of the program? [4.1.4.C4]

4.1.4.Q5 Is there a plan to conduct an ASR, or has one been completed in preparation for a Milestone A decision?

- If not, what are the exit criteria for conducting the review?
- If yes, what was the rationale for the selection of the preferred system concept?
  - What role did safety (ESOH) considerations and constraints play in the decision?
  - How were the hazards documented in the PHL addressed in proceeding to the Technology Development (TD) Phase? [4.1.4.C5]

4.1.4.Q6: How has a strategy for safety (ESOH) risk management been addressed in the SEP? [4.1.4.C3]

4.1.4.Q7: Have the PHL and defined safety criteria for the preferred system concept been incorporated in the preliminary System Specification? [4.1.4.C6]

4.1.4.Q8: What ESOH hazard test and verification methodologies have been defined and incorporated in the T&E strategy? [4.1.4.C6]

4.1.4.Q9: From the safety perspective, what potential ESOH operation and maintenance (O&M) issues have been identified?

- Have any emerging safety technologies and or hazards been considered or identified? [4.1.4.C6]

Pre-Milestone B

Criteria

4.1.4.C7: As a result of evaluation of alternative system concepts, system safety personnel should define the materiel solution (preferred system concept) safety criteria and requirements for incorporation in the ICD, CDD, and preliminary system specification.

4.1.4.C8: During this phase, the activities focus on defining and evaluating enabling/critical technologies required for the materiel solution. Safety should characterize ESOH risks for continuing trade studies as a result of the AoA effort.

4.1.4.C9 During the TD phase, safety should continue to interpret user needs and analysis of operational capabilities and environmental constraints and update potential safety (ESOH) hazards. Key activities include:

- Update identification of system safety constraints
- Develop system safety (ESOH) criteria for critical technology needs
- Identify needed ESOH technology development
- Update strategy for integrating ESOH risk management into the SEP

4.1.4.C10: In developing the preferred system and enabling/critical technologies, safety should update the PHL to reflect these technologies and related constraints, identify potential O&M training and staffing requirements, and estimate system attrition rates.

4.1.4.C11: In the demonstration and modeling phase, critical components, system functionality, and integrated system performance versus evaluation plans and system specifications are evaluated with safety actively providing support by:

- Evaluating enabling/critical technologies from system safety perspective
- Reviewing demonstration/modeling results for hazards
- Develop a Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE) (statutory requirement for Milestone B)

4.1.4.C12: A System Requirements Review (SRR) is conducted to assess system requirements as captured in the preliminary system specification to ensure their consistency with the preferred system solution as well as available technologies matured in this phase. Safety should prepare and present system safety performance criteria, along with an updated PHL, and strategy for managing identified ESOH risks during the System Development and Demonstration (SDD) phase.

4.1.4.C13: System safety should address evaluation of system test verification criteria and must consider the implications of full-up Live Fire Test and Evaluation (LFT&E) on the system. Safety should evaluate the risk implications of not doing LFT&E, and develop alternative approach to verify system survivability. The Test and Evaluation Master Plan (TEMP) should document the latest test approach based on these evaluations.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.4.Q10: What safety criteria and requirements have been determined and recommended for the preferred system approach?

- Has this criteria been incorporated in the draft CDD? [4.1.4.C7]

4.1.4.Q11: What hazards and safety risks have been documented as a result of evaluating alternative system concepts?

- What is the status of completed evaluations and defining the preferred system concept?
- What key or critical technologies have been identified to mature during the TD phase? [4.1.4.C8]

4.1.4.Q12: What are the system safety criteria and constraints that are emerging from trades and analyses of technologies needed for the preferred system? [4.1.4.C9]

4.1.4.Q13: In evaluating the needed critical technologies, are there spin-off technology considerations being identified to address the ESOH hazards?

- How are these technologies being addressed and prioritized in the critical technologies priority list for study and maturation?
- How will they be funded? [4.1.4.C9]

4.1.4.Q14: How are ESOH risk management efforts being integrated into the SE processes used to mature the needed technologies? [4.1.4.C9]

- Has the SEP been updated to reflect the focus of the current risk management plan?

4.1.4.Q15: How have safety hazards been evaluated in the efforts to mature the technologies and evaluate the preferred system and its component elements?

- How is the system being considered for its O&M implications in terms of safety criteria and constraints for a projected life cycle of support?
- What safety attributes of maintenance and training are being considered?
- Does the PHL reflect the maturity status and risks of using enabling/critical technologies developed during this phase? [4.1.4.C10]

4.1.4.Q16: Describe the role of safety in the modeling and simulation/demonstration activities in assessing and documenting ESOH hazards and how safety criteria is being incorporated in the technology maturation efforts. [4.1.4.C11]

4.1.4.Q17: Is there a plan to conduct an SRR, or has one been completed in preparation for a Milestone B decision?

- If not, what are the exit criteria and plan for conducting the review?
- If yes, what system safety requirements and criteria (safety specifications and standards) were incorporated in the System Performance Specification?
- What technology readiness assessments (TRAs) were completed, and how did they address safety risk mitigation?
- How has safety contributed to the development of the Program Protection Plan? The TEMP? [4.1.4.C12]

4.1.4.Q18: What is the status of the PESHE, and what safety hazards and analyses are documented? [4.1.4.C11]

4.1.4.Q19: How has safety addressed survivability verification test requirements and evaluated the implications of not doing system LFT&E and possible waiver requirements?

- Has a waiver to LFT&E been filed?
- What alternatives were considered and how will the program proceed to Milestone B? [4.1.4.C13]

Pre-Milestone C

Criteria

4.1.4.C14: During this phase system safety personnel define and provide the ESOH criteria for the system and contribute updates to acquisition and program management documentation including the system threat assessment, CDD, ASR, SEP, TEMP, and system integration support plan, Integrated Master Plan/Integrated Master Schedule (IMP/IMS). Safety also provides technical support to the technical reviews conducted during SDD including the SRR, Integrated Baseline Review (IBR), System Functional Review (SFR), Preliminary Design Review (PDR), Critical Design Review (CDR), Test Readiness Review (TRR), and System Verification Review (SVR), as required.

4.1.4.C15: At the beginning of the SDD phase, the program management office (PMO) and developer collectively review the system requirements via the SRR or IBR and assess the level of risk associated with the system development and the system performance specifications. Safety ensures that the latest system safety requirements and criteria are clearly defined and documented in the specifications.

4.1.4.C16: Safety should establish exit criteria for this phase that includes (1) a safety assessment report of the system that addresses the disposition of all identified ESOH hazards determined from system performance verification; and (2) documented concurrence and approval of the system Safety Assessment Report by all appropriate safety boards.

4.1.4.C17: Safety is integral to the SE process of system design definition, analysis, and decomposition from system specifications to the component configuration item specifications, and provides safety critical analysis, hazards definition, and risk management of the defined hazard mitigation plans. Key activities and inputs include:

- Develop hazard analyses and threat hazard assessment concurrent with design definition and decomposition
- Develop more detailed system safety criteria concurrent with design definition and decomposition
- Update documented safety-critical requirements (e.g. Safety Requirements/Criteria Requirements Analysis (SRCA))
- Verify that system safety-critical requirements are included in the requirements tracking system during the requirements decomposition process

- Develop safety-related input to system life cycle management phases through demilitarization/disposal planning of the system
- Include system safety-critical specifications in the System Verification Plan

4.1.4.C18: In support of the individual configuration item verification/Development Test and Evaluation (DT&E), safety should:

- Ensure completion of safety tests and evaluate results for effective hazard control
- Recommend hazard closures based on test results
- Update hazard analyses based on configuration changes
- Provide safety releases for upcoming tests

4.1.4.C19: In support of System DT&E (or combined DT&E/Operational Test and Evaluation (OT&E), LFT&E, and operational assessments (OA), safety should:

- Ensure completion of safety tests and evaluate results for effective hazard control
- Verify that testing procedures include appropriate tests derived from safety analyses
- Update hazard status and recommend hazard closures as appropriate

4.1.4.C20: With the completion of verification testing safety continues to support the technical review and reporting process with updates to the status of safety-critical hazards and risk mitigation

- Test Reports – Verify effectiveness of hazard risk mitigation controls and report on analyses of safety anomalies, incidents, and mishaps
- TEMP – Update specific system test requirements in accordance with appropriate MIL Standards and Directives
- Product Support Requirements – Provide the results of the Operating and Support Hazard Analysis (O&SHA)
- PESHE – Update to reflect the results of verification testing and evaluation
- Program Documentation - Inputs to the Capability Production Document (CPD), System Threat Assessment, Integrated Support Plan, Systems Engineering Plan, Cost/Manpower Estimate, (e.g., update hazard mitigation requirements, system attrition rate due to mishaps, O&M training and staffing requirements, etc.)

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.4.Q20: What system ESOH criteria and requirements have been identified and documented to establish the system performance specifications for the design effort?

- What acquisition documents have been updated to reflect these criteria and requirements?
- Is ESOH planning and status incorporated in the IMP/IMS?
- How has the status of planning and management of ESOH design considerations been reported at each of the technical reviews? [4.1.4.C14]

4.1.4.Q21: What system safety requirements are defined in the system performance specifications?

- What specific verification criteria are documented for these safety requirements and how are they required to be verified (i.e., component testing, live fire, etc.)?
- What risk mitigation approach and management criteria are required as an outcome of the reviews? [4.1.4.C15]

4.1.4.Q22: What safety-related exit criteria have been defined to proceed to a Milestone C production decision?

- What approval authority is required for acceptance of the Safety Assessment Report?
- What is the expected disposition of identified safety (ESOH) hazards? [4.1.4.C16]

4.1.4.Q23: What safety hazards and analyses have been defined and evaluated, concurrent with the system, subsystem, and component level design process?

- Is a safety risk mitigation plan integrated within and tracked as part of the overall system risk management plan?
    - What are the top five safety-related risks that are currently being tracked? [4.1.4.C17]

4.1.4.Q24: What is the process to maintain/update and track the current defined safety-critical requirements of the system as the design is progressing?

- How are these requirements integrated within the system configuration item verification planning and documentation? [4.1.4.C17]

4.1.4.Q25: What specific life cycle support (including initial deployment, O&M, and demilitarization and disposal) hazards for the system have been documented to date and by what means?

- How is this information being incorporated in the support and resource planning for the system? [4.1.4.C17]

4.1.4.Q26: What are the qualifications and numbers of safety personnel (PMO and developer) in place to support the system verification/DT&E activities?

- How are the staff resourcing and providing support to:
    - Subsystem and component testing?
    - Evaluation of procedures to maintain control of hazards during testing?
    - Providing safety releases for upcoming tests? [4.1.4.C18]

4.1.4.Q27: What are the qualifications and numbers of safety personnel (PMO and developer) in place to support the system developmental testing (DT)/operational testing (OT) combined testing, LFT&E, and operational assessments?

- What are the primary roles and tasks of the safety personnel in supporting the test program?
- How effectively has the testing verified the documented safety hazards and requirements documented in the system specifications?

- What additional hazard(s) (ESOH) have been identified during testing that requires closure prior to a Milestone C production decision? [4.1.4.C19]

4.1.4.Q28: What is the status of key program documentation (TEMP, SEP, PESHE, CPD, etc.) regarding the update of safety-critical testing and hazards mitigation?

- What are the outstanding safety (ESOH) issues that require risk mitigation and tracking during system deployment?
    - Are they fully documented in the system Integrated Support Plan? [4.1.4.C20]

Post-Milestone C (Production & Deployment)

Criteria

4.1.4.C21: During Initial Operational Test & Evaluation (IOT&E), safety continues to support the technical review and reporting process with updates to the status of safety-critical hazards and risk mitigation

- Test Results – Verify effectiveness of hazard risk mitigation controls and report on analyses of safety anomalies, incidents, and mishaps
- TEMP – Update specific system test requirements in accordance with appropriate MIL Standards and Directives
- Product Support Requirements – Provide the results of the O&SHA
- PESHE – Update to reflect the results of verification testing and evaluation
- Program Documentation - Inputs to update the CPD, System Threat Assessment, Integrated Support Plan, Systems Engineering Plan, Cost/Manpower Estimate, (e.g. update hazard mitigation requirements, system attrition rate due to mishaps, O&M training and staffing requirements, etc.)

4.1.4.C22: Safety assists the program in analyzing deficiencies to determine corrective actions. This can include reviewing deficiency reports for system safety implications, assisting with development of corrective actions, and participation in configuration control boards to review Engineering Change Proposals (ECPs).

4.1.4.C23: A Physical Configuration Audit (PCA) of the system is conducted to validate the recorded physical configuration of the system as tested. Safety participates in the validation of safety-critical items, and the recording the production baseline of the system

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.4.Q29: How effective have the implemented hazard controls been in mitigating or eliminating safety-related hazards as verified in the IOT&E phase of the program?

- What outstanding or new safety-critical hazards have been documented?
- What is the impact on follow-on testing requirements
- What is the impact on O&M support and training requirements? [4.1.4.C21]

4.1.4.Q30: What resulting recommendations for actions are required to be incorporated in the system to obtain the necessary safety releases for production of the system?

- Have these recommendations been approved by the appropriate safety or configuration control boards and fully documented? [4.1.4.C22]

4.1.4.Q31: What is the status of the system-level PCA?

- Are safety-critical hardware or software configuration changes required to the production baseline?
- Are proposed changes documented in the acquisition documentation (TEMP, PESHE)?

References

"System Safety in Systems Engineering." Continuous Learning Course. Defense Acquisition University.

Defense Acquisition Guidebook (DAG), Section 4.4.11.

Integrating ESOH into Systems Engineering. Defense Acquisition University, January 2008.

MIL-STD-882D: DoD Standard Practice for System Safety, February 2000.

Factor 4.1.5 – Spectrum Management

Pre-Milestone A

Criteria

4.1.5.C1: There is sufficient electromagnetic spectrum available to support the operations of a spectrum-dependent equipment or system.

4.1.5.C1a: The DD Form 1494 – Stage 1 (Conceptual) request for a spectrum supportability determination has been submitted to the Military Communications-Electronics Board (MCEB) during Concept Refinement.

4.1.5.C1b: The DD Form 1494 – Stage 2 (Experimental) spectrum supportability determination was obtained by Milestone A (Technology Development).

4.1.5.C2: The Electronic Environmental Effects (E3) control requirements have been established early in the acquisition process to ensure the system, subsystems and equipment are designed to be self-compatible and operate compatibly in the operational electromagnetic environment.

Note: E3 control applies to the electromagnetic interactions of both spectrum-dependent and non-spectrum-dependent objects within the operational environment. Examples of non-spectrum-dependent objects that could be affected by the electromagnetic environment are ordnance, personnel, and fuels.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.5.Q1: Has the program manager (PM) included the following statement (or something similar) in the Initial Capabilities Document (ICD)?

"This system will comply with DoD, national and international spectrum management policies." *Note: Though spectrum supportability is not required in the ICD, it is one of the earliest opportunities to start the process.* [4.1.5.C1]

4.1.5.Q2: Do responsible personnel in the program management office (PMO) understand, and have they received training in, spectrum management (SM), spectrum supportability, and E3 controls*? Note: Verify personnel's knowledge and awareness of the stipulations, requirements, and direction in the following references, as a minimum: DoD Directive 4650.1 (Policy for Management and Use of the Electromagnetic Spectrum, 8 June 2004, CJCSM 3212.02B (Performing Electronic Attack in the United States and Canada for Tests, Training and Exercises, 15 October 2003), Military Communications-Electronics Board (MCEB) Pub 1 (MCEB Organization, Mission and Functions Manual, 1 March 2003, DoDI 4630.8 (Procedures for Interoperability and Supportability of Information Technology (IT) and National Security Systems, 2 May 2002), and MIL-STD-461 (Requirements for the Control of Electromagnetic Interference of Subsystems and Equipment, 11 January 1993.)* [4.1.5.C1]

4.1.5.Q3: Has a Stage 1 (Conceptual) request for a spectrum supportability determination (i.e., a DD Form 14914) been submitted to the MCEB prior to Milestone A?

- If a determination has not been received by Milestone A, is there a plan to obtain spectrum supportability with the concurrently submitted initial Milestone B Information Support Plan (ISP)?
- Does the request for a spectrum supportability determination identify those host nations into which deployment is planned or likely?
    - Is the approval for each host nation identified in the ICD? [4.1.5.C1a]

4.1.5.Q4: Has a Stage 2 (Experimental) spectrum supportability determination (i.e., a DD Form 14914) been obtained prior to Milestone A?

- If not, has the Milestone Decision Authority for the program provided specific authority to proceed? [4.1.5.C1b]

4.1.5.Q5: Have all requirements for E3 control been identified early in the Concept Refinement and Technology Development phases? [4.1.5.C2]

Pre-Milestone B

Criteria

4.1.5.C3: There is sufficient electromagnetic spectrum available to support the operations of a spectrum-dependent equipment or system.

4.1.5.C3a: The DD Form 1494 – Stage 3 (Developmental) spectrum supportability determination has been obtained by Milestone B (System Development and Demonstration).

4.1.5.C4: Spectrum supportability requirements are ensured through the contract.

4.1.5.C5: The Electronic Environmental Effects (E3) control requirements have been specified and defined in the Capabilities Development Document (CDD), the Test and Evaluation Master Plan (TEMP), and the Information Support Plan (ISP), at a minimum.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.5.Q6: Has the PM included the following statement (or something similar) in the CDD and ISP? "Spectrum Supportability. Procurement or acquisition of this wireless spectrum-dependent device will be conducted IAW DoD guidance (e.g., DoDD 3222.3 and DoDD 4650.8), as well applicable military publications. A request for spectrum supportability assessment (determination) was initiated on (insert date). The DD Form 1494 was releasable to those foreign countries (host nations) in which permanent, or lengthy temporary use is contemplated. The program manager acknowledges that, before assuming contractual obligations for deployment, testing, production, or procurement of this spectrum-dependent system, the required spectrum support is or will be available in those host nations determined for the equipment's intended use. The program manager has (will develop) a plan to obtain appropriate equipment allocation guidance/status prior to Milestone B or Milestone C as outlined in DoDD 4650.1 in order to progress to the next phase." [4.1.5.C3 and 4.1.5.C4]

4.1.5.Q7: Has there been a change in the PMO personnel responsible for SM and E3 controls?

- Do the new personnel understand and have received training in SM, spectrum supportability, and E3 controls? [4.1.5.C3]

4.1.5.Q8: Has a Stage 3 (Developmental) spectrum supportability determination (i.e., a DD Form 14914) been obtained by Milestone B?

- If not, has specific authority from the Milestone Decision Authority (MDA) been received for the program to proceed into the System Development and Demonstration (SDD) phase, and has the justification and plan to obtain spectrum supportability been provided to the Under Secretary of Defense (USD), Acquisition, Technology and Logistics (AT&L), the Assistant Secretary of Defense (ASD), Networking, Information, and Information (NII), the Director, Operational Test and Evaluation (DOT&E), and Chair, MCEB? [4.1.5.C4]

4.1.5.Q9: Do the Statement of Work (SOW), Contract Data Requirement List (CDRL), and contract performance specifications address spectrum supportability and E3 control requirements? [4.1.5.C4 and 4.1.5.C5]

4.1.5.Q10: What are all the E3 issues?

- How were they assessed prior to entering the SDD phase? [4.1.5.C5]

4.1.5.Q11: Does the TEMP include within the scope of critical operational issues and sub-issues, the requirement to demonstrate the effective E3 control of the system, subsystems, and equipment? [4.1.5.C5]

4.1.5.Q12: How is the operational electromagnetic compatibility disposition of the system, subsystems. and equipment reported in the ISP or in other management/support plans analogous to the ISP? [4.1.5.C4 and 4.1.5.C5]

Pre-Milestone C

Criteria

4.1.5.C6: There is sufficient electromagnetic spectrum available to support the operations of a spectrum-dependent equipment or system.

4.1.5.C6a: The DD Form 1494 – Stage 4 (Operational) spectrum supportability determination has been obtained by Milestone C (System Production and Deployment).

4.1.5.C7: The operational effectiveness and suitability of the system in its intended operational Electromagnetic Environment (EME) has been demonstrated.

4.1.5.C8: E3 control requirements have been fully defined prior to Milestone C, and verified through the acquisition process (i.e., Critical Design Reviews).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.5.Q13: Has the PM included the following statement (or something similar) in the Capability Production Document (CPD) and ISP? "Spectrum Supportability. Procurement or acquisition of this wireless spectrum-dependent device will be conducted IAW DoD guidance (e.g., DoDD 3222.3 and DoDD 4650.8), as well applicable military publications. A request for spectrum supportability assessment (determination) was initiated on (insert date). The DD Form 1494 was releasable to those foreign countries (host nations) in which permanent, or lengthy temporary use is contemplated. The program manager acknowledges that, before assuming contractual obligations for deployment, testing, production, or procurement of this spectrum-dependent system, the required spectrum support is or will be available in those host nations determined for the equipment's intended use. The program manager has (will develop) a plan to obtain appropriate

equipment allocation guidance/status prior to Milestone B or Milestone C as outlined in DoDD 4650.1 in order to progress to the next phase." [4.1.5.C6 and 4.1.5.C7]

4.1.5.Q14: Has a Stage 4 (Operational) spectrum supportability determination (i.e., a DD Form 14914) been obtained by Milestone C?

- If not, has specific authority from the MDA been received for the program to proceed into the Production and Deployment (PD) phase, and has the justification and plan to obtain spectrum supportability been provided to the USD(AT&L), the ASD(NII), the DOT&E, and Chair, MCEB? [4.1.5.C6a]

4.1.5.Q16: Have all E3 issues been identified and assessed prior to entering the PD phase? [4.1.5.C8]

4.1.5.Q17: Does the TEMP include within the scope of critical operational issues and sub-issues, the requirement to demonstrate the effective E3 control of the system, subsystems, and equipment? [4.1.5.C7]

4.1.5.Q18: Is the operational electromagnetic compatibility disposition of the system, subsystems, and equipment reported in the ISP or in other management/support plans analogous to the ISP? [4.1.5.C7]

References

Acquisition Community Connection (ACC): Spectrum and E3 Compliance Special Interest Area
https://acc.dau.mil/sc.
Defense Acquisition Guidebook (Chapter 4).
DoDD 3222.3. "DoD Electromagnetic Environmental Effects (E3) Program," September 2004.
DoDD 4650.1. "Policy for Management and Use of the Electromagnetic Spectrum," June 2004
DoDI 5000.2. "Operation of the Defense Acquisition System," May 12, 2003.

Factor 4.1.6 – Sustainment as a Design Consideration

Description: Effective sustainment of weapon systems begins with the design and development of reliable and maintainable systems through the continuous application of a robust systems engineering methodology.

Scope: The scope of this factor will provide for an assessment of the program manager's (PM) overall plan for the sustainment of the system.

Perspective: The ability to maximize joint warfighting effectiveness is predicated on establishing and maintaining a foundation of logistics support throughout the system life cycle. To develop this logistics support foundation and sustain essential warfighter performance, the logistics workforce must sharpen the focus on product support and sustainment planning and implementation, particularly in the early acquisition phases. A solid product support strategy is built around the

acquisition logistics requirements and sustainment elements and is the result of continuous assessment and stakeholder collaboration (Independent Logistics Assessment 2006).

Pre-Milestone A

Criteria

4.1.6.C1: One major objective for including sustainment-related activities at the earliest program stages is to ensure an optimized (cost-effective and efficient) support strategy is planned from the start.

4.1.6.C2: The Milestone Decision Authority (MDA), or his designee, must actively pursue sustainment planning from the earliest program stages. This responsibility transitions to the PM once assigned.

4.1.6.C3: Development of an optimized support strategy requires the active participation of all stakeholders.

4.1.6.C4: A second goal of early consideration of sustainment is to allow trade-offs between availability, reliability, and ownership cost. These trades should maximize system availability while optimizing ownership costs and minimizing logistics footprint requirements.

4.1.6.C5: The PM is required to seek the most cost effective support program possible. This requirement includes Performance-Based Agreements (PBAs), performance-based logistics (PBL), balancing public and private sector support, and meeting statutory requirements for government/industry work shares.

4.1.6.C6: The PM is responsible for ensuring that the program is fully funded, realistically scheduled, and affordable at the earliest stage possible. Since sustainment makes up 50-70 percent of the average program's life cycle cost (LCC), consideration of sustainment alternatives and their costs must be included from the outset of program planning.

4.1.6.C7: Sustainment must be treated as a performance parameter with equal status to all other performance parameters.

4.1.6.C8: Reliability, availability, and maintainability (RAM) improvements are a major goal of sustainment strategy optimization.

4.1.6.C9: The support strategy must form part of the Acquisition Strategy. The documented support strategy should include descriptions of the planned activities, their results when available, and the rationale for decisions made. Plans for continuous affordability improvements throughout the system life cycle should also be included.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.6.Q1: What are the program's approaches to ensuring improvements in operational support are realized? [4.1.6.C1]

4.1.6.Q2: How is the program ensuring an optimal support strategy is implemented? [4.1.6.C1]

4.1.6.Q3: How is the MDA (or designee) active in the program? [4.1.6.C2]

4.1.6.Q4: How is the program planning to include inputs from warfighters, users, developers, acquirers, technologists, testers, budgeters, and sustainers during capability needs development? [4.1.6.C3]

4.1.6.Q5: What is the program's initial approach to maximizing total system availability while minimizing cost and logistics footprint? [4.1.6.C4]

4.1.6.Q6: What performance-based logistics strategies are being pursued? [4.1.6.C4] [4.1.6.C5]

4.1.6.Q7: What public and private sector capabilities are being investigated to ensure an optimized support strategy? [4.1.6.C5]

4.1.6.Q8: What government/industry partnering initiatives are planned, if any, in accordance with statutory requirements? [4.1.6.C5]

4.1.6.Q9: What analysis ensures that program funding is stable and sufficient? [4.1.6.C6]

4.1.6.Q10: How does the program know that the schedule is realistic? [4.1.6.C6]

4.1.6.Q11: How does the schedule allow adequate time for testing throughout development? [4.1.6.C6]

4.1.6.Q12: What long-range investment plans, consistent with affordability assessments, are in place? [4.1.6.C6]

4.1.6.Q13: What are the PM's plans for implementing and verifying total life cycle systems management including sustainment? [4.1.6.C6]

4.1.6.Q14: What is the estimate (and breakdown) of total ownership cost? [4.1.6.C6]

4.1.6.Q15: What planning for supportability during Operation and Support is under way? [4.1.6.C6]

4.1.6.Q16: What logistics footprint reductions are anticipated? [4.1.6.C7]

4.1.6.Q17: How has the program afforded supportability, life cycle costs, performance, and schedule equal status when making program decisions? [4.1.6.C7]

4.1.6.Q18: What specific RAM improvements (over existing or similar systems) are being planned? [4.1.6.C8]

4.1.6.Q19: How is the support strategy detailed in the Acquisition Strategy? [4.1.6.C9]

4.1.6.Q20: How does the support strategy describe the supportability planning analyses and tradeoffs performed in order to optimize the support concept? [4.1.6.C9]

4.1.6.Q21: What plans for continuous affordability improvements throughout the product life cycle are identified in the support strategy? [4.1.6.C9]

Pre-Milestone B

Criteria

4.1.6.C10: One purpose of the System Development and Demonstration (SDD) phase is to ensure operational supportability with particular attention to reducing the logistics footprint.

4.1.6.C11: The PM is responsible for ensuring that the program is fully funded, realistically scheduled, and affordable at the earliest stage possible. Since sustainment makes up 50-70 percent of the average program's LCC, consideration of sustainment alternatives and their costs must be included from the outset of program planning.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.6.Q22: What activities have been planned/completed to evaluate achieved operational supportability? [4.1.6.C10]

4.1.6.Q23: What evidence is there that supportability related considerations have been incorporated into the system design? [4.1.6.C10]

4.1.6.Q24: What logistics footprint reductions have been verified? [4.1.6.C10]

4.1.6.Q25: How is the program ensuring that the support strategy has been updated and is consistent with program goals? [4.1.6.C11]

4.1.6.Q26: What is the PM's assessment of program affordability? [4.1.6.C11]

4.1.6.Q27: How is the affordability assessment being updated after each applicable program event? [4.1.6.C11]

4.1.6.Q28: What readiness requirements are finalized (with values and confidence levels)? [4.1.6.C11]

4.1.6.Q29: What supportability-related programmatic and technical risks have been/are being tracked and mitigated? [4.1.6.C11]

4.1.6.Q30: How have total ownership cost (TOC) concerns and tradeoffs been addressed to optimize expected TOC? [4.1.6.C11]

Pre-Milestone C and FRP

Criteria

4.1.6.C12: Sustainment analysis requires that the manufacturing processes be under control and operational supportability achieved be acceptable, as well as demonstration that the system is affordable throughout the life cycle.

4.1.6.C13: One sustainment objective during the Operations and Support phase is the execution of the support system in a way that meets requirements and sustains the system in the most cost-effective manner possible while allowing for appropriate end-of-life system disposal.

4.1.6.C14: As part of an effective sustainment approach, the PM shall employ human factors engineering to design systems that require minimal manpower; provide effective training; can be operated and maintained by users; and are suitable (habitable and safe with minimal environmental and occupational health hazards) and survivable (for both the crew and equipment).

4.1.6.C15: The PM shall work with the users to document performance and support requirements in performance agreements specifying objective outcomes, measures, resource commitments, and stakeholder responsibilities. The military Services shall document sustainment procedures that ensure integrated combat support.

4.1.6.C16: The DoD Components shall initiate system modifications, as necessary, to improve performance and reduce ownership costs.

4.1.6.C17: PMs shall optimize operational readiness through affordable, integrated, embedded diagnostics and prognostics, and embedded training and testing; serialized item management; automatic identification technology (AIT); and iterative technology refreshment.

4.1.6.C18: The Services, in conjunction with users, shall conduct continuing reviews of sustainment strategies, utilizing comparisons of performance expectation as defined in performance agreements against actual performance measures. PMs shall revise, correct, and improve sustainment strategies as necessary to meet performance requirements.

4.1.6.C19: Sustainment strategies shall evolve and be refined throughout the life cycle, particularly during development of subsequent increments of an evolutionary strategy, modifications, upgrades, and reprocurement. The PM shall ensure that a flexible, performance-oriented strategy to sustain systems is developed and executed.

4.1.6.C20: During the design process, PMs shall document hazardous materials contained in the system, and shall estimate and plan for the system's demilitarization and safe disposal (DoDI 5000.2).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.6.Q31: What manufacturing processes have been investigated, and are they under control? [4.1.6.C12]

4.1.6.Q32: How has operational supportability been demonstrated as acceptable? [4.1.6.C12]

4.1.6.Q33: What assurances are there that the system is affordable throughout the life cycle? [4.1.6.C12]

4.1.6.Q34: How has the support program been demonstrated as being cost effective? [4.1.6.C13]

4.1.6.Q35: What disposal plans are in place and financed for the system? [4.1.6.C13]

4.1.6.Q36: How has human factors engineering been considered throughout system development? [4.1.6.C14]

4.1.6.Q37: What training has been planned, implemented, and evaluated for effectiveness? [4.1.6.C14]

4.1.6.Q38: How has system maintenance and operation been demonstrated (considering the anticipated users)? [4.1.6.C14]

4.1.6.Q39: How has system survivability in the anticipated environment been demonstrated? [4.1.6.C14]

4.1.6.Q40: What assurances are there that the system is suitable for operation by the anticipated users? [4.1.6.C14]

4.1.6.Q41: What system performance has been documented, and is it acceptable? [4.1.6.C15]

4.1.6.Q42: How do system support requirements meet performance agreement specifications? [4.1.6.C15]

4.1.6.Q43: How is the program evaluating that system support resources are meeting commitments? [4.1.6.C15]

4.1.6.Q44: How are stakeholder responsibilities being met? [4.1.6.C15]

4.1.6.Q45: How is the applicable Service documenting sustainment procedures and requirements to ensure integrated combat support? [4.1.6.C15]

4.1.6.Q46: What system modifications designed to improve performance and/or reduce ownership costs are being pursued? [4.1.6.C16]

4.1.6.Q47: How have embedded diagnostics and prognostics been implemented to ensure operational readiness? [4.1.6.C17]

4.1.6.Q48: What embedded training and testing have been implemented? [4.1.6.C17]

4.1.6.Q49: What serialized item management or automatic identification technology is in place? [4.1.6.C17]

4.1.6.Q50: What iterative technology refreshment is planned? [4.1.6.C17]

4.1.6.Q51: How is the Service performing continuing reviews of sustainment strategies to compare performance expectations against actual measures? [4.1.6.C18]

4.1.6.Q52: How has the PM evaluated sustainment strategies and, where necessary, revised, corrected, or improved those strategies to ensure sustainment performance expectations are met? [4.1.6.C18]

4.1.6.Q53: What policies are in place to evolve or refine sustainment strategies for subsequent increments, modifications, upgrades, and/or reprocurements? [4.1.6.C19]

4.1.6.Q54: How has the PM ensured a flexible, performance oriented sustainment strategy is in place and executed for the system? [4.1.6.C19]

4.1.6.Q55: What hazardous material strategies are in place? [4.1.6.C20]

4.1.6.Q56: What is the system demilitarization and disposal strategy, and is it in place? [4.1.6.C20]

References

Designing and Assessing Supportability in DoD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint. Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, October 24, 2003.

DoD Directive 5000.1. "The Defense Acquisition System," May 12, 2003.

DoD Guide for Achieving Reliability, Availability, and Maintainability. Washington, DC: Office of the Deputy Under Secretary of Defense for Acquisition and Technology, Systems and Software Engineering, August 2005.

DoD Instruction 5000.2. "Operation of the Defense Acquisition System," May 12, 2003.

Independent Logistics Assessment Handbook. Version 1.0. Department of the Air Force, January 2006.

Factor 4.1.7 – Corrosion

Pre-Milestone A

Criteria

4.1.7.C1: Corrosion Prevention and Control Planning (CPCP) is a significant influencing factor that is considered in trade studies and the Analysis of Alternatives (AoA) to select the preferred system concept (PSC). Supportability factors, e.g. maintainability, support manpower, and training and susceptibility to corrosion are considered. Corrosion-related considerations during the AoA process is the focus of a government-formed Corrosion Prevention Action Team (CPAT) early in the CR phase of the program.

4.1.7.C2: The corrosive effects of expected operating environments on existing systems to be replaced are highlighted in the Initial Capabilities Document (ICD). This is consistent with the role of the ICD in defining the capability gap (and its operating environment) to be filled by the selected system.

4.1.7.C3: The Technology Development Strategy (TDS) defines the plan for verification of availability and suitability of materials for system solutions, to include environmental impacts, and corrosive vulnerabilities.

4.1.7.C4: The knowledge of field performance of legacy systems has been researched for indicators of corrosion issues or risks that could apply to the preferred system. (This knowledge could define a focus of technology efforts during the TD phase).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.7.Q1: How has corrosion been a consideration in the AoA process and selection of the preferred system concept?

- What corrosion considerations were influential in selecting the preferred system concept? [4.1.7.C1]

4.1.7.Q2: What supportability factors were evaluated as part of the AoA?

- What are the major areas of susceptibility of the preferred system concept to the effects of corrosion? [4.1.7.C1]

4.1.7.Q3: What trade studies have been identified or are completed that examine alternative material considerations to improve supportability from a corrosion mitigation perspective?[4.1.7.C1]

- How will corrosion prevention be integrated with supportability planning and sustainment over the system life cycle? [4.1.7.C1]

4.1.7.Q4: Has a Corrosion Prevention Action Team (CPAT) been formed during the CR phase of the program?

- If not, is there a resource or staffing issue?
- If yes, has a corrosion prevention plan been drafted for the preferred system concept (PSC)?[4.1.7.C1]

4.1.7.Q5: What does the ICD highlight regarding the expected operational environment and its corrosive effects on system capabilities and operational readiness?

- What level of emphasis on corrosion prevention and mitigation will be required in pursuit of the new capability? [4.1.7.C2]

4.1.7.Q6: What are the expected categories and effects of environmental degradation on operability over the lifecycle?

- Is there a potential for catastrophic effects of system failure on operating personnel if the system is not protected? [4.1.7.C2]

4.1.7.Q7: What issues or technology needs related to corrosion prevention and material suitability have been defined in the TDS for evaluation during the Technology Development phase? [4.1.7.C3]

4.1.7.Q8: How has the history of performance of legacy or similar systems been evaluated to determine indicators of corrosion risks applicable to the preferred system concept? [4.1.7.C4]

Pre-Milestone B

Criteria

4.1.7.C5: In accordance with regulatory requirements in the DoDI 5000.02, a Corrosion Prevention and Control Plan (CPCP) is required as part of the documented Acquisition Strategy for the Milestone B and Milestone C decisions.

4.1.7.C6: The Capabilities Development Document (CDD) defines the expected system performance and highlights corrosion-related degradation of existing systems based on the known operating environments.

4.1.7.C7: The program has technical personnel who are experienced with corrosion prevention and knowledgeable in the physics (cause and effects) of corrosion. Influencing factors on corrosion are

understood, to include interrelationship between materials and their environments; the effects of design specific configurations, manufacturing processes, operation, and maintenance. A government Corrosion Prevention Action Team (CPAT) remains in tact and plans to expand with contractor participation during the System Development and Demonstration (SDD) phase.

4.1.7.C8: The program manager views corrosion as a risk factor equivalent to other technical parameters, acknowledging its criticality as a design consideration that requires verification (accounting for the verification of corrosion prevention/control by managing corrosion as a technical risk contributes to reduction of total ownership cost). *Note: The OSD corrosion web site (www.corrdefense.org) provides resources for the program manager, including the Corrosion Prevention and Control Planning Guidebook.*

4.1.7.C9: Cost benefit analyses have been conducted to justify the up-front cost of the design to use corrosion resistant materials and techniques, and avoid the costly effects of system degradation and repair during the life cycle.

4.1.7.C10: The program has defined the appropriate process or finish specifications that accompany the material specifications (when relevant to corrosion resistant applications) no later than the beginning of the Milestone B phase of the program. All performance and environmental constraints of the system are documented in the system specification. The level of detail of the constraints provides traceability to the allocated design as well as test verification considerations.

4.1.7.C11: To ensure adequate maintainability, predictable corrosion resistance and control constraints are established during design that can be verified through test or support demonstrations.

4.1.7.C12: Logistics support factors are considered in the design to take into account transportation and storage requirements of the system and the potential for a corrosive environment.

4.1.7.C13: The system design process incorporates one or more of the basic approaches to planning for corrosion control which include: selection of corrosion resistant materials and manufacturing processes; application of protective coatings; implementing corrosion prevention and control design attributes; modifying the environment.

4.1.7.C14: The design takes into consideration material suitability, design geometries that avoid wear, and provide access for maintenance and inspection, avoidance of dissimilar metals if possible, insulation of materials when needed, and changes to controlled environments when possible. Emphasis is placed on understanding of the operational environment of the system.

4.1.7.C15: The contractor has the capability to conduct accelerated corrosion tests as part of the design trade process to verify performance under actual environmental conditions when possible. The contractor should recognize the limitation on duplicating actual environments.

4.1.7.C16: Verification testing of corrosion control mechanisms of the system are contractually mandated by the developing contractor.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.7.Q9: Has the program established a corrosion prevention strategy for development of the system?

- Was the DoD Corrosion Prevention and Control Planning Guidebook used in establishing corrosion control attributes for the system?
- Has a Corrosion Prevention and Control Plan (CPCP) been approved? [4.1.7.C5]

4.1.7.Q10: What does the CDD highlight regarding the expected operational environment and its corrosive effects on existing system capabilities and operational readiness?

- How does the program corrosion strategy mitigate or alleviate the degrading effects of the environment for the system to be developed? [4.1.7.C6]

4.1.7.Q11: What is the past experience of the engineering/technical staff in planning and implementing corrosion prevention and mitigation programs as part of the design process?

- Is a government Corrosion Prevention Action Team (CPAT) in place and actively developing the objectives of the corrosion prevention effort? If so, how are they integrated with the IPT process?
- What mechanisms have been put in place to ensure that corrosion is integral to the design process and selection of materials?
- Who are the stakeholders on the design team that have a vested interest in the corrosion program? [4.1.7.C7]

4.1.7.Q12: What emphasis has the program manager placed on corrosion prevention as integral to the design process? [4.1.7.C8]

4.1.7.Q13: How does corrosion prevention remain visible and measurable in the context of meeting the expectations of the CPCP?

- Is corrosion planning status reported out at all of the technical reviews?
- What verification parameters have been established and documented in test planning documentation? [4.1.7.C8]

4.1.7.Q14: What design trade studies or analyses have been done that consider the cost benefits of applying corrosion mitigation methods and materials in the design process to reduce life cycle operating cost of the system? [4.1.7.C9]

4.1.7.Q15: Does the system specification include measurable parameters and operating constraints to enable the verification of objectives of the CPCP?

- What are the parameters/constraints and the verification objectives? [4.1.7.C10]

4.1.7.Q16: What are the maintainability-related specifications that pertain to corrosion control for the system?

- How do they affect the logistical support concept? [4.1.7.C11], [4.1.7.C12]

4.1.7.Q17: What are the major design attributes of the system that are considered for corrosion prevention or mitigation of corrosive environments?

- What is the impact on selection of materials?
- What is the impact on manufacturing processes and facilities? [4.1.7.C13]

4.1.7.Q18: What design practices are used to ensure that the system possesses the desired corrosion resistance?

- What if any operational requirements of the system pose a corrosive condition that cannot be mitigated by design? [4.1.7.C14]

4.1.7.Q19: How is the contractor equipped to verify the selection of materials during the design process? [4.1.7.C15]

4.1.7.Q20: What test verification requirements and test plans are established within the CPCP and Test and Evaluation Master Plan (TEMP) to verify the corrosion protection actions in the system operating environment?

- Are accelerated life tests included as part of the verification process of subsystems or lower level components of the system?
- If so, how are the accelerated life tests validated as acceptable substitutes for the operating environment? [4.1.7.C16]

Pre-Milestone C

Criteria

4.1.7.C17: In accordance with regulatory requirements in the DoDI 5000.02, a Corrosion Prevention and Control Plan (CPCP) is required as part of the documented Acquisition Strategy for the Milestone B and Milestone C decisions.

4.1.7.C18: The Capabilities Development Document (CDD) defines the expected system performance and highlights corrosion-related degradation of existing systems based on the known operating environments.

4.1.7.C19: The program has formed a joint technical team with contractor personnel who comprise the Corrosion Prevention Action Team (CPAT) and manage the corrosion prevention and control program. They directly advise the program manager on related matters that could affect the corrosion program during the development and demonstration phase.

4.1.7.C20: The program manager views corrosion as a risk factor equivalent to other technical parameters, acknowledging its criticality as a design consideration that requires verification (accounting for the verification of corrosion prevention/control by managing corrosion as a technical risk contributes to reduction of total ownership cost). *Note: The OSD corrosion web site (www.corrdefense.org) provides resources for the program manager, including the Corrosion Prevention and Control Planning Guidebook.*

4.1.7.C21: Cost-benefit analyses have been conducted to justify the up-front cost of the design to use corrosion resistant materials and techniques, and avoid the costly effects of system degradation and repair during the life cycle.

4.1.7.C22: The program has defined the appropriate process or finish specifications that accompany the material specifications (when relevant to corrosion resistant applications). All performance and environmental features of the system are documented in the system design. The level of detail of the constraints provides traceability to the allocated design as well as test demonstration plans. Tests will verify corrosion protection attributes and maintainability requirements.

4.1.7.C23: Logistics support factors are considered in the design to take into account transportation and storage requirements of the system and the potential for a corrosive environment.

4.1.7.C24: The system design incorporates one or more of the basic approaches to planning for corrosion control which include: selection of corrosion resistant materials and manufacturing processes; application of protective coatings; implementing corrosion prevention and control design attributes; modifying the environment.

4.1.7.C25: The design takes into consideration material suitability, design geometries that avoid wear, and provide access for maintenance and inspection, avoidance of dissimilar metals if possible, insulation of materials when needed, and changes to controlled environments when possible. Emphasis is placed on understanding of the operational environment of the system.

4.1.7.C26: The contractor performed the necessary corrosion tests as part of the design trade process to verify performance under actual environmental conditions when possible. The limitation on duplicating actual environments was noted as appropriate.

4.1.7.C27: Verification testing of corrosion control mechanisms of the system are adequately planned or completed in accordance with contractual requirements.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.7.Q21: What is the current corrosion prevention strategy for development of the system?

- Was the DoD Corrosion Prevention and Control Planning Guidebook used in establishing corrosion control attributes for the system?
- Has a Corrosion Prevention and Control Plan (CPCP) been approved? [4.1.7.C17]

4.1.7.Q22: What does the CDD highlight regarding the expected operational environment and its corrosive effects on existing system capabilities and operational readiness?

- How does the program corrosion strategy mitigate or alleviate the degrading effects of the environment for the system being developed? [4.1.7.C18]

4.1.7.Q23: What is the membership and experience of joint Corrosion Prevention Action Team (CPAT) formed between the government and contractor?

- How effective is the CPAT in working with the IPTs to ensure that the CPAP is fully implemented within the trade space of cost and performance of the system design?
- Who are the stakeholders on the design team that have a vested interest in the corrosion program? [4.1.7.C19]

4.1.7.Q24: What emphasis has the program manager placed on corrosion prevention as a priority consideration in the system design? [4.1.7.C20]

4.1.7.Q25: How does corrosion prevention remain visible and measurable in the context of meeting the expectations of the CPCP?

- Is corrosion planning status reported out at all of the technical reviews?
- What verification parameters have been established and documented in test planning documentation? [4.1.7.C20]

4.1.7.Q26: What design trade studies or analyses have been done that justify the added cost of corrosion mitigation methods and materials in the design process, to reduce life cycle operating cost of the system? [4.1.7.C21]

4.1.7.Q27: Does the system specification include measurable parameters and operating constraints to enable the verification of objectives of the CPCP?

- What are the parameters/constraints and the verification objectives?
- What are the test verification requirements as documented in system test plans and are they traceable to the system specification? [4.1.7.C22]

4.1.7.Q28: What are the maintainability-related specifications that pertain to corrosion control for the system?

- How do they affect the logistical support concept?
- How do maintainability demonstration plans address corrosion control? [4.1.7.C22 and 4.1.7.C23]

4.1.7.Q29: What are the major design attributes of the system that are being implemented for corrosion prevention or mitigation of corrosive environments?

- What is the impact on selection of materials?
- What is the impact on manufacturing processes and facilities? [4.1.7.C24]

4.1.7.Q30: What design practices are used to ensure that the system possesses the desired corrosion resistance?

- What if any operational requirements of the system pose a corrosive condition that cannot be mitigated by design? [4.1.7.C25]

4.1.7.Q31: How is the selection of materials verified during the design process? [4.1.7.C26]

4.1.7.Q32: What test verification requirements and test plans are established within the CPCP and Test and Evaluation Master Plan (TEMP) to verify the corrosion protection actions in the system operating environment?

- Are accelerated life tests included as part of the verification process of subsystems or lower level components of the system?
- If so, how are the accelerated life tests validated as acceptable substitutes for the operating environment? [4.1.7.C27]

References

DoD Corrosion web site: http://www.corrdefense.org/default.aspx.

DoDD 5000.1. "The Defense Acquisition System," May 12, 2003.

DoDI 5000.2. "Operation of the Defense Acquisition System," May 12, 2003.

DoDI 5000.67. "Prevention and Mitigation of Corrosion on DoD Military Equipment and Infrastructure," January 25, 2008

OSD(AT&L) Office of Corrosion Policy and Oversight. Corrosion Prevention and Control Planning Guidebook, Spiral 3, September 2007.

USD(AT&L) Policy Letter, "Corrosion Prevention and Control," November 12, 2003.

Factor 4.1.8 – Human Systems Integration (HSI)

Pre-Milestone A, Pre-Milestone B and Pre-Milestone C

1. Manpower Planning

Note: Manpower factors include job tasks, operation and maintenance (O&M) rates, workload, and operational conditions used to determine the number and mix of military and DoD civilian manpower needed to operate, support, maintain and provide training for the system.

Criteria

4.1.8.C1: DoDD 5000.1 requires the Component Services to plan programs within projected future year manpower availability. Program manpower requirements should be based on studies and analyses that consider all operational facets of the Concept of Operations (CONOPS) to account for the manpower mix, and the impact on any established Service-level constraints on manpower end strength.

4.1.8.C2: The Initial Capabilities Document (ICD)/Capabilities Development Document (CDD) should document the projected operational and environmental conditions of the CONOPS and specify any manpower constraints that are critical to system utility and affordability. These attributes are necessary to establish the manpower requirements for operation, training, and support of the system.

4.1.8.C3: Manpower analyses should consider the following:

- Change in manpower constraints when developing new systems that replace existing systems in the inventory

- Need to specify a manpower key performance parameter (KPP) if maintaining requirements is critical to specified constraints
- Operational conditions that may affect manpower needs, e.g. peacetime versus wartime surge capabilities
- Operational battlefield conditions (risk of using contractors in hostile environments) and support labor costs that influence the mix of DoD versus contractor support
- Reduction of labor-intensive tasks that are high manpower and cost drivers
- System functional requirements that affect physical, cognitive, and sensory demands
- Manpower workload commonalities associated with systems of systems and families-of-systems

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.8.Q1: How does the ICD/CDD address manpower objectives and thresholds (including Departmental constraints) for operation and support of the system?

- How are battlefield operational locations and threat conditions described for consideration in the manpower analysis of requirements?
- Are scenario-based factors such as environmental conditions, conflict durations, etc. included? [4.1.8.C1, C2]

4.1.8.Q2: What is the analytical basis (i.e., task analyses) for the system manpower requirements? [4.1.8.C3]

- Are the requirements based upon task analyses conducted during the system functional allocation process?
    - What human factors are considered in the task analyses? (should consider fatigue, cognitive, physical, sensory overload, environmental conditions, and reduced visibility)
    - Explain how the task analyses factor in personnel capabilities, training, and human factors engineering tradeoffs [4.1.8.C3]

4.1.8.Q3: In the case of systems of systems or families of systems, how are the individual systems reviewed (may require program manager (PM) to be proactive with other PMs) to identify commonalities, merge operations, and avoid duplication? [4.1.8.C3]

- Are the cumulative effects of these systems, including their related system integration being considered in developing the manpower estimates?

4.1.8.Q4: Who are the stakeholders in the systems engineering process for conducting the manpower analyses?

(Should include the necessary functional elements to consider process improvements, design options, or other initiatives to reduce manpower requirements and/or enhance support services and activities) [4.1.8.C3]

4.1.8.Q5: Does the system support strategy document the approach needed to provide the most efficient and cost-effective mix of DoD manpower and contract support? [4.1.8.C3]

- What analyses or tools were used to optimize the mix of support?
- Does the support strategy identify any cost, schedule, or performance issues or uncompleted studies that could affect the PM's ability to execute the program?

2. Personnel Planning

Note: Personnel factors include human aptitudes (i.e., cognitive, physical, and sensory capabilities), knowledge, skills, abilities, and experience levels needed to perform the job tasks associated with the system. These factors are used to develop military occupational specialties (MOS), DoD Component personnel classifications, and civilian job series.

Criteria

4.1.8.C4: The Target Audience Description (TAD) is a key personnel document that should be developed by the PM early in the program in collaboration with the human factors and military personnel community. The TAD is critical to align the personnel needs to operate and support the system with the population of resources (military occupational specialties (MOS)/civilian job series to be available when the system is fielded.
Key considerations include:

- Required operator and maintainer human capabilities (cognitive, physical, sensory, etc.) versus attributes of the available target personnel audience
- Identification of any aptitude-sensitive critical tasks
- Issues of recruitment or retention of the required MOS for the system
- New military personnel policies that will affect the population skill requirements
- Pursuit of engineering design trades to minimize personnel requirements
- Identification of personnel commonalities with other families or systems of systems for possible shared Operations and Support (O&S) resources
- Establishment of new MOS categories needed to execute the program

4.1.8.C5: Establishment of the human capabilities of the system is needed to define the Capabilities Development Document (CDD) requirements and the test criterion in the Test and Evaluation Master Plan (TEMP). System testing should ensure that available personnel representative of the required skill set are used during development and operational and support test verification.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.8.Q6: Does the program assessment of personnel requirements use a Target Audience

Description (TAD) of projected available resources as a baseline for determining manpower needs? [4.1.8.C4]

What are the key personnel attributes included in the TAD? (Should include key information such as force structure, standards of grade authorizations, personnel classification descriptions, physical qualifications, aptitude descriptions, etc.)

4.1.8.Q7: What is the extent of the personnel planning effort within the constraints of the TAD? (Should compare the cognitive and physical demands of the system against the personnel who are the target audience) [4.1.8.C4]

4.1.8.Q8: How are the personnel requirements defined in the CDD and in the TEMP? [4.1.8.C4 and 4.1.8.C5]

4.1.8.Q9: From a human systems integration (HSI) perspective, how will an user aptitude be factored into the selection of available resources be used during test and evaluation (T&E) to determine a reasonable measure of system performance? [4.1.8.C5]

- What aptitude constraints have been identified that could affect system use when deployed (T&E should use aptitude-based representatives required for system performance)?

4.1.8.Q10: How does the acquisition and support strategy address major personnel initiatives or establishment of new military occupational specialties (MOS) or the need for hard-to-fill occupations to achieve system readiness? [4.1.8C4]

3. Training Planning

Note: Training is the learning process by which personnel acquire or enhance predetermined job-relevant knowledge, skills, and abilities by developing their cognitive, physical, sensory, and team dynamic abilities.

Criteria

4.1.8.C6: Training planning is considered early in the capabilities development process that results in the development of the ICD and CDD. The CDD should discuss specific training requirements that consider:

- Potential training interaction between platforms or units (e.g., use of simulation, virtual exercise)
- Incorporation of embedded (in-system) training capabilities in operational systems that will not degrade system performance below thresholds, nor degrade maintainability, component, or system life
    - Embedded training is considered early in determining capabilities
    - Conduct tradeoffs between embedded training and more traditional methods
    - Meeting system Initial Operational Capability (IOC) (to include training capabilities for embedded systems)

- Potential for imbedded performance measurement feedback system (operational readiness measure) for embedded training systems
- Training logistics needed to support training concepts

4.1.8.C7: Programs should use transformational training methods/tools (e.g. computer-based and interactive courseware, simulators, and embedded training systems (Ref. DoDD 1322.18 – Military Training) to meet the needs of the DoD Combatant Commanders (COCOM).

- The Joint Capabilities Integration and Development System (JCIDS) process should address joint training parameters for all military and civilian personnel who operate, maintain, and support the system.

4.1.8.C8: The Training Program should employ a cost-effective training solution that considers existing training programs and/or new innovative solutions

- Training programs' objectives are to enhance user capabilities, improve readiness, reduce training costs over system life cycle
- Training programs should be supported by in-depth analyses that address life cycle cost considerations of alternative methods
- Human factors should be a key consideration in the choice of training methods and equipment selected

4.1.8.C9: The training community is a stakeholder in translating capabilities into system requirements where embedded training is planned, to consider:

- Operational modes for interactive training in operation (e.g. generating fault conditions for diagnosis
- Feature repair rehearsal for fault isolation
- Generating threats for enhanced training maneuvers
- Validation of training capability to declare IOC
- Training logistics to support the training concept (e.g. requirements for facilities)

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.8.Q11: To what level of detail are training program requirements described in the ICD/CDD? [4.1.8.C6]

4.1.8.Q12: How does the approach comply with DoDD 1322.18 - Military Training, with respect to meeting COCOM needs? [4.1.8.C7]

- How are system of systems and families of systems considered in the training plan?

4.1.8.Q13: What analyses were used to estimate the life cycle cost estimates of the training program ? [4.1.8.C8]

- How does the planned program strike a balance between new and existing approaches to training and the most cost-effective solution?

- What attributes of HSI were critical to the training solution?

4.1.8.Q14: What role did the training community play in the systems engineering process in developing the system requirements? [4.1.8.C9]

4.1.8.Q15: What training capability is required at planned training site(s) as criteria for declaring Initial Operational Capability (IOC)? [4.1.8.C6, C9]

What support requirements are critical to the training plan to accomplish this requirement?

4. Human Factors Planning

Note: Human Factors Engineering (HFE) is necessary to design-in the human-machine interfaces consistent with the physical, cognitive, and sensory abilities of the people who operate and maintain the system.

Criteria

4.1.8.C10: HFE must be incorporated in the earliest stages of the design beginning with the Concept Refinement phase and is included in the development of the ICD and CDD.

4.1.8.C11: The HFE effort must include active involvement in major areas of system development:

- Analysis – defining system functions from required mission capabilities; functional allocation to personnel, equipment, and software; task analysis, definition, and assignment of human performance

- Design and Development – converting mission, system, and task analyses data into detailed design that includes the human-system interface

- T&E – Defining the T&E methods to verify the HFE requirements that address operation, maintenance, and support of the system, and validation of the intended training

4.1.8.C12: Systems engineering (SE) should incorporate a human factors engineering effort that:

- Synthesizes allocated functions to associated tasks and required human performance parameters in the mission operational environments

- Identifies high-risk areas of the required human factors

- Includes maintenance and sustainment functions

4.1.8.C13: The program management office (PMO) should require contract deliverables to ensure HFE is integral to system development and support over the life of the program to meet HSI requirements

- The IPT structure should identify HFE as a primary stakeholder in the SE process

Focus Questions

Pertinent criteria numbers follow each question.]

4.1.8.Q16: How does the ICD/CDD articulate the human factors requirements expected to operate and support the system (i.e., the cognitive, physical, and sensory requirements)?

- Do any of these requirements highlight or imply the need for unique personal attributes that may require special human factors capabilities? [4.1.8.C10]

4.1.8.Q17: How has HFE been integrated into the development of the system? [4.1.8.C11]

Has a HFE analysis been performed using the system functional allocation description?

4.1.8.Q18: How have the results of HFE task analyses been factored into the detailed design of the system and support equipment? [4.1.8.C11, C12]

4.1.8.Q19: Is a HFE evaluation plan integrated with early design, modeling and simulation, and engineering testing? [4.1.8.C11]

- How does the developmental test planning address the means to evaluate the test environment relative to HFE operating criteria?
- Is HFE compliance specifically called out in development and operational test planning (Test and Evaluation Strategy (TES) and TEMP) documents? [4.1.8.C11]

4.1.8.Q20: What planning is in place to ensure that human factors engineering/cognitive engineering is integral to the systems engineering effort over the life of the program? [4.1.8.C13]

5. Environmental Safety and Occupational Health Planning (See also Sub-Area 6.1 – ESOH)

Note: Safety factors are design characteristics intended to minimize potential for mishaps. Occupational health factors are design features established to minimize the risk of injury/reduce job performance.

The following three actions relate to Pre-Milestone A only:

1. Evaluate Environmental Safety and Occupational Health (ESOH) functional requirements for each system concept based on component tests/analyses and finalize a Preliminary Hazard List (PHL) and ESOH criteria for each system concept.
2. Recommend ESOH level of effort for the Technology Development (TD) phase based upon PHL results.
3. Identify top-level hazards from the Concept Refinement (CR) phase trade studies.

Criteria

4.1.8.C14: Safety and health hazard parameters apply to all activities inherent in the system life cycle, including test activity, operations, support, and final demilitarization and disposal; these requirements can stem from human factors issues, and should be specified in measurable terms (e.g., thresholds of maximum noise levels, vibration, temperature, etc.) in the CDD.

4.1.8.C15: A Health Hazards Analysis (HHA) should be completed as early as possible in the development cycle to identify all possible hazards and associated risks, and to define the safety and health hazard parameters that are factored into the design. The HHA typically addresses the following health hazard issues: acoustical energy levels, biological and chemical substances,

oxygen deficiency, radiation energy (ionizing), shock, temperature extremes and humidity, physical trauma, and vibration.

4.1.8.C16: A Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE) is a requirement (as specified in DoDI 5000.2, Appendix E.3) for entering a program new start at Milestone B. The PESHE is intended to address the coordination of efforts related to HSI and ESOH in the systems engineering process.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.8.Q21: How has the program evaluated the potential safety and health hazards that may exist inherent in the system design and its operational environment?

- Has a formal Health Hazards Analysis been completed?
- What aspects of the CONOPS were considered in the analysis, and what methods and tools were used (e.g. legacy system data, modeling and simulation (M&S), prototypes, etc) [4.8.C15]

4.1.8.Q22: What specific safety and occupational health hazard threshold requirements have been incorporated in the ICD/CDD? [4.8.C.14]

4.1.8.Q23: Has the PMO completed a Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE) for the program? [4.1.8.C15 and 4.1.8.C16]

- What inherent safety and health hazards (and threshold limits) have been identified considering all life cycle activities of the system (testing, operation, maintenance, and final demilitarization and disposal)? [4.1.8.C15]
- What results of a Health Hazards analysis performed on the proposed system was used as the basis for the PESHE?
- How Is the PESHE being used as a management tool on the program?
- Describe how the identified health hazards are addressed in the risk mitigation program for system development and test?

6. Personnel Survivability Planning

Note: Personnel survivability factors are reflected in system design features that reduce the risk of fratricide, detection, and probability of attack; they are intended to allow endurance of man-made hostile environments to execute the mission and avoid personal harm.

Criteria

4.1.8.C17: The CDD should address applicable system personnel (operating crew) survivability parameters to include requirements to reduce the risks of fratricide, detection, or attack in hostile environments (e.g., nuclear, biological, and chemical (NBC) conditions) on the battlefield.

4.1.8.C18: The program manager should establish a Personnel Survivability Program for the purpose of identifying the combat threats related to the system and CONOPS, and take the appropriate actions to minimize the effects of these threats on the system, combat mission, and crew. The program also should address the system effects on survivability, integral to the systems engineering process and T&E planning and activities.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.8.Q24: What requirements of the system combat performance and survivability needs in operating and supporting the system in its intended environment are addressed in the CDD? [4.1.8.C17]

What personnel survivability parameters are specified relative to operational conditions of the system?

4.1.8.Q25: Has a personnel survivability program been established by the program?

- What analyses or assessments have been performed to identify personnel survivability issues with the system?
- What are the major threats to the system and personnel survivability for which risk mitigation actions must be addressed?
- What threats to the system are considered acceptable in mission performance? [4.1.8.C18]

4.1.8.Q26: How does the survivability program plan address (countermeasures) the following survivability components? [4.1.8.C17]

- Reduce fratricide?
- Reduce detectability?
- Reduce probability of attack?
- Minimize damage if attacked?
- Minimize injury?
- Minimize physical and mental fatigue?
- Survive extreme environments?

4.1.8.Q27: How is personnel survivability planning addressed in the system support strategy, including survivability risks and mitigation plans? [4.1.8.C18]

4.1.8.Q28: Does the Live Fire Test and Evaluation (LFT&E) program include testing and evaluation of crew survivability issues? [4.1.8.C18]

7. Habitability Planning

Note: Habitability factors are those living and working conditions, and services that are necessary to meet personnel needs (morale, safety, health, and comfort). They directly contribute to

personnel effectiveness and mission accomplishment, and can preclude recruitment and retention problems if addressed satisfactorily.

Criteria

4.1.8.C19: DoDI 5000.2 instructs the program manager to collaborate with habitability professionals in defining the requirements of the physical environment (personnel needs and services) and their impact on meeting/sustaining mission performance and effectiveness if not provided.

4.1.8.C20: To the extent practicable, habitability requirements should be integral to the system design and avoid being routinely traded away for other readiness considerations. These requirements should be addressed in the system support strategy.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.1.8.Q29: From an HSI perspective, how are habitability considerations addressed in the objective of achieving and sustaining successful mission performance?

- How do habitability considerations potentially affect personnel retention as applied to this system? [4.1.8.C19]

4.1.8.Q30: What is the involvement of habitability representatives in the human factors supporting organization to establish minimum requirements for personnel living conditions and provided services? [4.1.8.C19]

4.1.8.Q31: How does the system support strategy include habitability planning to address issues that could affect personnel morale, safety, health, or comfort, or degrade personnel performance and/or unit readiness?

- Are habitability issues considered in the systems engineering process of defining and designing the system? [4.1.8.C20]

References

DoDD 5000.1. May 12, 2003, Encl.1, paragraphs E1.23, E1.29.
DoDI 5000.2. "Operation of the Defense Acquisition System," May 12, 2003.
Defense Acquisition Guidebook (DAG). Chapter 6, "Human Systems Integration." Defense Acquisition University, https://akss.dau.mil/dag/.
VSYSYSCOM HSI, Vols. 1 & 2, https://home.navair.navy.mil/pmcwebtool.

SUB-AREA 4.2 – REQUIREMENTS DEVELOPMENT

Description: Requirements development encompasses the definition and refinement of system-, subsystem-, and lower-level functional and performance requirements and interfaces to facilitate the design of open systems. It allocates and balances interoperability requirements among systems that should interoperate successfully to satisfy all appropriate integrated architectures and

requirements documents under which the proposed system falls. An integral part of defining and refining requirements is to provide technical support to the market research required early in the program life cycle. Systems engineers within DoD face the same sorts of requirements definition tasks that their commercial counterparts encounter in addressing market research (and customer needs). These tasks involve analyzing how a product can meet user requirements. This analysis ensures that open systems principles are applied to the maximum extent possible to reduce both life cycle costs and development cycle time. Since some of the requirements may become defined only through system decomposition at later stages of the program, iterative application of rigorous systems engineering is key.

Requirements: Development complements Logical Analysis and Decomposition, and Design Solution technical processes. The processes are iterated at each level of the system structure, and then applied recursively to lower levels of the physical architecture throughout development. The objective is to help ensure that the requirements derived from the customer-designated capabilities are feasible and effective, as well as updated, as more information is learned about the requirements and interfaces through analysis.
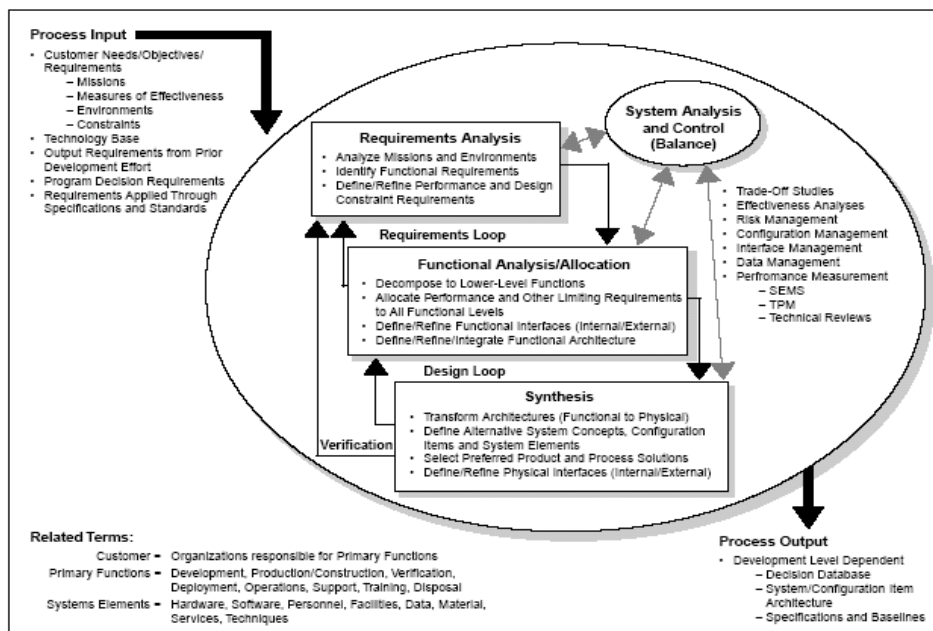
Figure 4-1 Interrelationships among System Design Processes

Figure 4-1 illustrates the recursive relationship among the system design processes. These processes start with the collection and clarification of the stakeholders' expectations, including the system performance objectives, constraints, design drivers, operational objectives, and criteria for defining success. This set of stakeholder expectations and high-level requirements is used to drive an iterative design loop where a straw man architecture/design and derived requirements are

developed. These three products must be consistent with one another and will require iterations and design decisions to achieve this consistency.

Scope: The assessment of this sub-area deals with the sufficiency of the design effort to allow analytical verification of the design to the requirements. In particular, the process to transform stakeholder expectations into a definition of the problem, and then into a complete set of validated technical requirements that can be used for defining a design solution is assessed for effectiveness.

The quality of the technical product, including support systems, is quintessential to a successful program. The maturity of the program provides differing perspectives due to the integral nature of the product maturation process that is a direct parallel to the development life cycle. This should be regarded as the most important Sub-Area for assessment; hence, should never be overlooked and should always involve the most time and scrutiny.

Perspective: The requirements development process is a recursive and iterative one that develops the stakeholder's requirements, system requirements, and lower level subsystem/component requirements. The final requirements should enable the description of all inputs, outputs, and required relationships between inputs and outputs. The requirements documents organize and communicate requirements to the stakeholders and the technical community.

It is important to note that the program manager (PM) does not rely solely on the requirements received to design the system. Communication and iteration with the relevant stakeholders are essential to ensure a mutual understanding of each requirement. Otherwise, the PM runs the risk of misunderstanding and implementing an unwanted solution based on a different interpretation of the requirements.

The PM works with the user to establish and refine operational needs, attributes, performance parameters, and constraints that flow from capabilities described through the Joint Capabilities Integration and Development System (JCIDS), and then they ensure that all relevant requirements are addressed. Together with the user, the program manager should translate "customer needs" into the following program and system requirements:
- Performance parameter objectives and thresholds
- Affordability constraints
- Scheduling constraints
- Technical constraints

Factor 4.2.1 – Analysis and Decomposition

Pre-Milestone A

Criteria

4.2.1.C1: System requirements specifications and performance test/verification requirements are linked and verification methods are defined. *Note: Allocation of system functions defines the functional baseline of the system design.*

- Traceability to current requirements documentation is configuration managed for approved capability upgrades commensurate with maturity of the technology required for the upgrade. Maturity is verified through readiness assessments and well-defined metrics.
- The system architecture is well defined and documented, and is in accordance with all applicable standards, protocols and data interchange definitions as defined by key interface descriptions.
- Test verification descriptions, critical to the process, are defined for each performance requirement.
- Specifications are allocated and defined to the appropriate level consistent with the Technology Development (TD) phase objectives.

4.2.1.C2: All inputs available at this stage of the program (i.e., Initial Capabilities Document, Analysis of Alternatives Plan, exit criteria for the phase, concept alternatives for the overall system, as well as associated support system, training system, and interoperable systems) have been aggregated, system capabilities and constraints have been identified, and the preferred system concept strikes the best balance in providing the needed capabilities within the constraints on the program.

4.2.1.C3: All of the related constraints to be applied to the effort have been identified:

- Environmental – systems threats, usage environment, support environment, doctrine,
- operational concepts
- Resource – industrial base; notional available development, operation, and support budgets; required date for system fielding
- Technology – applicable technology base to be used for concept maturation
- Statutory and regulatory – the Federal Acquisition Regulation; the DoD 5000-series

4.2.1.C4: The program manager (PM) or contractor has an effective systems engineering (SE) process in place to perform functional analysis and the allocation of functional requirements for the TD phase. This includes the traceability and verification of requirements across the entire system.

- The SE process is effective in defining system requirements, functionality, and allocated physical architecture.

- Technology maturity requirements are appropriately scoped for demonstration during the TD phase.
- Analyses provide a clear, detailed description of the technical approach resulting from functional analysis and allocation.
- The SE process uses rigorous and disciplined definitions of interfaces, and defines the key interfaces that require test verification within the system.
- The SE process partitions the system into self-contained, groupings of interchangeable and adaptable modules. The process enables identification of key test and evaluation (T&E) requirements to verify sub-assembly performance during the TD phase.

4.2.1.C5: A design process is defined and applied to all design activities, including those of contractors and subcontractors, during the TD phase. The design process is being implemented with proven methods and tools.

- A feasibility study of using open interface standards for key interfaces has been developed and will be executed during TD.
- Criteria to select the most appropriate standards for key interfaces will be established during TD.
- The architecture as designed incorporates Modular Open Systems Approach (MOSA) via approved standards. MOSA requirements are addressed in the design interfaces. *Note: By following the MOSA principles in design synthesis, TD ensures that the selected physical architecture will remain robust and adaptable throughout the system life cycle.*

4.2.1.C6: Software development process is integral to hardware design. Software code and unit test follow a specific process that is described in the software development plan. This process includes reviews, methods, and tools.

- Hardware implementation follows a defined process that is described in an engineering document. Prototypes are part of the TD process as are reviews, methods, and tools.
- There is an internal review process used during design to include both hardware and software design. The schedule, scope, organization, and coordination of this SE process between the engineering disciplines ensures an integrated design.
- Software requirements are evaluated to ensure that they are complete, unambiguous, correct, consistent, verifiable, modifiable, traceable, ranked for importance, and ranked for stability. *Note: Compliance with IEEE Recommended Practice for Software Requirements Specifications, IEEE Std 830-1998.*

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.1.Q1: What is the function-related process(es) that will be used to allocate the capability requirements to lower-level operational functions? [4.2.1.C1]

4.2.1.Q2: What are the internal "design rules" that are used to partition the proposed system into its functional elements? [4.2.1.C1]

4.2.1.Q3: What are the features of the design architecture that will ensure it remains robust and adaptable throughout the system life cycle? [4.2.1.C1]

4.2.1.Q4: What inputs are available at this stage of the program (i.e., Initial Capabilities Document, Analysis of Alternatives Plan, exit criteria for the phase, concept alternatives for the overall system, as well as associated support system, training system, and interoperable systems)?

- Have they been aggregated?
- What system capabilities and constraints have been identified?
- What is the preferred system concept?
    - How does it strike the best balance in providing the needed capabilities within the constraints on the program? [4.2.1.C2]

Note: Key to this initial step of concept refinement is to ensure that all drivers of the concept definition are completely captured and managed as an integrated whole, and that all of the drivers can be met by each of the concept alternatives under consideration. This defines the expectations of the overall system concept, and defines the trade space and risk associated with each of the constraints, above. Defining the trade space and risk enables the comprehensive analysis of system alternatives, and allows a rational selection of a preferred system concept. The preferred system concept should strike the best balance in providing the needed capabilities within the constraints on the program.

4.2.1.Q5: What are the constraints to be applied to the effort?

- Environmental?
- Resource?
- Technology?
- Statutory and regulatory? [4.2.1.C3]

4.2.1.Q6: What is the design process, including analysis and synthesis?

- How is the process defined or tailored for the TD phase?
- Is the same process used by subcontractors? If no, why not?
- What are the methods and tools used in support of the process?
- How has previous experience from similar programs been used in the process? [4.2.1.C4]

4.2.1.Q7: What module characteristics (e.g., criticality of function, ease of integration, change frequency, interoperability, commonality, etc.) were used to identify key interfaces? How was the feasibility of using open interface standards assessed for the key interfaces? [4.2.1 mandate, industry consensus, market support, prime contractor recommendation, etc.)? [4.2.1.C4]

4.2.1.Q9: What are the system specifications including both the performance and verification requirements?

- How are they traceable to user requirements? [4.2.1.C4]

4.2.1.Q10: What is the contractor's SE process for requirements definition and allocation?

- Is the same process used across the program, including subcontractors? If no, why not? [4.2.1.C4]

4.2.1.Q11: What are the program's primary SE processes?

- How do they relate to the SE engine or V diagram?
- What is the basis for the selection and tailoring of processes?
- Can the PM/contractor describe the "who, what, when, where, and why" for each process? *Note: PM/contractor should provide flow diagrams with timelines, if applicable.*
- How is the SE process integrated within the Acquisition Strategy?
  - What are the key technical objectives, inputs, and deliverables/outputs?
- How are SE engineering processes and products managed and controlled across Integrated Process/Product Teams (IPTs)?
  - What is the process for capturing and sharing lessons learned; implementing lessons learned from other IPTs and programs?
- How does the program solicit non-advocate or peer reviews?
  - What issues do they have or will they address?
  - Have their recommendations been implemented? If no, why not? [4.2.1.C4]

4.2.1.Q12: In partitioning the system into modules, how does the program use standardized definitions of modular interfaces?

- What are the key interfaces within the system?
- What is the process for changes to external interfaces (outside program control)? [4.2.1.C5]

4.2.1.Q13: Based on the interface definitions, how will the requirements for data extraction and collection to be used in the test program be defined?

- How will the key interfaces be tested during the TD phase? [4.2.1.C5]

4.2.1.Q14: How does the program's functional analysis and allocation include MOSA in the design approach? [4.2.1.C5]

4.2.1.Q15: How does the SE process used during TD implement the hardware design and related supportability functions?

- How are prototypes involved in the process?
- What is the description of the hardware implementation process?
- What are the methods and tools used in support of the process? [4.2.1.C5]

4.2.1.Q16: What is the internal review process used during design, to include the schedule, scope, organization, and coordination between the engineering disciplines to ensure an integrated system design?

- How does it address both hardware and software design? [4.2.1.C5]

4.2.1.Q17: How will the design solutions to be produced during TD, verify the application of MOSA principles (i.e., modular design, key interfaces designation, and use of open standards) during the design synthesis? [4.2.1.C5]

4.2.1.Q18: What is the process planned to be used during the TD phase to implement the software design in terms of code and unit test?

- What are the methods and tools used in support of the process?
- What are the reviews involved in the implementation of software design in terms of code and unit test? [4.2.1.C6]

Pre-Milestone B

Criteria

4.2.1.C7: System requirements specifications and performance test/verification requirements are linked and verification methods are defined. *Note: Allocation of system functions defines the functional baseline of the system design.*

- Traceability to current requirements documentation is configuration managed for approved capability upgrades commensurate with maturity of the technology required for the upgrade. Maturity is verified through readiness assessments and well-defined metrics.
- The system architecture is well defined and documented, and is in accordance with all applicable standards, protocols and data interchange definitions as defined by key interface descriptions.
- Test verification descriptions, critical to the process, are defined for each performance requirement.
- Specifications are allocated and defined to the appropriate level consistent with the System Development and Demonstration (SDD) phase objectives.

4.2.1.C8: All inputs available at this stage of the program (i.e., Capabilities Development Document, results of the Analysis of Alternatives, exit criteria for the phase, concept alternatives for the overall system, as well as associated support system, training system, and interoperable systems) have been aggregated, system capabilities and constraints have been identified, and the selected system concept continues to strike the best balance in providing the needed capabilities within the constraints on the program.

4.2.1.C9: All of the related constraints to be applied to the effort have been identified:

- Environmental–systems threats, usage environment, support environment, doctrine, operational concepts
- Resource–industrial base; notional available development, operation, and support budgets; required date for system fielding
- Technology–applicable technology base to be used for concept maturation

- Statutory and regulatory–the Federal Acquisition Regulation; the DoD 5000-series

4.2.1.C10: The PM or contractor has an effective SE process in place to perform functional analysis and the allocation of functional requirements for the SDD phase. This includes the traceability and verification of requirements across the entire system.

- The SE process is effective in defining system requirements, functionality, and allocated physical architecture.
- Technology maturity requirements are appropriately scoped for demonstration during the TD phase.
- Analyses provide a clear, detailed description of the technical approach resulting from functional analysis and allocation.
- The SE process uses rigorous and disciplined definitions of interfaces, and defines the key interfaces that require test verification within the system.
- The SE process partitions the system into self-contained, groupings of interchangeable and adaptable modules. The process enables identification of key T&E requirements to verify sub-assembly performance during the SDD phase.
- System-level specifications are directly traceable to user requirements using established systems engineering methods and tools.
    - System and lower-level specifications are completely defined and stable, including subcontractor development specifications.
    - Specifications are allocated and defined to the appropriate level consistent with the SDD phase.

4.2.1.C11: The design process from the TD phase, is applied to all design activities, including those of contractors and subcontractors, during the SDD phase. The design process is being implemented with proven methods and tools.

- The results of the feasibility study of using open interface standards for key interfaces, developed in the TD phase, is being effectively executed during the SDD phase.
- Criteria, established in the TD phase to select the most appropriate standards for key interfaces, continue to be valid. If not, the criteria have been changed and approved through the internal review process.
- The architecture as designed incorporates MOSA via approved standards. MOSA requirements are addressed in the design interfaces.

4.2.1.C12: The software development process is integral with hardware design. Software code and unit test follow a specific process that is described in the software development plan. This process includes reviews, methods, and tools.

- Hardware implementation follows a defined process that is described in an engineering document. Prototypes are used as part of the SDD process, as are reviews, methods, and tools.

- There is an internal review process used during design to include both hardware and software design. The schedule, scope, organization, and coordination of this SE process between the engineering disciplines, ensures an integrated design.

- Software requirements are evaluated to ensure that they are complete, unambiguous, correct, consistent, verifiable, modifiable, traceable, ranked for importance, and ranked for stability. *Note: Compliance with IEEE Recommended Practice for Software Requirements Specifications, IEEE Std 830-1998.*

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.1.Q19: What is the function-related process(es) that will be used to allocate the capability requirements to lower level operational functions?

- What system function-related analyses planned or completed that are being used to allocate system requirements (include risk analyses if applicable). [4.2.1.C7]

4.2.1.Q20: What are the internal "design rules" that are used to partition the proposed system into its functional elements? [4.2.1.C7]

4.2.1.Q21: What are the features of the design architecture that will ensure it remains robust and adaptable throughout the system life cycle? [4.2.1.C7]

4.2.1.Q22: What inputs are available at this stage of the program (i.e., Capabilities Development Document, results of the Analysis of Alternatives, exit criteria for the phase, concept alternatives for the overall system, as well as associated support system, training system, and interoperable systems)?

- Have they been aggregated?
- What system capabilities and constraints have been identified?
- What is the preferred system concept?
    - How does it strike the best balance in providing the needed capabilities within the constraints on the program? [4.2.1.C8]

4.2.1.Q23: What are the constraints to be applied to the effort?

- Environmental?
- Resource?
- Technology?
- Statutory and regulatory? [4.2.1.C9]

4.2.1.Q24: What is the design process, including analysis and synthesis?

- How is the process defined or tailored for the TD phase?
- Is the same process used by subcontractors? If no, why not?
- What are the methods and tools used in support of the process?
- How has previous experience from similar programs used in the process?

- What are the standards used in the systems engineering process to establish the system design? [4.2.1.C10]

4.2.1.Q25: What module characteristics (e.g., criticality of function, ease of integration, change frequency, interoperability, commonality, etc.) were used to identify key interfaces? How was the feasibility of using open interface standards assessed for the key interfaces? [4.2.1.C10]

4.2.1.Q26: What criteria are used in selecting standards for key interfaces (e.g., DoD mandate, industry consensus, market support, prime contractor recommendation, etc.)? [4.2.1.C10]

4.2.1.Q27: What are the system specifications including both the performance and verification requirements?

- How are they traceable to user requirements? [4.2.1.C10]

4.2.1.Q28: What is the contractor's SE process for requirements definition and allocation?

- Is the same process used across the program, including subcontractors? If no, why not? [4.2.1.C10]

4.2.1.Q29: What are the program's primary SE processes?

- How do they relate to the SE engine or V diagram?
- What is the basis for the selection and tailoring of processes?
- Can the PM/contractor describe the "who, what, when, where, and why" for each process? *Note: PM/contractor should provide flow diagrams with timelines, if applicable.*
- How is the SE process integrated within the Acquisition Strategy?
  - What are the key technical objectives, inputs, and deliverables/outputs?
- How are SE engineering processes and products managed and controlled across IPTs?
  - What is the process for capturing and sharing lessons learned; implementing lessons learned from other IPTs and programs?
- How does the program solicit non-advocate or peer reviews?
  - What issues do they have or will they address?
  - Have their recommendations been implemented? If no, why not? [4.2.1.C10]

4.2.1.Q30: In partitioning the system into modules, how does the program use standardized definitions of modular interfaces?

- What are the key interfaces within the system?
- What is the process for changes to external interfaces (outside program control)? [4.2.1.C11]

4.2.1.Q31: Based on the interface definitions, how will the requirements for data extraction and collection to be used in the test program be defined?

- How will the key interfaces be tested during the SDD phase? [4.2.1.C11]

4.2.1.Q32: How does the program's functional analysis and allocation include MOSA in the design approach? [4.2.1.C11]

4.2.1.Q33: How does the SE process used during the SDD phase implement the hardware design and related supportability functions?

- How are prototypes involved in the process?
- What is the description of the hardware implementation process?
- What are the methods and tools used in support of the process? [4.2.1.C11]

4.2.1.Q34: What is the internal review process used during design, to include the schedule, scope, organization, and coordination between the engineering disciplines to ensure an integrated system design?

- How does it address both hardware and software design? [4.2.1.C11]

4.2.1.Q35: How will the design solutions to be produced during SDD verify the application of MOSA principles (i.e., modular design, key interfaces designation, and use of open standards) during the design synthesis? [4.2.1.C11]

4.2.1.Q36: What is the process planned to be used during the SDD phase to implement the software design in terms of code and unit test?

- What are the methods and tools used in support of the process?
- What are the reviews involved in the implementation of software design in terms of code and unit test? [4.2.1.C12]

Pre-Milestone C

Criteria
4.2.1.C13: System requirements specifications and performance test/verification requirements are linked and verification methods are defined.

- Traceability to current requirements documentation is configuration managed for approved capability upgrades commensurate with maturity of the technology required for the upgrade. Maturity is verified through readiness assessments and well-defined metrics.
- The system architecture is well defined and documented, and is in accordance with all applicable standards, protocols and data interchange definitions as defined by key interface descriptions.
- Test verification descriptions, critical to the process, are defined for each performance requirement.
- Specifications are allocated and defined to the appropriate level consistent with the Production and Deployment (PD) phase objectives.

4.2.1.C14: All inputs available at this stage of the program (i.e., Capability Production Document, exit criteria for the phase, results of trade studies, concept alternatives for the overall system, as well as associated support system, training system, and interoperable systems) have been aggregated, system capabilities and constraints have been identified, and the selected system

concept continues to strike the best balance in providing the needed capabilities within the constraints on the program.

4.2.1.C15: All of the related constraints to be applied to the effort have been identified:

- Environmental–systems threats, usage environment, support environment, doctrine, operational concepts
- Resource–industrial base; notional available development, operation, and support budgets; required date for system fielding
- Technology–applicable technology base to be used for concept maturation
- Statutory and regulatory–the Federal Acquisition Regulation; the DoD 5000-series

4.2.1.C16: The PM or contractor has an effective SE process in place to perform functional analysis and the allocation of functional requirements for the PD phase. This includes the traceability and verification of requirements across the entire system.

- The SE process is effective in defining system requirements, functionality, and allocated physical architecture.
- Technology maturity requirements are appropriately scoped for demonstration during the PD phase.
- Analyses provide a clear, detailed description of the technical approach resulting from functional analysis and allocation.
- The SE process uses rigorous and disciplined definitions of interfaces, and defines the key interfaces that require test verification within the system.
- The SE process partitions the system into self-contained groupings of interchangeable and adaptable modules. The process enables identification of key T&E requirements to verify sub-assembly performance during the PD phase.
- System-level specifications are directly traceable to user requirements using established systems engineering methods and tools.
  - System-level and lower-level specifications are completely defined and stable, including subcontractor development specifications.
  - Specifications are allocated and defined to the appropriate level consistent with the SDD phase.

4.2.1.C17: The design process is applied to all design activities, including those of contractors and subcontractors, during the PD phase. The design process is being implemented with proven methods and tools.

- The results of the feasibility study of using open interface standards for key interfaces, developed in the SDD phase, is being effectively executed during the PD phase.
- Criteria, established in the TD phase to select the most appropriate standards for key interfaces, continue to be valid. If not, the criteria have been changed and approved through the internal review process.

- The architecture as designed incorporates Modular Open Systems Approach (MOSA) via approved standards. MOSA requirements are addressed in the design interfaces.

4.2.1.C18: Software development process is integral with hardware design. Software code and unit test follow a specific process that is described in the software development plan. This process includes reviews, methods, and tools.

- Hardware implementation follows a defined process that is described in an engineering document.
- There is an internal review process used during design to include both hardware and software design. The schedule, scope, organization, and coordination of this SE process between the engineering disciplines, ensures an integrated design.
- Software requirements are evaluated to ensure that they are complete, unambiguous, correct, consistent, verifiable, modifiable, traceable, ranked for importance, and ranked for stability. *Note: Compliance with IEEE Recommended Practice for Software Requirements Specifications, IEEE Std 830-1998.*

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.1.Q37: What function-related process(es) will be used to allocate the capability requirements to lower-level operational functions?

- What system function-related analyses planned or completed are being used to allocate system requirements (include risk analyses if applicable)?
- How were supportability and maintainability included in the analyses? [4.2.1.C13]

4.2.1.Q38: What are the internal "design rules" that are used to partition the proposed system into its functional elements? [4.2.1.C13]

4.2.1.Q39: What are the features of the design architecture that will ensure it remains robust and adaptable throughout the system life cycle? [4.2.1.C13]

4.2.1.Q40: What inputs are available at this stage of the program (i.e., Capabilities Development Document, Analysis of Alternatives results, exit criteria for the phase, concept alternatives for the overall system, as well as associated support system, training system, and interoperable systems)?

- Have they been aggregated?
- What system capabilities and constraints have been identified?
- What is the preferred system concept?
    - How does it strike the best balance in providing the needed capabilities within the constraints on the program? [4.2.1.C14]

4.2.1.Q41: What are the constraints to be applied to the effort?

- Environmental?
- Resource?

- Technology?
- Statutory and regulatory? [4.2.1.C15]

4.2.1.Q42: What is the design process, including analysis and synthesis?

- How is the process defined or tailored for the TD phase?
- Is the same process used by subcontractors? If no, why not?
- What are the methods and tools used in support of the process?
- How has previous experience from similar programs used in the process?
- What are the standards used in the systems engineering process to establish the system design? [4.2.1.C16]

4.2.1.Q43: What module characteristics (e.g., criticality of function, ease of integration, change frequency, interoperability, commonality, etc.) were used to identify key interfaces? How was the feasibility of using open interface standards assessed for the key interfaces? [4.2.1.C16]

4.2.1.Q44: What criteria are used in selecting standards for key interfaces (e.g., DoD mandate, industry consensus, market support, prime contractor recommendation, etc.)? [4.2.1.C16]

4.2.1.Q45: What are the system specifications including both the performance and verification requirements?

- How are they traceable to user requirements? [4.2.1.C16]

4.2.1.Q46: What is the contractor's SE process for requirements definition and allocation?

- Is the same process used across the program, including subcontractors? If no, why not? [4.2.1.C16]

4.2.1.Q47: What are the program's primary SE processes?

- How do they relate to the SE engine or V diagram?
- What is the basis for the selection and tailoring of processes?
- Can the PM/contractor describe the "who, what, when, where, and why" for each process? *Note: PM/contractor should provide flow diagrams with timelines, if applicable.*
- How is the SE process integrated within the Acquisition Strategy?
  - What are the key technical objectives, inputs, and deliverables/outputs?
- How are SE engineering processes and products managed and controlled across IPTs?
  - What is the process for capturing and sharing lessons learned; implementing lessons learned from other IPTs and programs?
- How does the program solicit non-advocate or peer reviews?
  - What issues do they have or will they address?
  - Have their recommendations been implemented? If no, why not? [4.2.1.C16]

4.2.1.Q48: In partitioning the system into modules, how does the program use standardized definitions of modular interfaces?

- What are the key interfaces within the system?

- What is the process for changes to external interfaces (outside program control)? [4.2.1.C17]

4.2.1.Q49: Based on the interface definitions, how will the requirements for data extraction and collection to be used in the test program be defined?

- How will the key interfaces be tested during the PD phase? [4.2.1.C17]

4.2.1.Q50: How does the program's functional analysis and allocation include MOSA in the design approach? [4.2.1.C17]

4.2.1.Q51: How does the SE process used during the PD phase implement the hardware design and related supportability functions?

- How are prototypes involved in the process?
- What is the description of the hardware implementation process?
- What are the methods and tools used in support of the process?
- How is supportability of the system quantified and measurable in the current design? [4.2.1.C17]

4.2.1.Q52: What is the internal review process used during design, to include the schedule, scope, organization, and coordination between the engineering disciplines to ensure an integrated system design?

- How does it address both hardware and software design? [4.2.1.C17]

4.2.1.Q53: What is the process planned to be used during the PD phase to implement the software design in terms of code and unit test?

- What are the methods and tools used in support of the process?
- What are the reviews involved in the implementation of software design in terms of code and unit test?
- In which languages is the software for all the subsystems written?
  - What is the size of the software?
- Which software is highly complex, contains unprecedented functionality, or involves flight/safety critical components?
- Can the software subject matter expert (SME) describe the history of software size growth from start through current status?
  - What are the sources for software growth (e.g., customer requirements changes, evolution/understanding of requirements/design)? [4.2.1.C18]

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Factor 4.2.2 – Management of Requirements

Pre-Milestone A

Criteria

4.2.2.C1: As described in Figure 4-2, the program manager (PM) has planned for an effective requirements management process to ensure there is: the management of the product requirements identified, baselined, and used in the definition of the Work Breakdown Structure (WBS) during system design; bidirectional traceability from the WBS to the user-defined capabilities as documented through the Joint Capabilities Integration and Development System (JCIDS); and the management of changes to established requirements baseline over the lifecycle of the system, to include documenting these changes with the rationale recorded for each change.

From:
System Design Processes

From:
Technical Assessment
Process

Inputs

From:
Verification& Validation
Results

| Prepare to conduct requirements management |
| Conduct requirements management |
| Conduct expectations and requirements traceability |
| Manage expectations and requirements changes |
| Capture work from requirements management activities |

To:
Configuration Management Process

Outputs

To:
Technical Data Management Process
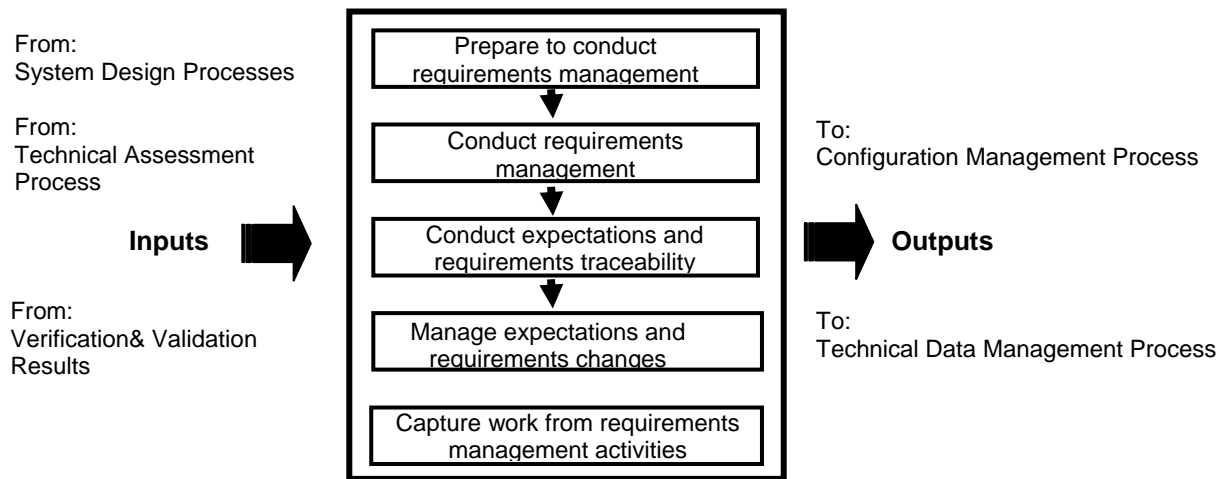
Figure 4-2 Requirements Management Process

4.2.2.C2:The program uses requirements management tools to effectively and efficiently collect, define, and decompose requirements, manage changes, and produce requirements specifications. These tools are characterized by support of multi-user collaborative environments and data exchange capability between other common and specialized tools. The overall effectiveness of the tools is characterized by:

- Ability to capture and identify requirements – document enrichment/analysis, document change/comparison analysis, automatic parsing of requirements, semiautomatic and manual requirement identification, and requirement classification
- Ability to capture system element structure
- Traceability/requirements flow-down capability – requirements derivation, allocation of performance requirements to system elements, bidirectional requirement linking to system

elements, capture of allocation rationale, accountability, test, validation, criticality, and issues

- Traceability analysis – identify inconsistencies, visibility into existing links from source to implementation (i.e., follow the links, verification of requirements)
- Configuration Management (CM) tasks such as baseline/version control, track history of requirement changes
- Provision of documents and other output media – specification output, quality and consistency in checking and status reporting
- Ability to interface with other selected engineering and office tools
- Provision of sufficient system environment – single user/multiple concurrent users, multiple platforms and operating systems, resource requirements
- Adequate user interfaces
- Adequate support and maintenance – warranty, network license policy, maintenance and upgrade policy, on-line help
- Adequate training

4.2.2.C3: There is initial requirements management planning that:

- Identifies the relevant stakeholders who are/will be involved in the requirements management process (e.g., those who may be affected by, or may affect, the product as well as the processes).
- Provides a schedule for performing the requirements management procedures and activities.
- Assigns responsibility, authority, and adequate resources for performing the requirements management activities, developing the requirements management work products, and providing the requirements management services defined in the activities (e.g., staff, requirement management database tool).
- Defines the level of configuration management/data management control for all requirements management work products.
- Identifies the training for those who will be performing the requirements management activities.

4.2.2.C4: The evolutionary Acquisition Strategy (AS) utilizes a management system that continually defines the requirements and development activities to support the evolving needs; adequately addresses the various concerns of users, developers, and managers; and mitigates the risks associated with these issues are mitigated. The basic system architecture is designed to accommodate change. Techniques such as open systems design, functional partitioning and modular design have been addressed by the PM to achieve a flexible system that can be easily and affordably modified.

4.2.2.C5: The program's systems engineering (SE) process during the Technology Development (TD) phase is disciplined in documenting and tracking specifications at all levels, and structured to manage changes. Integral to this process is configuration management (CM). The CM plan lays out the process and plans to ensure that designs are traceable to requirements, that change is controlled and documented, that interfaces are defined and understood, and that there is consistency between the product and its supporting documentation. *Note: Factor 4.3.2, Configuration Management, provides more information, criteria and focused questions.*

4.2.2.C6: Audits are an integral part of the program's SE process, and as described in the AS, are planned to be conducted periodically to verify that the actual performance of the configuration item meets specification requirements. In the Concept Refinement (CR) phase, the Alternative System Review (ASR) was conducted to ensure that the resulting set of requirements agrees with the customer's needs and expectations. As a result of the ASR, there is a preliminary system specification, consistent with technology maturity and the proposed program cost and schedule that captured the system technical baseline*. Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions regarding the ASR.*

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.2.Q1: How are the appropriate stakeholders included in each step of the management of the requirements process?

- Who are the relevant stakeholders involved in the process?
- What is each stakeholder's role in the process?
- How are conflicts resolved? [4.2.2.C1 and 4.2.2.C3]

4.2.2.Q2: In cases where immature technology components or subsystems are necessary to achieve requirements, what are the interim performance requirements?

- How are they documented? [4.2.2.C1]

4.2.2.Q3: How is each requirement or expectation traced back to the parent/source requirement in a baselined document?

- Which ones are specified (fundamental or essential), allocated, implied or derived requirements?
- What is the rationale for each requirement? [4.2.2.C1]

4.2.2.Q4: How are the system-level requirements derived from the Initial Capabilities Document (ICD)? [4.2.2.C1]

4.2.2.Q5: What is the method of defining requirements to verify performance? [4.2.2.C1]

4.2.2.Q6: How is the requirements management process during TD supported by the resource management tools?

- How do they identify the relationships between requirements?
- Is this identification automatic?
- When changes are made, how are the impacted requirements identified and accounted for in the updated system? [4.2.2.C2]

4.2.2.Q7: How do the requirements management tools collect, define, and decompose requirements, manage changes, and produce requirements specifications?

- Are they effective and efficient? If not, why not? [4.2.2.C2]

4.2.2.Q8: Do the stakeholders understand and accept all the requirements? [4.2.2.C3]

4.2.2.Q9: How does the requirements management plan address the validation of requirements?

- How will the project requirements be considered complete and understandable?
- How are the prioritized evaluation criteria consistent with requirements, and the operations and sustainment concepts? [4.2.2.C3]

4.2.2.Q10: How does the PM plan to manage "requirements creep"? [4.2.2.C3]

4.2.2.Q11: How are follow-on capability improvements addressed in an evolutionary Acquisition Strategy? [4.2.2.C4]

4.2.2.Q12: How are open systems considered during the TD phase in reducing life cycle costs? [4.2.2.C4]

4.2.2.Q13: What are the results of the analysis performed to determine the extent of open systems application? [4.2.2.C4]

4.2.2.Q14: For the needed capabilities, how are the requirements identified and defined by the SE process? [4.2.2.C5]

4.2.2.Q15: How does the SE process address market analysis, technology assessment, and modeling and simulation (M&S) in support of tradeoff studies, life cycle cost, the identification of measurable technical specifications, and the approach to verify performance? [4.2.2.C5]

4.2.2.Q16: How does the use of the SE process optimizes system performance against cost, schedule, and risk? [4.2.2.C5]

4.2.2.Q17: How was the program's SE process during Concept Refinement (CR) phase disciplined in documenting and tracking specifications at all levels and structured to manage changes?

- How is configuration control integrated within the SE process? [4.2.2.C5]

4.2.2.Q18: In the Technology Development (TD) phase, how will the program's SE process document and track specifications at all levels and how will it be structured to manage changes? [4.2.2.C5]

4.2.2.Q19: How is the SE process planned to be used in the TD phase to:

- Translate required operational capabilities into technical specifications?
- Allocate, verify and manage specifications (including change management and control) from the system level to the lowest level?
- Determine the logistics support requirements? [4.2.2.C5]

4.2.2.Q20: What were the results of the ASR in terms of the development of a set of requirements that are aligned with the warfighter's needs and expectations?

- How are system requirements and performance requirements, derived from the ICD or draft Capabilities Development Document (CDD), defined?
    - How are the system requirements consistent with the preferred system solution as well as available technologies? [4.2.2.C6]

Pre-Milestone B

Criteria

4.2.2.C7: An effective requirements management process ensures there is management of the product requirements identified, baselined, and used in the definition of the Work Breakdown Structure (WBS) during system design; bidirectional traceability from the WBS to the user-defined capabilities as documented through the Joint Capabilities Integration and Development System (JCIDS); and the management of changes to established requirements baseline over the lifecycle of the system, to include documenting these changes with the rationale recorded for each change.

4.2.2.C8: The program uses requirements management tools to effectively and efficiently collect, define, and decompose requirements, manage changes, and produce requirements specifications. These tools are characterized by support of multi-user collaborative environments and data exchange capability between other common and specialized tools. The overall effectiveness of the tools is characterized by:

- Ability to capture and identify requirements – document enrichment/analysis, document change/comparison analysis, automatic parsing of requirements, semiautomatic and manual requirement identification, and requirement classification
- Ability to capture system element structure
- Traceability/requirements flow-down capability – requirements derivation, allocation of performance requirements to system elements, bidirectional requirement linking to system elements, capture of allocation rationale, accountability, test, validation, criticality, issues, etc.
- Traceability analysis – identify inconsistencies, visibility into existing links from source to implementation (i.e., follow the links, verification of requirements)
- Configuration management tasks such as baseline/version control, track history of requirement changes
- Provision of documents and other output media – specification output, quality and consistency in checking and status reporting
- Ability to interface with other selected engineering and office tools

- Provision of sufficient system environment – single user/multiple concurrent users, multiple platforms and operating systems, resource requirements
- Adequate user interfaces
- Adequate support and maintenance – warranty, network license policy, maintenance and upgrade policy, on-line help
- Adequate training

4.2.2.C9: The PM's requirements management plan:

- Identifies the relevant stakeholders who are/will be involved in the requirements management process (e.g., those who may be affected by, or may affect, the product as well as the processes).
- Provides a schedule for performing the requirements management procedures and activities.
- Assigns responsibility, authority, and adequate resources for performing the requirements management activities, developing the requirements management work products, and providing the requirements management services defined in the activities (e.g., staff, requirement management database tool).
- Defines the level of configuration management/data management control for all requirements management work products.
- Identifies the training for those who will be performing the requirements management activities.

4.2.2.C10: The evolutionary Acquisition Strategy (AS) utilizes a management system that continually defines the requirements and development activities to support the evolving needs; adequately addresses the various concerns of users, developers, and managers; and mitigates the risks associated with these issues. The basic system architecture is designed to accommodate change. Techniques such as open systems design, functional partitioning and modular design have been addressed by the PM to achieve a flexible system that can be easily and affordably modified.

4.2.2.C11: The program's SE process during the System Development and Demonstration (SDD) phase is disciplined in documenting and tracking specifications at all levels, and structured to manage changes. Integral to this process is configuration management (CM). The CM plan lays out the process and plans to ensure that designs are traceable to requirements, that change is controlled and documented, that interfaces are defined and understood, and that there is consistency between the product and its supporting documentation. *Note: Factor 4.3.2, Configuration Management, provides more information, criteria and focused questions.*

4.2.2.C12: Audits are an integral part of the program's SE process, and as described in the AS, are conducted periodically to verify that the actual performance of the configuration item meets specification requirements. In the Technology Development (TD) phase:

- A System Requirements Review (SRR) was conducted to ensure that that all system requirements and performance requirements derived from the Initial Capabilities Document or draft Capabilities Development Document are defined, that the system requirements are captured in the system specification, and that the system requirements are consistent with the preferred system solution as well as available technologies resulting from the TD phase. *Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions.*
- An Integrated Baseline Review (IBR) was conducted in the TD phase by the program manager and the contractor to assess the Performance Measurement Baseline to ensure consistency with the authorizing documents, at a minimum. *Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions.*

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.2.Q21: How are the appropriate stakeholders included in each step of the management of requirements process?

- Who are the relevant stakeholders involved in the process?
- What is each stakeholder's role in the process?
- How are conflicts resolved? [4.2.2.C7 and 4.2.2.C9]

4.2.2.Q22: In cases where immature technology components or subsystems are necessary to achieve requirements, what are the interim performance requirements?

- How are they documented? [4.2.2.C7]

4.2.2.Q23: How is each requirement or expectation traced back to the parent/source requirement in a baselined document?

- Which ones are specified (fundamental or essential), allocated, implied or derived requirements?
- What is the rationale for each requirement? [4.2.2.C7]

4.2.2.Q24: How are the system-level requirements derived from the Initial Capabilities Document (ICD)? [4.2.2.C7]

4.2.2.Q25: What is the method of defining requirements to verify performance? [4.2.2.C7]

4.2.2.Q26: How is the requirements management process during SDD supported by the resource management tools?

- How do they identify the relationships between requirements?
- How are engineering tools applied to trace the applicability of all CDD requirements to all WBS elements?
- What is the functional interface collaboration among the WBS elements?

- When changes are made, how are the impacted requirements identified and accounted for in the updated system? [4.2.2.C8]

4.2.2.Q27: How do the requirements management tools collect, define, and decompose requirements, manage changes, and produce requirements specifications?

- Are they effective and efficient? . If not, why not? {4.2.2.C8]

4.2.2.Q28: Do the stakeholders understand and accept all the requirements? [4.2.2.C9]

4.2.2.Q29: How does the requirements management plan address the validation of requirements?

- How will the project requirements be considered complete and understandable?
- How are the prioritized evaluation criteria consistent with requirements, and the operations and sustainment concepts? [4.2.2.C9]

4.2.2.Q30: How does the PM manage "requirements creep"? [4.2.2.C9]

4.2.2.Q31: How are follow-on capability improvements addressed in an evolutionary Acquisition Strategy? [4.2.2.C10]

4.2.2.Q32: How are open systems considered during the SDD phase in reducing life cycle costs? [4.2.2.C10]

4.2.2.Q33: What are the results of the analysis performed to determine the extent of open systems application? [4.2.2.C10]

4.2.2.Q34: For the needed capabilities, how are the requirements identified and defined by the SE process? [4.2.2.C11]

4.2.2.Q35: How does the SE process address market analysis, technology assessment, and modeling and simulation (M&S) in support of tradeoff studies, life cycle cost, the identification of measurable technical specifications, and the approach to verify performance? [4.2.2.C11]

4.2.2.Q36: How does the use of SE process optimizes system performance against cost, schedule, and risk? [4.2.2.C11]

4.2.2.Q37: How was the program's SE process during the Technology Development (TD) phase disciplined in documenting and tracking specifications at all levels and structured to manage changes?

- How is configuration control integrated within the SE process? [4.2.2.C11]

4.2.2.Q38: In the SDD phase, how will the program's SE process document and track specifications at all levels and how will be structured to manage changes? [4.2.2.C11]

4.2.2.Q39: What is the SE process planned to be used in the SDD phase to:

- Translate required operational capabilities into technical specifications?
- Allocate, verify and manage specifications (including change management and control) from the system level to the lowest level?
- Determine the logistics support requirements? [4.2.2.C11]

4.2.2.Q40: What were the results of the SRR, (i.e., how are the system requirements are consistent with the preferred system solution)?

- How were the system requirements and performance requirements, as derived from the CDD, defined? [4.2.2.C12]

4.2.2.Q41: What were the results of the IBR (i.e., is the Performance Measurement Baseline consistent with authorizing documents)? [4.2.2.C12]

Pre-Milestone C

Criteria

4.2.2.C13: An effective requirements management process ensures there is: management of the product requirements identified, baselined, and used in the definition of the Work Breakdown Structure (WBS) during system design; bidirectional traceability from the WBS to the user-defined capabilities as documented through the Joint Capabilities Integration and Development System (JCIDS); and the management of changes to established requirements baseline over the lifecycle of the system, to include documenting these changes with the rationale recorded for each change.

4.2.2.C14: The program uses requirements management tools to effectively and efficiently collect, define, and decompose requirements, manage changes, and produce requirements specifications. These tools are characterized by support of multi-user collaborative environments and data exchange capability between other common and specialized tools. The overall effectiveness of the tools is characterized by:

- Ability to capture and identify requirements – document enrichment/analysis, document change/comparison analysis, automatic parsing of requirements, semiautomatic, and manual requirement identification, and requirement classification
- Ability to capture system element structure
- Traceability/requirements flow-down capability – requirements derivation, allocation of performance requirements to system elements, bidirectional requirement linking to system elements, capture of allocation rationale, accountability, test, validation, criticality, issues, etc.
- Traceability analysis – identify inconsistencies, visibility into existing links from source to implementation (i.e., follow the links, verification of requirements)
- Configuration management tasks such as baseline/version control, track history of requirement changes
- Provision of documents and other output media – specification output, quality, and consistency in checking and status reporting
- Ability to interface with other selected engineering and office tools
- Provision of sufficient system environment – single user/multiple concurrent users, multiple platforms and operating systems, resource requirements
- Adequate user interfaces

- Adequate support and maintenance – warranty, network license policy, maintenance and upgrade policy, on-line help
- Adequate training

4.2.2.C15: The PM's requirements management plan:

- Identifies the relevant stakeholders who are/will be involved in the requirements management process (e.g., those who may be affected by, or may affect, the product as well as the processes).
- Provides a schedule for performing the requirements management procedures and activities.
- Assigns responsibility, authority, and adequate resources for performing the requirements management activities, developing the requirements management work products, and providing the requirements management services defined in the activities (e.g., staff, requirement management database tool).
- Defines the level of configuration management/data management control for all requirements management work products.
- Identifies the training for those who will be performing the requirements management activities.

4.2.2.C16: The evolutionary Acquisition Strategy (AS) utilizes a management system that continually defines the requirements and development activities to support the evolving needs; adequately addresses the various concerns of users, developers, and managers; and mitigates the risks associated with these issues. The basic system architecture is designed to accommodate change. Techniques such as open systems design, functional partitioning and modular design have been addressed by the PM to achieve a flexible system that can be easily and affordably modified.

4.2.2.C17: The program's SE process during the Production and Deployment (PD) phase is disciplined in documenting and tracking specifications at all levels, and structured to manage changes. Integral to this process is configuration management (CM). The CM plan lays out the process and plans to ensure that designs are traceable to requirements, that change is controlled and documented, that interfaces are defined and understood, and that there is consistency between the product and its supporting documentation. *Note: Factor 4.3.2, Configuration Management, provides more information, criteria and focused questions.*

4.2.2.C18: Audits are an integral part of the program's SE process, and as described in the AS, are conducted periodically to verify that the actual performance of the configuration item meets specification requirements. In the System Development and Demonstration (SDD) phase:

- An Integrated Baseline Review (IBR) was conducted in the SDD phase by the program manager and the contractor to assess the Performance Measurement Baseline to ensure consistency with the authorizing documents, at a minimum. *Note: See Factors 3.2.2,*

Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused question.

- A System Functional Review (SFR) was conducted to determine whether the system's lower-level performance requirements are fully defined and consistent with the mature system concept, and whether lower-level systems requirements trace to top-level system performance and the Capabilities Development Document (CDD). *Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions.*

- A Preliminary Design Review (PDR) was conducted to assess the system preliminary design as captured in performance specifications for each configuration item in the system (allocated baseline), and to ensure that each function in the functional baseline has been allocated to one or more system configuration items. *Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions.*

- A Critical Design Review (CDR) was conducted to assess the system final design as captured in product specifications for each configuration item in the system (product baseline), and to ensure that each product in the product baseline has been captured in the detailed design documentation. *Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions.*

- A System Verification Review (SVR) was conducted to asses the system final product, as evidenced in its production configuration, and to determine if it meets the functional requirements (derived from the Capabilities Development Document and draft Capability Production Document) documented in the Functional, Allocated, and Product Baselines. *Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions.*

- A Production Readiness Review was conducted to evaluate the full, production-configured system to determine if it correctly and completely implements all system requirements. The review determines whether the traceability of final system requirements to the final production system is maintained. *Note: See Factors 3.2.2, Entrance and Exit/Success Criteria and Sub-Area 4.3, Technical Baselines for more information, criteria and focused questions.*

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.2.Q42: How are the appropriate stakeholders included in each step of the management of requirements process?

- Who are the relevant stakeholders involved in the process?
- What is each stakeholder's role in the process?
- How are conflicts resolved? [4.2.2.C13 and 4.2.2.C15]

4.2.2.Q43: In cases where immature technology components or subsystems are necessary to achieve requirements, what are the interim performance requirements?

- How are they documented? [4.2.2.C13]

4.2.2.Q44: How is each requirement or expectation traced back to the parent/source requirement in a baselined document?

- Which ones are specified (fundamental or essential), allocated, implied or derived requirements?
- What is the rationale for each requirement? [4.2.2.C13]

4.2.2.Q45: How are the system-level requirements derived from the Initial Capabilities Document (ICD)? [4.2.2.C13]

4.2.2.Q46: What is the method of defining requirements to verify performance? [4.2.2.C13]

4.2.2.Q47: How is the requirements management process during SDD supported by the resource management tools?

- How do they identify the relationships between requirements?
- How are engineering tools applied to trace the applicability of all CDD requirements to all WBS elements?
- What is the functional interface collaboration among the WBS elements?
- When changes are made, how are the impacted requirements identified and accounted for in the updated system? [4.2.2.C14]

4.2.2.Q48: How does the requirements management tools collect, define, and decompose requirements, manage changes, and produce requirements specifications?

- Are they effective and efficient? If not, why not? {4.2.2.C14]

4.2.2.Q49: Do the stakeholders understand and accept all the requirements? [4.2.2.C15]

4.2.2.Q50: How does the requirements management plan address the validation of requirements?

- How will the project requirements be considered complete and understandable?
- How are the prioritized evaluation criteria consistent with requirements, and the operations and sustainment concepts? [4.2.2.C15]

4.2.2.Q51: How does the PM manage "requirements creep"? [4.2.2.C15]

4.2.2.Q52: How are follow-on capability improvements addressed in an evolutionary Acquisition Strategy? [4.2.2.C16]

4.2.2.Q53: How are open systems considered during the SDD phase in reducing life cycle costs? [4.2.2.C16]

- 4.2.2.Q54: What are the results of the analysis performed to determine the extent of open systems application? [4.2.2.C16]

4.2.2.Q55: For the needed capabilities, how are the requirements identified and defined by the SE process? [4.2.2.C17]

4.2.2.Q56: How does the SE process address market analysis, technology assessment, and modeling and simulation (M&S) in support of tradeoff studies, life cycle cost, the identification of measurable technical specifications, and the approach to verify performance? [4.2.2.C17]

4.2.2.Q57: How does the use of SE process optimize system performance against cost, schedule, and risk? [4.2.2.C17]

4.2.2.Q58: How was the program's SE process during the SDD disciplined in documenting and tracking specifications at all levels and structured to manage changes?

- How is configuration control integrated within the SE process? [4.2.2.C17]

4.2.2.Q59: In the PD phase, how will the program's SE process document and track specifications at all levels and how will be structured to manage changes? [4.2.2.C17]

4.2.2.Q60: How is the SE process planned to be used in the PD phase to:

- Translate required operational capabilities into technical specifications?
- Allocate, verify and manage specifications (including change management and control) from the system level to the lowest level?
- Determine the logistics support requirements? [4.2.2.C17]

4.2.2.Q61: What were the results of the IBR (i.e., is the Performance Measurement Baseline consistent with authorizing documents)? [4.2.2.C18]

4.2.2.Q62: What were the results of the SFR, (i.e., are the system's lower-level performance requirements fully defined and consistent with the mature system concept, and are lower-level systems requirements trace to top-level system performance and the Capabilities Development Document (CDD))? [4.2.2.C18]

4.2.2.Q63: What were the results of the PDR (i.e., the assessment of the system preliminary design as captured in performance specifications for each configuration item in the system (allocated baseline))?

- Has each function in the functional baseline been allocated to one or more system configuration items? [4.2.2.C18]

4.2.2.Q64: What were the results of the CDR (i.e., the assessment of the system final design as captured in product specifications for each configuration item in the system (product baseline))?

- Has each product in the product baseline been captured in the detailed design documentation? [4.2.2.C18]

4.2.2.Q65: What were the results of the SVR; the assessment of the system final product, as evidenced in its production configuration?

- How are the functional requirements (derived from the Capabilities Development Document and draft Capability Production Document) documented in the Functional, Allocated, and Product Baselines? [4.2.2.C18]

4.2.2.Q66: What were the results of the Production Readiness Review (PRR) (i.e., evaluation of the full, production-configured system to determine if it correctly and completely implements all system requirements)?

- Did the review determine whether the traceability of final system requirements to the final production system is maintained? [4.2.2.C18]

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USAF Space & Missile Center, SMC Systems Engineering Primer & Handbook, April 2005.
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NASA, Systems Engineering Handbook, SP-2007-6105 Rev 1, December 2007.

Factor 4.2.3 – Technology Maturity and Integration

Pre-Milestone A

Criteria

4.2.3.C1: An Analysis of Alternatives (AoA) or equivalent, and trade studies are employed to refine the selected concept documented in the Initial Capabilities Document (ICD) and provide input to the Technology Development Strategy (TDS) for the selection of feasible technologies for the Technology Development (TD) phase.

4.2.3.C2: Appropriate technology readiness metrics are applied to determine the new technologies to be developed during the TD phase. They are based on acceptable quantification methods for determining the appropriate Technology Readiness Level (TRL).

4.2.3.C3: Critical Technology components or subsystems are initially identified in the Concept Refinement (CR) phase. Mature alternative components or subsystems are tentatively identified for each immature Critical Technology, in the event that the technology does not mature quickly enough to support the program schedule.

4.2.3.C4: The results of a demonstration/validation of new or advanced technologies quantify risk elements, and support the design strategy. A risk mitigation plan is initially developed to address the attendant risks, including adequate resources and schedule to accomplish planned mitigation activities.

4.2.3.C5: An Alternative System Review (ASR) was conducted to validate the results of the AoA and support the selected system concept for the TD effort.

4.2.3.C6: A Technology Readiness Assessment (TRA), per DoD Instruction 5000.2, the TRA was conducted to assess the maturity of Critical Technology Elements (CTEs), in particular, and to assess program risk and the adequacy of technology maturation planning.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.3.Q1: How well does the program manager (PM) use the systems engineering (SE) process to identify and select technologies for the TD effort? [4.2.3.C1]

4.2.3.Q2: What was the scope of the capability tradeoff studies and what is the relationship between the result of the trades and the AoA? [4.2.3.C1]

- What was the extent of alternatives considered in the AoA?
- Did the AoA include non-materiel solutions? If not, why not?
- How was the AOA conducted (e.g., simulation, war gaming or other method)?
- Were the AoA tools used previously for other purposes, and if so, were they validated or accepted credible?
- Were the assumptions of the AoA and scenarios based on the approved concept of operations (CONOPS), and what is the relationship between the ICD and the CONOPs? [4.2.3.C1]

4.2.3.Q3: For a system of systems (SoS) and family of systems (FoS), what is the process used to assess the impact of incorporating a new capability within the hierarchy of systems? [4.2.3.C1]

4.2.3.Q4: What are the metrics for determining the level of maturity required to incorporate the new technology into the system design? [4.2.3.C2]

4.2.3.Q5: What are the initially identified CTEs for components or subsystems, along with each TRL? [4.2.3.C3]

4.2.3.Q6: What is the plan to identify the mature alternative components or subsystems for each immature Critical Technology, in the event that the technology does not mature quickly enough to support the program schedule? [4.2.3.C3]

4.2.3.Q7: What is the plan for the demonstration and validation of the proposed technologies and the quantifiable risks that remain to mature the technologies for system development and integration?

- What are the risk mitigation plan and the resources required to validate (i.e., verification testing, modeling and simulation, etc)? [4.2.3.C4]

4.2.3.Q8: What were the results of the ASR?

- How do they support the selected system concept to be demonstrated in the TD phase?

- What is the PM's understanding of the available system concepts to meet the capabilities described in the ICD (draft Capabilities Development Document (CDD)), and the affordability, operational effectiveness, and technology risks inherent in each alternative concept?
- How many preferred solutions are being carried forward into the TD phase?
  - What is the rationale for this decision?
- How is the ASR addressed in the System Engineering Plan (SEP)? [4.2.3.C5]

4.2.3.Q9: What was the result of the TRA, conducted concurrently with the ASR?
- Was it a systematic, metrics-based process?
- How did it assess the maturity of the CTEs?
  - What is the PM's understanding of CTEs? *Note: If a platform or system depends on specific technologies to meet system operational threshold requirements in development, production, and operation, and if the technology or its application is either new or novel, then that technology is considered a CTE.*
- How did the TRA score the current readiness level of selected system elements using defined TRLs?
- How did the TRA highlight critical technologies and other potential technology risk areas that require program manager attention?

Pre-Milestone B

Criteria

4.2.3.C7: The SE process manages technology maturation within the context of the documented Technology Development Strategy (TDS), and manages the associated risk.

4.2.3.C8: Fiscal Year 2006, Public Law 109-163, Section 801 requires that the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) certify, before Milestone B, that "the technology in the program has been demonstrated in a relevant environment." This wording equates to Technology Readiness Level (TRL) 6. For each immature critical technology, a more mature alternative technology has been identified in order to reduce the program risk if the immature technology does not mature as planned. This is described in the Critical Technology Element (CTE) maturation plan, which explains in detail how the required TRL will be reached prior to the next milestone decision date or relevant decision point. This plan includes the identification of adequate resources and schedule to accomplish planned mitigation activities.

4.2.3.C9: Technology Readiness Assessments (TRAs) are conducted concurrently with technical reviews in order to define the maturity of the technologies developed in the Technology Development (TD) phase. The TRA is a comprehensive review, using an established program

Work Breakdown Structure as an outline, of the entire platform or system. This review, using a conceptual or established baseline design configuration, identifies program CTEs; an objective scoring of the level of technological maturity for each CTE by subject matter experts; and develops maturation plans for achieving an acceptable maturity roadmap for CTEs prior to Milestone B.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.3.Q10: How does the PM describe the iterative process for evaluating/incorporating new/advanced technologies in potential system solutions? [4.2.3.C7]

4.2.3.Q11: For a system of systems, what is the process for assessing the impact of incorporating new technologies on interface control and system supportability with the hierarchy of systems? [4.2.3.C7]

4.2.3.Q12: What is the PM's process to ensure that all critical technologies achieve TRL 6 prior to Milestone B?

- For all immature technologies with risk of failing to achieve TRL 6 prior to Milestone B, what is the mature alternative technology, and the scheduled date of the decision regarding substitution of the mature alternative technology? [4.2.3.C8]

4.2.3.Q13: What were the results of the TRA?

- Was it a systematic, metrics-based process?
- How did it assess the maturity of the CTEs?
    - What is the PM's understanding of CTEs? *Note: If a platform or system depends on specific technologies to meet system operational threshold requirements in development, production, and operation, and if the technology or its application is either new or novel, then that technology is considered a CTE.*
- How did the TRA score the current readiness level of selected system elements using defined TRLs?
- How did the TRA highlight critical technologies and other potential technology risk areas that require program manager attention? [4.2.3.C9]

Pre-Milestone C

Criteria

4.2.3.C10: The SE process manages technology maturation within the context of the documented Technology Development Strategy (TDS), accounts for the impact on planned production, and manages the associated risk.

- The SE process utilizes performance, cost, and supportability trades and is applied for assessing the impact of incorporating new technologies, including impacts on interfaces in family of systems or system of systems applications.
- The technologies proposed for use in the system design should have measurable metrics that demonstrate their level of maturity.
- The results of a demonstration/validation of new or advanced technologies quantify risk elements, and support the design strategy. There is a risk mitigation plan that addresses the attendant risks, including adequate resources and schedule to accomplish planned mitigation activities.

4.2.3.C11: Critical Technology Elements (CTEs), identified at Milestone B as not TRL 6, have been reviewed for maturity. For each immature Critical Technology, a more mature alternative technology has been identified in order to reduce the program risk if the immature technology does not mature as planned. This is described in the Critical Technology Element (CTE) maturation plan. New technologies, resulting from unplanned performance issues in the System Development and Demonstration (SDD) phase, and manufacturing technologies, have been reviewed to discover and assess any new CTEs.

- TRL 7 is the required TRL for all components and subsystems prior to Milestone C.
- Critical manufacturing technologies are required to be at TRL 8.

For those technologies not at their required TRL (7 or 8, respectively), CTE maturation plans are described in the Technology Readiness Assessment (TRA).

4.2.3.C12: Technology Readiness Assessments (TRAs) are conducted concurrently with technical reviews in order to define the maturity of the technologies developed in the SDD phase. The TRA reflects the resolution of any technology deficiencies that arose during SDD; establishes that all critical manufacturing technologies are mature for hardware systems; and documents successful development, test, and evaluation (DT&E) for Major Automated Information System (MAIS) acquisitions and software-intensive systems.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.3.Q14: For an evolutionary Acquisition Strategy, what is the PM's description of the iterative process for evaluating/incorporating new/advanced technologies in the follow-on capability upgrade of the current system design?

- What is the explanation for how capability upgrades will be incorporated into the current planned production version? [4.2.3.C10]

4.2.3.Q15: For an SoS/FoS, what is the process for assessing the impact of incorporating new technologies on interface control within the hierarchy of systems? [4.2.3.C10]

4.2.3.Q16: What are the metrics for determining the level of maturity required to incorporate the new/advanced technology into the system design? [4.2.3.C10]

4.2.3.Q17: Where new technologies are being used in the design, what are the results of the design trade studies and maturity metrics that support the use of the new technology? [4.2.3.C10]

4.2.3.Q18: What is the PM's process to ensure that all critical performance and manufacturing technologies achieve TRL 7 and TRL 8, respectively, prior to Milestone C?

- For all immature performance technologies with risk of failing to achieve TRL7 prior to Milestone C, what is the mature alternative technology, and the scheduled date of the decision regarding substitution of the mature alternative technology?

- For all immature manufacturing technologies with risk of failing to achieve TRL 8 prior to Milestone C, what is the mature alternative technology, and the scheduled date of the decision regarding substitution of the mature alternative technology? [4.2.3.C11]

4.2.3.Q19: What were the results of the TRA?

- How did it assess the maturity of the CTEs?

  - What is the PM's understanding of CTEs? *Note: If a platform or system depends on specific technologies to meet system operational threshold requirements in development, production, and operation, and if the technology or its application is either new or novel, then that technology is considered a CTE.*

- How did the TRA score the current readiness level of selected system elements using defined TRLs?

- How did the TRA highlight critical technologies and other potential technology risk areas that require program manager attention? [4.2.3.C12]

Post-Milestone C

Criteria

4.2.3.C13: Full-rate production (FRP) will not be initiated if a critical manufacturing technology has not reached TRL 8—successfully qualified through test and demonstration—or TRL 9. This implies the following:

- Manufacturing processes, materials, and assembly methods have been demonstrated on production-representative articles with no known significant manufacturing risk

- Yields, quality, and reliability are within 25 percent of goals

- Design is mature (process requirements proven and validated)

- Quality management structures are in place

Focus Questions

[Pertinent criteria numbers follow each question.]

4.2.3.Q20: Are all critical manufacturing technologies at TRL 8—successfully qualified through test and demonstration—or TRL 9? How does the PM describe the following:

- Manufacturing processes, materials, and assembly methods have been demonstrated on production-representative articles with no known significant manufacturing risk?
- Yields, quality, and reliability within 25 percent of goals?
- Design mature (process requirements proven and validated)?
- Quality management structures in place? [4.2.3.C13]

References

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NASA, Systems Engineering Handbook, SP-2007-6105 Rev 1, December 2007.

USAF Research Laboratory, Manufacturing Readiness Assessment (MRA) Deskbook (Draft), November 2007.

USAF Space & Missile Center, SMC Systems Engineering Primer and Handbook, April 2005.

USN, Naval Systems Engineering Guide, October 2004.

SUB-AREA 4.3 – TECHNICAL BASELINES

Description: The establishment of technical baselines from the Concept Refinement phase to production, deployment, operations and support (O&S) is an integral part of the systems engineering process as described in detail in the DoD Instruction 5000.2, the Defense Acquisition Guidebook (DAG), and the Department of Defense Architecture Framework (DoDAF). The programs technical baseline is developed, managed, and used to control the acquisition program baseline cost and schedule. Technical reviews are an integral part of the systems engineering process and management of acquisition programs. Technical reviews provide the program manager with an assessment of the readiness to enter the next technical phase.

Scope: The scope of this sub-area will support an assessment of the programs technical baseline, integrated baseline, configuration, maturity level, stability, risk and readiness to move forward to the next phase. Technical reviews are a primary method for assessing the technical health of a program at key points in the acquisition management framework.

Perspective: The overarching objective of technical reviews is to ensure a well-managed technical effort leading to successful development and operational testing, and the fielding of an effective and suitable system for the warfighter. Technical reviews are event driven and conducted only when the entry criteria are achieved. Technical reviews also bring to bear additional non-advocate subject matter expertise to the development process in an effort to ensure overall program success.   Figure 4-3 shows the timing of technical reviews in relation to the milestones.
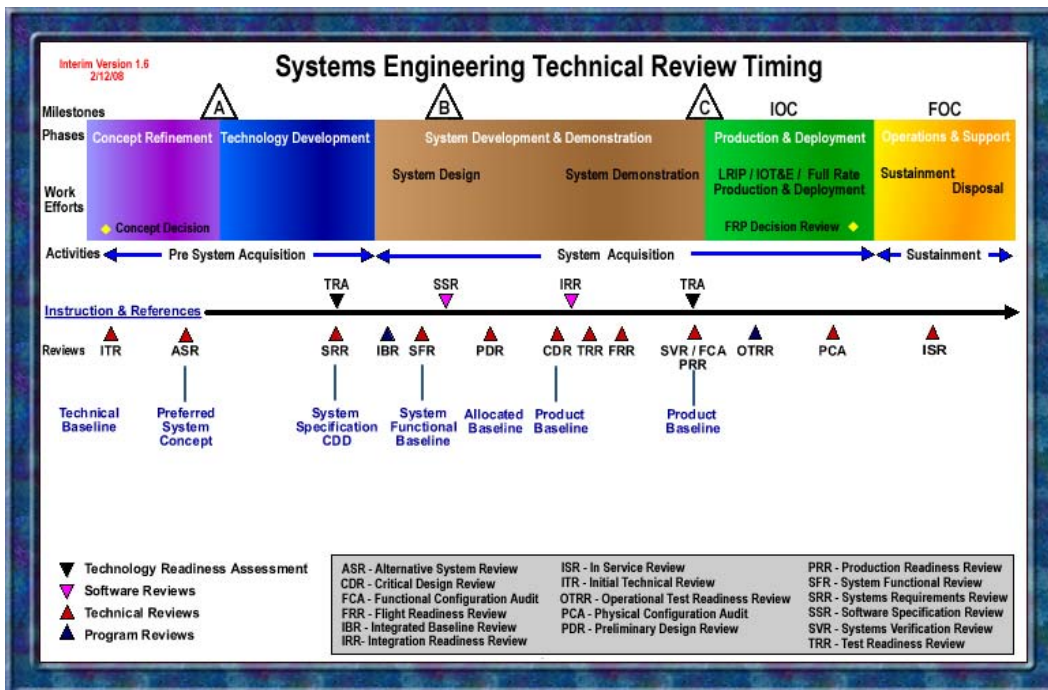
Figure 4-3 Systems Engineering Technical Review Timing

Factor 4.3.1 – Technical Review Planning

All Acquisition Category (ACAT) programs should include the essential technical reviews shown on the timeline, as applicable. Technical reviews provide a systematic process for continuously assessing the technical baseline, design maturity, technical risk, and programmatic risk of acquisition programs. Technical reviews are consistent with existing and emerging commercial and industrial standards and form the backbone of an effective Systems Engineering Plan (SEP).

Pre-Milestone A

Criteria

Initial Technical Review (ITR)

4.3.1.C1: The Initial Technical Review (ITR) is conducted to support the program's initial POM (Program Objective Memorandum) submission.

4.3.1.C2: The ITR assesses the envisioned requirements and conceptual approach of the proposed program and verifies that the requisite research, development, test, engineering, logistic, and programmatic bases for the project reflect the complete spectrum of technical challenges and risks.

4.3.1.C3: The ITR ensures that a program's technical baseline is sufficiently rigorous to support a valid cost estimate (with acceptable cost risk), and enable an independent assessment of that estimate by cost, technical, and program management subject matter experts.

4.3.1.C4: The ITR is held well in advance of the actual cost estimate submission to allow time for issue resolution and proper executive level concurrence on process and results.

4.3.1.C5: Prior to the review, the Integrated Process/Product Team (IPT) should prepare a data repository that includes:

- A program Cost Analysis Requirements Description (CARD)-like document for use by the ITR participants
- Assumptions that relate to the CARD-like document
- Preliminary cost estimates for the program (cost department lead)

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical ITR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q1: Does the CARD-like document capture the key program cost drivers, development costs (all aspects of hardware, human integration, and software), production costs, and operation and support costs? [4.3.1.C2, 5]

4.3.1.Q2: Is the CARD-like document complete and thorough? [4.3.1.C2]

4.3.1.Q3: Are the underlying assumptions used in developing the CARD-like document technically and programmatically sound and complete? [4.3.1.C3]

4.3.1.Q4: Have the appropriate technical and programmatic competencies been involved in the CARD-like document development? [4.3.1.C4]

4.3.1.Q5: Have the proper subject matter experts been involved in the review? [4.3.1.C3]

4.3.1.Q6: Are the risks known and manageable within the cost estimate? [4.3.1.C3]

4.3.1.Q7: Is the program, as captured in the CARD-like document, executable? [4.3.1.C4, 5]

Criteria

Alternative System Review (ASR)

4.3.1.C6: The Alternative System Review (ASR) is conducted to ensure that the resulting set of requirements agrees with the customers' needs and expectations and that the system under review can proceed into the Technology Development phase.

4.3.1.C7: The ASR assesses the alternative systems that have been evaluated during the Concept Refinement phase, and ensures that the Technology Development Plan is consistent with the preferred system solution and is adequately resourced to reduce System Development and Demonstration entry risk to an acceptable level.

4.3.1.C8: The ASR ensures that the preferred system alternative is cost effective, affordable, operationally effective and suitable, and can be developed to provide a timely solution to a need at an acceptable level of risk.

4.3.1.C9: It is held well in advance of Milestone A to allow time for issue resolution and proper executive level concurrence on process and results.

4.3.1.C10: The ASR entry criteria requires:

- A preliminary agenda coordinated (nominally) 30 days prior to the ASR
- A data repository that includes:
    - Analysis of Alternatives (AoA) results/report
    - Preferred System Solution(s) description
    - Draft Request for Proposal (RFP)

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical ASR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q8: Have all the draft Requests for Action (RFAs) been signed off? [4.3.1.C6]

4.3.1.Q9: Can the preferred system solution(s), as disclosed, satisfy the Initial Capabilities Document (ICD)? [4.3.1.C7]

4.3.1.Q10: Is/are the preferred system solution(s) sufficiently detailed and understood to enable entry into Technology Development with low technical risk? [4.3.1.C8]

4.3.1.Q11: Is the system software scope and complexity sufficiently understood and addressed in the Technology Development Plan to enable low software technical risk? [4.3.1.C8]

4.3.1.Q12: Are the risks known and manageable for Technology Development? [4.3.1.C8, 9]

4.3.1.Q13: Is the program schedule executable (technical/cost risks)? [4.3.1.C8, 9]

4.3.1.Q14: Is the program properly staffed? [4.3.1.C9]

4.3.1.Q15: Is the program's Technology Development work effort executable within the existing budget? [4.3.1.C8]

4.3.1.Q16: Has the system technical baseline been captured in a preliminary system specification that is consistent with technology maturity and the proposed program cost and schedule? [4.3.1.C8, 9, 10]

Pre-Milestone B (New DoDI 5000.02)

The use of competitive prototyping is required by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD(AT&L)) policy through the Technology Development phase up to Milestone B, which will include the Preliminary Design Review.

Criteria

System Requirements Review (SRR)

4.3.1.C11: The System Requirements Review (SRR) is conducted to ensure that the system under review can proceed into the Engineering, Manufacturing Development and Demonstration (EMDD) phase.

4.3.1.C12: The SRR ensures that all system and performance requirements derived from the Initial Capabilities Document (ICD) or draft Capabilities Development Document (CDD) are defined and consistent with cost (program budget), schedule (program schedule), risk, and other system constraints.

4.3.1.C13: The SRR is typically held well in advance of Milestone B to allow time for issue resolution and proper executive level concurrence on process and results. Technical performance results from competitive prototyping should factor into the trade space for system requirements.

4.3.1.C14: A second SRR may be necessary if significant system changes occur at Milestone B or as a result of requirements maturation associated with competitive prototyping.

4.3.1.C15: The SRR is typically conducted by a technical review board consisting of a government chairperson selected outside (independent of) the government program office. The review board can operate as separate functional IPTs, and should be composed of program manager (PM) representatives (both industry and government); assistants to the PMs for systems and software engineering, logistics, cost estimating, testing, and contracts; and specific subject matter experts as needed to address system concepts and related technologies.

4.3.1.C16: The documented performance specifications should satisfy each and every requirement in the Initial Capabilities Document (ICD) or Draft Capabilities Development Document (CDD), and their traceability should be verified.

4.3.1.C17: The approval of a preliminary system performance specification establishes the system requirements baseline. A preliminary Cost Analysis Requirements Description (CARD) should be available prior to the SRR.

4.3.1.C18: The performance requirements should be clearly defined and described in enough detail to allow functional allocation to the subsystem and component level for the system design.

4.3.1.C19: The Technology Development (TD) phase results should provide the basis for planned systems engineering processes and tools, and quantifiable EMDD exit criteria to successfully manage the program. This planning should be documented in an updated Systems Engineering Plan (SEP).

4.3.1.C20: Human factors, a key consideration early in a program, should be considered when selecting the preferred system approach/system solution that addresses user needs and mission capabilities. This should be verified by the SRR.

4.3.1.C21: The TD effort should mature the prototype technologies to an acceptable level of risk to proceed to EMDD and assessment by the SRR. The results of the TD effort should be reflected in updates to a formal risk assessment and a SEP for the EMDD phase of the program.

4.3.1.C22: The SRR should verify that both the government program office and the developer have qualified personnel with the appropriate level of technical experience, which is tracked to a resource requirements plan and budget as needed to execute the EMDD phase of the program.

4.3.1.C23: The approved budget should track to the Information Management Plan (IMP) and Integrated Master Schedule (IMS) for EMDD and production.

4.3.1.C24: A successful SRR is predicated on the reviewers' (e.g. IPTs) consensus that the system requirements, preferred system solution, available technology (as verified during TD), and program resources (funding, schedule, staffing, and processes) form a satisfactory (acceptable level of defined risk) basis to proceed to the System Development and Demonstration (SDD) phase.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.3.1.Q17: Describe the composition of the technical review board selected to conduct the SRR. Include the organization of the board (IPT structure if applicable), the stakeholder representatives involved (both government and industry) and how the members were selected. [4.3.1.C11]

4.3.1.Q18: How are the system requirements, as documented, traceable to the ICD or draft CDD? [4.3.1.C12]

4.3.1.Q19: Did the completed SRR result in an approved system performance specification? When was it approved?

Is there an updated draft Cost Analysis Requirements Description (CARD) that reflects the approved system performance specification? [4.3.1.C13]

4.3.1.Q20: How did competitive prototyping affect the SRR?

How did prototype technical performance results help to mature the system requirements? Provide some examples. [4.3.1.C13]

4.3.1.Q21: How was it determined that the performance specifications are sufficiently detailed and clearly stated, to enable system functional definition and decomposition to the component level? [4.3.1.C13, 14]

4.3.1.Q22: Is the software functionality clearly defined in the specifications, and consistent with software sizing estimates? [4.3.1.C13]

What are the size estimates of the software code?

What is the resource loading schedule to develop the software?

What is the status of the Software Development Plan?

4.3.1.Q23: What systems engineering planning and processes, and exit criteria (metrics) are in place for the program to proceed to the EMDD phase? [4.3.1.C19]

4.3.1.Q24: What Human Systems Integration (HSI) requirements have been reviewed and included in the performance specifications? [4.3.1.C20]

Were any HSI attributes verified during the TD phase?

4.3.1.Q25: How has the TD effort sufficiently reduced development risks? [4.3.1.C21]

- Have the remaining technical risks been accounted for (cost and schedule) to proceed with EMDD phase as planned?
- How are they reflected in an updated risk assessment? [4.3.1.C21]

4.3.1.Q26: What is the status of a SEP for the EMDD phase of the program? [4.3.1.C22]

- Was it available prior to conducting the SRR and reflective of the documented risks from the TD phase?

4.3.1.Q27: How will the program staffed (specify qualifications of technical staff and number) to proceed with EMDD? [4.3.1.C23]

- Is this staffing plan consistent with the funding allocated to resources and reflected in the IMS?

4.3.1.Q28: How is the EMDD program determined executable within the existing budget? [4.3.1.C23]

- Does the updated (post-TD phase) cost estimate fit within the approved budget for EMDD?

4.3.1.Q29: What attributes and metrics were used as criteria to determine the success of the SRR as a basis to proceed to the EMDD phase of the program? [4.3.1.C24]

- What were the findings and recommendations of the technical review board and how were they recorded?

Criteria

Technology Readiness Assessment (TRA)

4.3.1.C25: The Technology Readiness Assessment (TRA) is a regulatory information requirement per DoDI 5000.2. The TRA is a systematic metrics-based process that assesses the maturity of Critical Technology Elements (CTEs) and is a requirement for all acquisition programs.

4.3.1.C26: The TRA will score the current readiness level of selected system elements, using defined Technology Readiness Levels (TRLs), highlighting critical technologies and other potential technology risk areas requiring program manager (PM) attention.

4.3.1.C27: The TRA may be conducted concurrently with other Technical Reviews, specifically SRR, Critical Design Review (CDR), System Verification Review (SVR), and/or Production Readiness Review (PRR). It is conducted prior to both Milestones B and C:

- For ACAT ID or IAM programs, the TRA process has proven to require between 8 and 10 months prior to the decision date.
- For ACAT II programs, the TRA process requires between 5 and 7 months.
- For ACAT III and IV programs, the TRA process requires less than 5 months.

4.3.1.C28: The TRA entry criteria requires that:

- An Alternative Systems Review (ASR) and/or a System Requirements Review (SRR) have been successfully completed (if applicable).
- The systems engineering technical authority (at the Integrated Process/Product Team (IPT) systems engineer's request) has designated the TRA chair.
- Contractors receive funding for TRA preparation and execution.

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical TRA exit criteria include affirmative answers to the following exit questions:

4.3.1.Q30: Was a final report prepared documenting the findings of the assessment panel? [4.3.1.C25]

4.3.1.Q31: Did the chair submit the TRA report to the appropriate service officials and the PM? Was the TRA approved? [4.3.1.C26, 27]

4.3.1.Q32: For ACAT ID or IAM programs, the service acquisition official provides a recommendation to the Director, Defense Research and Engineering (DDR&E) of the Office of the Secretary of Defense for Deputy Under Secretary of Defense for Science and Technology (DUSD(S&T)) final approval. If deemed necessary, the DDR&E can conduct an Independent Technical Assessment (ITA) in addition to, and totally separate from, the TRA:

- Was the TRA submitted to DDR&E?
- Was the TRA accepted by DDR&E or did they conduct an ITA? [4.3.1.C28]

Criteria

Integrated Baseline Review (IBR)

4.3.1.C29: The Integrated Baseline Review (IBR) process is employed by program managers (PMs) requiring Earned Value Management (EVM).

4.3.1.C30: The IBR establishes a mutual understanding of the Performance Measurement Baseline (PMB) and provides for an agreement on a plan of action to evaluate risks inherent in the PMB and the management processes that operate during project execution.

4.3.1.C31: IBRs are conducted throughout the life of the project (more than one time) in projects requiring EVM.

4.3.1.C32: The IBR requires:

- An established PMB by the performing organization (contractor or government) that reflects the entire scope of work documented at the appropriate level of detail
- IPT familiarity with the project scope of work (e.g., statement of work (SOW) or statement of objectives (SOO)) and the contractor's management processes

4.3.1.C33: The IBR establishes a mutual understanding of the project performance measurement baseline. Completion of the review should result in the assessment of risk within the program measurement baseline and the degree to which the following have been established:

(1) Technical scope of work is fully included and is consistent with authorizing documents.

(2) Key project schedule milestones are identified and supporting schedules reflect a logical flow to accomplish the work.

(3) Resources (budgets, facilities, personnel, skills, etc.) are available and are adequate for the assigned tasks.

(4) Tasks are planned and can be measured objectively relative to the technical progress.

(5) Rationales underlying the Performance Measurement Baseline are reasonable.

(6) Management processes support successful execution of the project.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.3.1.Q33: How soon is/was an IBR scheduled/performed on the program after contract award? (4-5 months is reasonable, and no more than 6 is the requirement) [4.3.1.C29,30]

4.3.1.Q34: What stakeholders are/were participants in the IBR planning according to their expertise (include subcontractors)? [4.3.1.C29,30]

4.3.1.Q35: What is the extent of formal team training for the IBR team participants? [4.3.1.C32]

4.3.1.Q36: How does the IBR process address the need for follow-on IBRs relative to contract modifications or changes to the PMB? [4.3.1.C31]

4.3.1.Q37: Have there been re-programming or re-baselining efforts that have resulted in an over target baseline (OTB)? [4.3.1.C31]

- How effectively did the contractor involve the program management office (PMO) in these actions?
- How many program re-baselines have occurred during the current phase of the program, and at what intervals?
- Was an IBR conducted after each re-baseline and in a timely manner?
- Will the re-baseline be reported in the selected acquisition report (SAR) and acquisition program baseline (APB)?
- Will re-baselining result in any APB or Nunn-McCurdy breaches?

4.3.1.Q38: How is the technical scope of work verified as consistent with the requirements documentation? [4.3.1.C32]

4.3.1.Q39: What are the key schedule milestones for the EMDD phase of the program? [4.3.1.C32, 33]

Criteria

System Functional Review (SFR)

4.3.1.C34: The System Functional Review (SFR) is conducted to ensure that the system under review can proceed into preliminary design, and that all system requirements and functional performance requirements derived from the Capabilities Development Document (CDD) are defined and consistent with cost (program budget), schedule (program schedule), risk, and other system constraints.

4.3.1.C35: The SFR assesses the system functional requirements as captured in system specifications (functional baseline), and ensures that all required system performance is fully decomposed and defined in the functional baseline.

4.3.1.C36: The SFR requires:

- A System Requirements Review (SRR) has been successfully completed
- A preliminary agenda coordinated (nominally) 30 days prior to the SFR
- An IPT data repository that includes:
  - Preliminary Functional Baseline
  - Preliminary system software functional requirements
  - Updated CARD-like document
  - Human Systems Integration (HSI)-related documentation

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical SFR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q40: Have all the draft Requests for Action (RFAs) been signed off? [4.3.1.C34]

4.3.1.Q41: Can the system functional requirements, as disclosed, satisfy the CDD? [4.3.1.C34]

4.3.1.Q42: Are the system functional requirements sufficiently detailed and understood to enable system design to proceed? [4.3.1.C35]

4.3.1.Q43: Are adequate processes and metrics in place for the program to succeed? [4.3.1.C34]

4.3.1.Q44: Are the risks known and manageable for design and development? [4.3.1.C34]

4.3.1.Q45: Is the program schedule executable (technical/cost risks)? [4.3.1.C34]

4.3.1.Q46: Is the program properly staffed? [4.3.1.C34]

4.3.1.Q47: Is the program, with the approved functional baseline, executable within the existing budget? [4.3.1.C34]

4.3.1.Q48: Is the updated CARD consistent with the approved functional baseline? [4.3.1.C34]

4.3.1.Q49: Does the updated cost estimate fit within the existing budget? [4.3.1.C34, 35]

4.3.1.Q50: Has the system functional baseline been established to enable preliminary design to proceed with proper configuration management? [4.3.1.C34, 35]

Criteria

Preliminary Design Review (PDR)

4.3.1.C37: The Preliminary Design Review (PDR) is conducted to ensure that the system under review can proceed into detailed design, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints. PDR entrance and exit criteria have been established and approved.

4.3.1.C38: The PDR assesses the system preliminary design as captured in performance specifications for each configuration item in the system (allocated baseline), and ensures that each function in the functional baseline has been allocated to one or more system configuration items.

4.3.1.C39: The PDR requires:

- A System Functional Review (SFR) has been successfully completed
- All SFR Requests for Action (RFAs) have been closed
- A preliminary agenda coordinated (normally) 30 days prior to the PDR
- PDR technical products for each system hardware and software configuration item are available to the cognizant PDR participants prior to the review
- A data repository that includes:
  - Updated system specification
  - Preliminary subsystem design specifications for each configuration item (hardware and software), with supporting trade-off analyses and data, as required

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical PDR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q51: Have all the draft Requests for Action (RFAs) been signed off? [4.3.1.C39]

4.3.1.Q52: Does the status of the technical effort and design indicate Operational Testing (OT) success (operationally suitable and effective)? [4.3.1.C38]

4.3.1.Q53: Can the preliminary design, as disclosed, satisfy the CDD? [4.3.1.C37]

4.3.1.Q54: Has the system allocated baseline been established and documented to enable detailed design to proceed with proper configuration management? [4.3.1.C38]

4.3.1.Q55: Are adequate processes and metrics in place for the program to succeed? [4.3.1.C37]

4.3.1.Q56: Have human integration design factors been reviewed and included, where needed, in the overall system design? [4.3.1.C37]

4.3.1.Q57: Are the risks known and manageable for Developmental Testing/Operational Testing (DT/OT)? [4.3.1.C37, 38]

4.3.1.Q58: Is the program schedule executable (technical/cost risks)? [4.3.1.C37]

4.3.1.Q59: Is the program properly staffed? [4.3.1.C37]

4.3.1.Q60: Is the program executable (technical/cost risks) within the existing program budget and with the approved system allocated baseline? [4.3.1.C37]

4.3.1.Q61: Does the updated cost estimate fit within the existing program budget? [4.3.1.C37]

4.3.1.Q62: Is the preliminary design producible within the production budget? [4.3.1.C37]

4.3.1.Q63: Is the updated CARD consistent with the approved allocated baseline? [4.3.1.C37, 38]

4.3.1.Q64: Is the software functionality in the approved allocated baseline consistent with the updated software metrics and resource-loaded program schedule? [4.3.1.C37, 38]

Pre-Milestone C

Criteria

Critical Design Review (CDR)

4.3.1.C40: The Critical Design Review (CDR) is conducted to ensure that the system under review can proceed into system fabrication, demonstration, and test, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints.

4.3.1.C41: The CDR assesses the system final design as captured in product specifications for each configuration item in the system (product baseline), and ensures that each product in the product baseline has been captured in the detailed design documentation.

4.3.1.C42: The CDR should be conducted prior to the Design Readiness Review (DRR), if a DRR is planned. The CDR is the technical input to the programmatic review at DRR.

4.3.1.C43: The CDR requires:

- A Preliminary Design Review (PDR) has been successfully completed

- All PDR Requests for Action (RFAs) have been closed

- All PDR exit criteria key issues are satisfied, if applicable

- A preliminary agenda coordinated (normally) 30 days prior to the CDR

- A data repository that includes:

  - Updated system and functional specifications

  - Product specifications for each hardware and software configuration item along with supporting trade-off analyses and data

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical CDR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q65: Have all the draft Requests for Action (RFAs) been signed off? [4.3.1.C42]

4.3.1.Q66: Does the status of the technical effort and design indicate Operational Testing (OT) success (operationally suitable and effective)? [4.3.1.C41]

4.3.1.Q67: Does the detailed design, as disclosed, satisfy the Capabilities Development Document (CDD) or any available draft Capability Production Document (CPD)? [4.3.1.C42]

4.3.1.Q68: Has the system product baseline been established and documented to enable hardware fabrication and software coding to proceed with proper configuration management? [4.3.1.C41, 42]

4.3.1.Q69: Has the detailed design satisfied Human Systems Integration (HSI) requirements? [4.3.1.C41, 42]

4.3.1.Q70: Are adequate processes and metrics in place for the program to succeed? [4.3.1.C40, 41]

4.3.1.Q71: Are the risks known and manageable for Developmental Testing/Operational Testing (DT/OT)? [4.3.1.C40, 41]

4.3.1.Q72: Is the program schedule executable (technical/cost risks)? [4.3.1.C40, 41]

4.3.1.Q73: Is the program properly staffed? [4.3.1.C40, 41]

4.3.1.Q74: Is the program executable within the existing budget and the approved product baseline? [4.3.1.C40, 41]

4.3.1.Q75: Is the detailed design producible within the production budget? [4.3.1.C40, 41]

4.3.1.Q76: Is the updated CARD consistent with the approved product baseline? [4.3.1.C40, 41]

4.3.1.Q77: Are critical safety items and critical application items identified? [4.3.1.C40, 41]

4.3.1.Q78: Does the updated cost estimate fit within the existing budget? [4.3.1.C40, 41]

4.3.1.Q79: Is the software functionality in the approved product baseline consistent with the updated software metrics and resource-loaded schedule? [4.3.1.C40, 41, 42]

Criteria

Test Readiness Review (TRR)

4.3.1.C44: The Test Readiness Review (TRR) is conducted to ensure that the subsystem or system under review is ready to proceed into formal test.

4.3.1.C45: The TRR assesses test objectives, test methods and procedures, and scope of tests, and determines if required test resources have been properly identified and coordinated to support planned tests.

4.3.1.C46: Depending on the program, determining test readiness may involve specialized reviews, such as a Flight Readiness Review in the case of aircraft. The program team should plan for, and include, these specialized reviews in the Systems Engineering Plan.

4.3.1.C47: The TRR requires:

- A defined and agreed upon test configuration system
- A defined and agreed upon interface configuration management plan
- A Version Description Document available to TRR participants a minimum of 7 working days prior to the review
- Successfully conducted functional, unit level, subsystem, system, and qualification tests
- All TRR specific materials such as test plans, test cases, and procedures are available to all participants prior to conducting the review (minimum of seven working days)
- All known system discrepancies are identified and dispositioned in accordance with an agreed upon plan
- All previous design review exit criteria and key issues are satisfied in accordance with an agreed upon plan
- All required test resources (people, facilities, test articles, test instrumentation) are identified and available to support required tests
- Roles and responsibilities of all test participants are defined and agreed upon

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical TRR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q80: Have all the draft Requests for Action (RFAs) been signed off? [4.3.1.C44]

4.3.1.Q81: Are test plans completed and approved for the system under test? [4.3.1.C45]

4.3.1.Q82: Are the identification and coordination of required test resources completed? [4.3.1.C45]

4.3.1.Q83: Do previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests? [4.3.1.C46, 47]

4.3.1.Q84: Is the risk level identified and accepted by program leadership? [4.3.1.C47]

Criteria

System Verification Review (SVR) / Function Configuration Audit (FCA)

4.3.1.C48: The System Verification Review (SVR) is conducted to ensure that the system under review can proceed into low-rate initial production (LRIP) and full-rate production (FRP) within cost (program budget), schedule (program schedule), risk, and other system constraints.

4.3.1.C49: The SVR is synonymous with the Functional Configuration Audit (FCA). The SVR is an audit trail from the CDR and assesses that the system final product, as evidenced in its production configuration, meets the functional requirements as derived from the Capabilities Development Document (CDD)/draft Capability Production Document (CPD) to the functional, allocated, and product baselines.

4.3.1.C50: The SVR requires:

- A Critical Design Review (CDR) milestone event has been successfully completed, if applicable
- All CDR Requests for Action (RFAs) have been closed, if applicable
- All CDR exit criteria key issues have been satisfied, if applicable
- A preliminary agenda coordinated (nominally) 30 days prior to the SVR/PRR
- All system performance specification qualification test requirements have been successfully completed, if applicable

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical SVR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q85: Have all the draft Requests for Action (RFAs) been signed off? [4.3.1.C48]

4.3.1.Q86: Does the status of the technical effort and system indicate Operational Testing (OT) success (operationally suitable and effective)? [4.3.1.C48]

4.3.1.Q87: Can the system, as it exists, satisfy the CDD/draft CPD? [4.3.1.C49]

4.3.1.Q88: Are adequate processes and metrics in place for the program to succeed? [4.3.1.C48]

4.3.1.Q89: Are the risks known and manageable? [4.3.1.C48, 49]

4.3.1.Q90: Is the program schedule executable within the anticipated cost and technical risks? [4.3.1.C48, 49]

4.3.1.Q91: Are the system requirements understood to the level appropriate for this review? [4.3.1.C48, 49]

4.3.1.Q92: Is the program properly staffed? [4.3.1.C48, 49]

4.3.1.Q93: Is the program non-recurring engineering requirement executable with the existing budget? [4.3.1.C48, 49]

4.3.1.Q94: Is the system producible within the production budget? [4.3.1.C50]

Criteria

Production Readiness Review (PRR)

4.3.1.C51: The Production Readiness Review (PRR) is an examination of the product to determine if the design is ready for production and the producer has accomplished adequate production planning without incurring unacceptable risks that will breach thresholds of schedule, performance, cost, or other established criteria.

4.3.1.C52: The SVR(FCA) and PRR are typically conducted by the same group and at the same location. They are often conducted concurrently.

4.3.1.C53: The PRR requires that PRR technical products have been made available to the cognizant PRR participants prior to the review:

- Results of the PRRs conducted at the major suppliers' facilities
- Transition to a Production/Manufacturing Plan
- Change control process established and the production configuration baseline approved by the customer
- Manufacturing/producibility and quality requirements addressed during the design/development phase
- Current risk assessment

Focus Questions

[Pertinent criteria numbers follow each question.]

Typical PRR exit criteria include affirmative answers to the following exit questions:

4.3.1.Q95: Have all the draft Requests for Action (RFAs) been signed off? [4.3.1.C51]

4.3.1.Q96: Has the system product baseline been established and documented to enable hardware fabrication and software coding to proceed with proper configuration management? [4.3.1.C51]

4.3.1.Q97: Are adequate processes and metrics in place for the program to succeed? [4.3.1.C51]

4.3.1.Q98: Are the risks known and manageable? [4.3.1.C51]

4.3.1.Q99: Is the program schedule executable (technical/cost risks)? [4.3.1.C51]

4.3.1.Q100: Is the program properly staffed? [4.3.1.C51]

4.3.1.Q101: Is the detailed design producible within the production budget? [4.3.1.C51, 52, 53]

Pre-Full-Rate Production

Criteria

Operational Test Readiness Review (OTRR)

4.3.1.C54: The Operational Test Readiness Review (OTRR) is conducted to ensure that the "production configuration" system can proceed into Operational Testing (OT) with a high probability of success.

4.3.1.C55: Of critical importance to this review is the understanding of available system performance to meet the Capability Production Document (CPD). Successful performance during Operational Testing generally indicates the system being tested is suitable and effective for service introduction.

4.3.1.C56: Prior to the OTRR the OUSD(AT&L) Systems and Software Engineering/Assessments and Support (SSE/AS) staff will conduct an assessment of operational test readiness (AOTR) to independently assess the successful completion of developmental test and evaluation (DT&E) and report the AOTR findings to the PM and Deputy, OUSD(A&T).

4.3.1.C57: The OTRR may be conducted in the timeframe of the Milestone C decision. The decision to enter full rate production (FRP) may be based on this successful determination.

4.3.1.C58: The OTRR must be completed prior to Initial Operational Test and Evaluation (IOT&E).

4.3.1.C59: By policy, Developmental Testing shall be integrated with Operational Testing (DT/OT) and Early Operational Assessments (EOAs). This is done to provide the operational testers an early opportunity to begin becoming familiar with the system while it is still in Developmental Testing.

4.3.1.C60a: The OTRR requires that:

- The Capability Production Document (CPD) operational requirements match the requirements tested in the Test and Evaluation Master Plan (TEMP)
- System requirement time phasing is traceable from the CPD to the system specification and the TEMP
- Spiral development, if incorporated, is supported by the CPD and other acquisition-related documentation

4.3.1.C60b: The OTRR is considered complete when all requirements for certification of readiness for Operational Testing (OT) are complete.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.3.1.Q102: Does the production configuration meet all system requirements? [4.3.1.C54, 55]

4.3.1.Q103: Have operational evaluators (OEs) been involved in DT? [4.3.1.C54, 55]

4.3.1.Q104: Are the OEs trained and familiar with the system to be tested? [4.3.1.C56]

4.3.1.Q105: Have all critical operational issues (COIs) been identified and understood? [4.3.1.C60a]

4.3.1.Q106: Have all IOT&E requirements been identified? [4.3.1.C60a]

4.3.1.Q107: Have all risk items identified during DT been mitigated? If not, why not? [4.3.1.C59]

4.3.1.Q108: Did OUSD(AT&L) SSE/AS conduct an analysis of operational test readiness (AOTR) review? [4.3.1.C56]

4.3.1.Q109: Is the system certified and ready for IOT&E? [4.3.1.C60b]

Criteria

Physical Configuration Audit (PCA)

4.3.1.C61: The Physical Configuration Audit (PCA) examines the actual configuration of an item being produced in order to verify that the related design documentation matches the item as specified in the contract. In addition, the PCA confirms that the manufacturing processes, quality control system, measurement and test equipment, and training are adequately planned, tracked, and controlled.

4.3.1.C62: A PCA is normally conducted when the government plans to control the detail design of the item it is acquiring via the technical data package (TDP).

4.3.1.C63: When the government does not plan to exercise such control or purchase the item's TDP (e.g., performance-based procurement), the contractor should conduct an internal PCA in order to define the starting point for controlling the detail design of the item and to establish a product baseline.

4.3.1.C64: The PCA is conducted in the timeframe of the full-rate production decision.

4.3.1.C65: The PCA requires:

- The first units produced as a result of low-rate initial production (LRIP) and, later, the first units produced as a result of full-rate production (FRP).
- A data repository that includes detailed documentation of the:
    – Contractual design specifications
    – Manufacturing processes
    – Quality control system
    – Measurement and test equipment
    – Training

Focus Questions

[Pertinent criteria numbers follow each question.]

4.3.1.Q110: Does the design and manufacturing documentation match the item as specified in the contract? [[4.3.1.C61 and 4.3.1.C62]

4.3.1.Q111: Have all the draft Requests for Action (RFAs) been signed off ? [4.3.1.C61, 62]

4.3.1.Q112: Does the government plan to take control of the TDP at PCA? [4.3.1.C62]

Criteria

In-Service Review (ISR)

4.3.1.C66: The In-Service Review (ISR) is conducted to ensure that the system under review is operationally employed with well-understood and managed risk.

4.3.1.C67: The ISR is intended to characterize the in-service technical and operational health of the deployed system by providing an assessment of risk, readiness, technical status, and trends in a measurable form that will substantiate in-service budget problems.

4.3.1.C68: Once a program enters the Operations and Support phase, an ISR will be held periodically (e.g., every year or every 2 years, for the rest of the program's life.

4.3.1.C69: The ISR requires:

- A preliminary agenda coordinated (nominally) 30 days prior to the ISR
- That ISR technical products for the operational system are available to the cognizant ISR participants prior to the review

Focus Questions

[Pertinent criteria numbers follow each question.]

4.3.1.Q113: Have draft Requests for Action (RFAs), if applicable, been signed off? [4.3.1.C66]

4.3.1.Q114: Have system problems have been categorized to support the Operations and Support (O&S) requirements determination process? [4.3.1.C66]

4.3.1.Q115: Have required budgets (in terms of work years) been established to address all system problems in all priority categories? [4.3.1.C67, 68]

4.3.1.Q116: Are current levels of system operational risk and system readiness quantified and related to current and future O&S and procurement budgets? [4.3.1.C67, 68]

Resources
http://www.dod.mil/ddre/doc/tra_deskbook_2005.pdf.
http://www.incose.org/ProductsPubs/pdf/SELeadingIndicators2007-0618.pdf.
http://www.navair.navy.mil/kms/41g/#.
http://www.srs.gov/general/EFCOG/02GovtReferences/02D0D/PMGuideIBRProcess.pdf.
https://learn.dau.mil/html/clc/Clc.jsp. DAU CLE003 Technical Reviews.

Factor 4.3.2 – Configuration Management

Pre-Milestone A, Pre-Milestone B, and Pre-Milestone C

Criteria

4.3.2.C1: Configuration Management (CM) and Control Authority are clearly defined and are integral to the systems engineering process in managing the configuration baseline.

4.3.2.C2: There should be a Configuration Management Plan that addresses the methodology to manage the system configuration throughout the program life cycle. The plan clearly defines the set of specifications/configuration items for both hardware and software that comprise the configuration baseline specified in the contract. The baseline should correlate with the system work breakdown structure (WBS).

4.3.2.C3: The configuration management process established by the contractor should consist of a formal methodology that sets the configuration baseline, tracks and controls changes and additions/deletions to the baseline, and maintains integrity of the process via formal audits or some other oversight mechanism. This methodology should include formal communication of the configuration to the contractor supplier base and highlight supportability issues that could affect the fielded system.

4.3.2.C4: The change management process used by the program should document the impact(s) of a proposed change on open interfaces used within and among systems (such as a system of systems).

4.3.2.C5: Configuration management should address obsolescence and technology refreshment.

4.3.2.C6: Configuration Management is an umbrella activity developed to:

- Identify change
- Manage that change
- Ensure that the change is being properly implemented
- Report the change to others who may have and interest
- Record the change for historical reference

Focus Questions

[Pertinent criteria numbers follow each question.]

4.3.2.Q1: Describe how the systems engineering applied process addresses configuration control and authority. Explain the roles and responsibilities of the configuration managers and how proposed changes are controlled and implemented. [4.3.2.C1]

4.3.2.Q2: Provide the details of the Configuration Management Plan, including the current configuration baseline and how it was derived. Does it provide coverage throughout the system life cycle? Does it cover the engineering change order process during production? [4.3.2.C2]

4.3.2.Q3: Describe the configuration management process to be used on the program, the content of the current configuration baseline and how the process will manage configuration changes. Are periodic configuration audits conducted to ensure the integrity of the product and the process? Please explain. [4.3.2.C2, 3]

4.3.2.Q4: How does the configuration management process include the supplier base? [4.3.2.C3]

4.3.2.Q5: Does the change management process used by the program identify the impact of change on open interfaces and supportability? Please explain. [4.3.2.C4]

4.3.2.Q6: Explain how the configuration management process addresses obsolescence and technology refreshment. [4.3.2.C5, 6]

References

DoD Guide to Uniquely Identifying Items.
    http://www.acq.osd.mil/dpap/UID/attachments/DoDUIDGuide.pdf

Little Book of Configuration Management (Nov 98).pdf.
    http://www.incose.org/ProductsPubs/pdf/TechMeasurementGuide_2005-1227.pdf

Factor 4.3.3 – Baseline Stability

Pre-Milestone A, Pre-Milestone B, and Pre-Milestone C

Criteria

4.3.3.C1: The Department of Defense (DoD) Components shall develop realistic program schedules, long-range investment plans, and affordability assessments, and shall strive to ensure stable program funding. The Milestone Decision Authority (MDA) shall determine the appropriate point at which to fully fund an acquisition program, generally when a system concept and design have been selected, a program manager (PM) has been assigned, capability needs have been approved, and system-level development is ready to begin. Full funding shall be based on the cost of the most likely system alternative.

4.3.3.C2: The number and specificity of performance parameters may change over time. Early in a program, the Acquisition Program Baseline should reflect broadly defined, operational-level measures of effectiveness or measures of performance to describe needed capabilities. As a program matures, system-level requirements become better defined. The Milestone Decision Authority also may add performance parameters to the Acquisition Program Baseline other than the Joint Requirements Oversight Council (JROC)-validated key performance parameters (KPPs).

4.3.3.C3: The functional baseline should be established at the System Functional Review (SFR) during the Technology Development phase. Competitive prototypes of system or subsystem components should be developed and tested to ensure program requirements are achievable.

4.3.3.C4: The allocated baseline should be established at the Preliminary Design Review (PDR).

4.3.3.C5: The program shall establish an acquisition program baseline (APB) and selected acquisition report (SAR) at PDR.

4.3.3.C6: The technical performance, cost, and schedule baselines shall be established and reported in the SAR using the Earned Value Management System (EVMS). Those programs required to use EVMS shall perform an Integrated Baseline Review (IBR). The program baseline should be stable at program initiation (Milestone B).

4.3.3.C7: The product baseline should be matured and established prior to the Critical Design Review (CDR).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.3.3.Q1: Is the program required to maintain EVMS? Has an IBR been performed? [4.3.3.C6]

4.3.3.Q2: Does the program have a detailed Work Breakdown Structure (WBS) and allocated baseline? [4.3.3.C3, 4, 5]

4.3.3.Q3: As a result of competitive prototyping, is the functional baseline stable or changing relative to the system requirements? [4.3.3.C3]

- How has competitive prototyping matured the functional baseline? Please explain.

4.3.3.Q4: Can the functional baseline be translated into an allocated baseline? [4.3.3.C3, 4]

- Can the allocated baseline be matured to a product baseline at CDR? [4.3.3.C7]

4.3.3.Q5: What stakeholders are/were participants in the IBR planning according to their expertise (include subcontractors)? [4.3.3.C6]

- What is the extent of formal team training for the IBR team participants? [4.3.3.C6]

4.3.3.Q6: How does the IBR process address the need for follow-on IBRs relative to contract modifications or changes? [4.3.3.C6]

4.3.3.Q7: Have re-programming or re-baselining efforts resulted in an over target baseline (OTB)? [4.3.3.C5, 6]

- How effectively did the contractor involve the program management office (PMO) in these actions?
- How many program re-baselines have occurred during the current phase of the program, and at what intervals?
- Was an IBR conducted after each re-baseline and in a timely manner?

4.3.3.Q8: What is the risk level associated with an APB performance, cost or schedule breach? [4.3.3.C5, 6]

Reference

http://www.sei.cmu.edu/programs/acquisition-support/publications/dod-riskguide.pdf

SUB-AREA 4.4 – ENGINEERING TOOLS

Description: A solid engineering approach employs the availability and proper use of engineering tools. These tools augment a well-documented technical approach by increasing the effectiveness and efficiency of the process. Limitations in funding and schedule drive the use of engineering tools to develop technologies into concepts and furthermore test concepts to determine the most appropriate and feasible set of solutions to the engineering problem.

Uses of engineering tools include, but are not limited to, the following:
- Refining operational concepts to extract system requirements
- Testing technical concepts against system requirements using modeling and simulation
- Extracting lower-level technical requirements based on simulation of operations
- Selecting the optimum solution for prototyping and development
- Developing and testing the software solutions for system operations
- Updating developmental models based on hardware test results
- Determining risk, life cycle (support, obsolescence, technology refresh, etc.) and training factors
- Determining the producibility of the system and its effect on performance
- Assessing system performance with and against other systems in operation or under development

Engineering tools may run the gamut of analytical models developed and manipulated by design engineers at their workstations to full motion simulators requiring trained operators and complex facilities. While it may not be feasible to evaluate completely the use of the former, it is important to determine and understand the level of engineering tools available to the developers and evaluators not only at the contractor's facilities, but at the government laboratories and test activities as well.

The types of engineering tools may include, but are not limited to, the following:
- Analytical models of varying complexity and uniformity to include computer-aided design
- Modeling and simulation facilities using emulated systems, to include systems integration laboratories (SILs)
- Software development tools to include hardware emulation and verification, validation and accreditation (VV&A)
- System level tools for design and life cycle support requirements

Specific tools may include, but are not limited to, the following:
- Requirements management

- DOORS
- RTM
- RequisitePro
- Diagramming
  - Visio
  - Microsoft PowerPoint
  - Requirements Driven Design (RDD)
- Analysis
  - Matlab
  - Mathview
- Computer-Aided Design
  - Unified Modeling Language (UML) (Rational, CoolJex, Rhapsody, etc.)
  - Solid Modeling (Catia, SolidWorks, etc.)
- Database/spreadsheet
  - Excel
  - Access

Scope: This assessment includes not only the types of system and software engineering tools available to the contractor and government, but also the use of these tools in the acquisition and employment of the total system. Focus on more than the number and sophistication of the tools used to evaluate the design of the system. Include the manner and uniformity of usage. Determine what products are being used from the tools and at what level of the program. Address the use of engineering tools in validating the requirements in operational scenarios, identifying and managing risks throughout the design process and verifying the design against requirements prior to and concurrent with hardware testing.

Perspective: The government has system engineering tools that define and manage requirements changes and real-time access to contractor's engineering development activities. The government will have access to either SWILs or other contractor tools or have a compatible facility for test planning and system of systems integration. The government program management office (PMO) will have only the tools that are required to track the technical progress on the program.

The contractor has in-depth knowledge and experience in working with system and software engineering and modeling and simulation tools. The contractor will possess the engineering development tools primarily directed at design and verification. The contractor will track requirements at the system level and decompose them to subsystem and component levels.

Factor 4.4.1 – Systems and Software Engineering (SSE) Tools

Pre-Milestone A

Criteria

4.4.1.C1: Dynamic requirements are carefully managed and traced both up to the operational capabilities and down to product design and execution.

4.4.1.C2: Systems engineering and program management tools such as Project, Outlook, and Excel are integrated with other systems engineering (SE) tools, rather than being stovepipe activities under a single umbrella.

4.4.1.C3: Baseline requirements and changes to requirements (changing operational capabilities, delayed technology, threat updates, etc.) are captured and system impacts are readily discernable through the use of relational databases that update models. Modeled system performance effects are traceable to requirements using engineering tools.

4.4.1.C4: Engineering analysis and designs are supported by appropriate diagramming and design tools.

4.4.1.C5: Engineering design is supported by the use of automated tools such as computer-aided design (CAD), Unified Modeling Language (UML), and modeling, simulation and analysis.

4.4.1.C6: Design analysis is conducted at the lowest level possible and as early as possible to avoid costly discoveries during later test and evaluation. Look for commonly used analysis tools such as CAD, analysis, simulation, database/spreadsheet, and UML among others.

4.4.1.C7: Test strategies and test design begin with a matrix identifying the verification method to be used for each requirement and design element identified in the SE process. It is essential that the verification matrix be linked to the requirement management and design tools.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.4.1.Q1: What SE tool(s) are used to capture and manage requirements? Provide a sample of the output of that tool. [4.4.1.C1]

4.4.1.Q2: How does the requirements management tool support requirements flow-down? Does the tool support capture of allocation rationale, accountability, test/validation, criticality, issues, and other factors? [4.4.1.C1]

4.4.1.Q3: How does the requirements management tool support traceability analysis? [4.4.1.C1]

4.4.1.Q4: What linkages exist between the management tool(s) and other SE tools used to support project management planning and execution? [4.4.1.C2]

4.4.1.Q5: How does the requirements management tool interface with performance models to determine the effects of changing requirements on system performance? [4.4.1.C3]

4.4.1.Q6: What tool(s) are used to capture system element structure? How does the tool graphically and textually capture system element structure? [4.4.1.C4]

4.4.1.Q7: What are the automated design tools used on the program? How are interfaces managed when different tools are used for different systems elements? Do the tools support multiple system views? [4.4.1.C5]

4.4.1.Q8: What tools and techniques are used for early verification of designs and interfaces at the part, component or module level? What tools are used to ensure designs at lower levels meet standards referenced at the requirements definition level? [4.4.1.C6]

4.4.1.Q9: Do tools used to trace requirements to test/verification events also perform the reverse function of tracing test/verification events back to the related requirements? [4.4.1.C7]

Pre-Milestone B and Pre-Milestone C

Criteria

4.4.1.C8: Dynamic requirements are carefully managed and traced both up to the operational capabilities and down to product design and execution.

4.4.1.C9: Systems engineering and program management tools such as Project, Outlook, and Excel are integrated with other SE tools, rather than being stovepipe activities under a single umbrella.

4.4.1.C10: Baseline requirements and changes to requirements (changing operational capabilities, delayed technology, threat updates, etc.) are captured and system impacts are readily discernable through the use of relational databases that update models. Modeled system performance effects are traceable to requirements using engineering tools.

4.4.1.C11: Systems engineering analysis and system designs should be supported by appropriate diagramming tools and design tools.

4.4.1.C12: Engineering design is supported by the use of automated tools such as computer-aided design (CAD), UML, and modeling, simulation and analysis.

4.4.1.C13: Design analysis is conducted at the lowest level possible and as early as possible to avoid costly discoveries during later test and evaluation. Look for commonly used analysis tools such as CAD, analysis, simulation, database/spreadsheet, and UML among others.

4.4.1.C14: Test strategies and test design begin with a matrix identifying the verification method to be used for each requirement and design element identified in the SE process. It is essential that the verification matrix be linked to the requirement management and design tools.

4.4.1.C15: Life cycle performance and support issues are included in engineering models to assess the effects on these issues by design attributes.

4.4.1.C16: Engineering tools are controlled centrally to ensure compatibility and configuration control. Data can be freely shared between system designers and decision makers at both the contractor and subcontractor levels.

4.4.1C17: System assurance is supported by the use of automated tools. Commonly used tools include intrusion detection and availability control. In general, guidelines such as the National Institute of Standards and Technology's Software Assurance Metrics and Tools Evaluation should be used to evaluate the contractor's methods.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.4.1.Q10: What systems engineering tool(s) are used to capture and manage requirements? Provide a sample of the output of that tool. [4.4.1.C8]

4.4.1.Q11: How does the requirements management tool support requirements flow-down? Does the tool support capture of allocation rationale, accountability, test/validation, criticality, issues, and other factors? [4.4.1.C8]

4.4.1.Q12: How does the requirements tool support traceability analysis? [4.4.1.C8]

4.4.1.Q13: What linkages exist between the management tool(s) and other SE tools used to support project management planning and execution? [4.4.1.C9]

4.4.1.Q14: What tool(s) are used to capture system element structure?

- How does the tool graphically and textually capture system element structure?
- What tools are used to create and maintain the software architecture?
- What problems have occurred using those tools and how were they overcome? [4.4.1.C10 and 11]

4.4.1.Q15: What are the automated design tools used on the program? How are interfaces managed when different tools are used for different systems elements? Do the tools support multiple system views? [4.4.1.C12]

4.4.1.Q16: What tools and techniques are used for verification of designs and interfaces at the part, component or module level? What tools are used to ensure designs at lower levels meet standards referenced at the requirements definition level? [4.4.1.C13]

4.4.1.Q17: Do tools used to trace requirements to test/verification events also perform the reverse function of tracing test/verification events back to the related requirements? [4.4.1.C14]

4.4.1.Q18: What tools exist to evaluate life cycle performance and support issues? How are these tools linked to design tools to evaluate design effects on life cycle? [4.4.1.C15]

4.4.1.Q19: How are engineering tools managed?

- What is the authority for configuration control of these tools?
- Are engineering tools specified in contracts and subcontracts? [4.4.1.C16]

4.4.1.Q20: What tools are used to develop and ensure system assurance requirements are met? [4.4.1.C17]

References

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Defense Acquisition Guidebook (DAG). Section 4.3, "Systems Engineering in System Life Cycle." Defense Acquisition University, https://akss.dau.mil/dag/.

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NASA Systems Engineering Handbook, SP610S, June 1995.

Naval Systems Engineering Guide. Department of the Navy, October 2004.

Factor 4.4.2 – Modeling and Simulation (M&S) Tools

Pre-Milestone A

Criteria

4.4.2.C1: The program has a documented modeling and simulation (M&S) approach for design and analysis, which covers its purpose and use. All assumptions and weaknesses inherent in the program's M&S activities are made apparent to decision makers. This approach is cross-referenced in the Test and Evaluation Master Plan (TEMP) and Systems Engineering Plan (SEP).

4.4.2.C2: The program makes logical decisions regarding the use of commercial and Department of Defense (DoD) standards that apply to M&S, including modeling notations, data exchange standards and simulation networking standards.

4.4.2.C3: The program uses M&S during the Concept Refinement and Technology Development phases to:

- Perform trade studies by comparing performance, cost, and life cycle issues
- Examine supportability and life cycle implications
- Evaluate reliability, availability, maintainability, transportability, provisioning, total ownership costs and human-machine interface issues
- Identify and assess the system's performance in its intended operating environment – both physical (mechanical and electromagnetic) and operational (information exchange, threat, etc.) environments
- Perform timely assessments of the system's design progress towards meeting requirements

4.4.2.C4: To the extent practicable, simulation modules are integrated, and hardware-in-the-loop is planned for the integration and test facilities to ensure high fidelity results.

4.4.2.C5: The program has a plan to acquire domain knowledge for each M&S objective-scenario set. This domain knowledge includes the entities, attributes and interactions that have significant bearing on the objective at the level of resolution and fidelity required for the effort.

4.4.2.C6: Life cycle simulations are used to derive reliability criteria, material needs, optimized support work and logistical arrangements.

4.4.2.C7: Government and contractor use common M&S tools to support both development and test and evaluation. Simulations used to evaluate program performance as part of the test and evaluation process are verified independently from contractor simulations and undergo the same level of verification, validation, and accreditation (VV&A).

4.4.2.C8: The program has a comprehensive information-sharing capability to ensure all program activities, including engineering design and M&S, are operating from a logically consistent understanding of the system and its operating environment. Appropriate data interchange standards are established. Information about data, metadata, is provided to allow consumers to understand valid uses of the data.

4.4.2.C9: Each of the M&S tool alternatives is assessed for strengths and shortfalls. Considerations include the tool's satisfaction of the program's M&S requirements and constraints; its VV&A history; the availability of trustworthy data to initialize/configure the tool(s); and the cost, schedule and risks of renting, procuring, modifying or developing each tool.

4.4.2.C10: Simulations are interfaced with other system simulations to help demonstrate interoperability. Real time simulations exist to evaluate performance of dynamically interfaced systems and hardware-in-the-loop.

4.4.2.C11: The M&S tools and products are based on Modular Open Systems Approach (MOSA) design principles to easily integrate different hardware and software products. All subsystems are pre-certified to avoid integration issues.

4.4.2.C12: In defining its M&S activities, the program considers constraints such as schedule, allowable response time, run speed, security classification and restrictions, staff limitations, funding limitations, available computing platforms and networks, applicable policies, etc.

4.4.2.C13: The M&S support strategy is documented in a plan, which encompasses the Technology Development Strategy (TDS).

4.4.2.C14: The program follows systems and software engineering best practices for M&S tool development projects, with VV&A an inherent quality assurance activity. The program has a policy regarding the VV&A of all other M&S uses. All VV&A investments are optimized to address the greatest risks.

4.4.2.C15: The program identifies any existing M&S tools that could meet the M&S requirements and constraints. Potential commercial sources are examined and a search of potential DoD sources is conducted via the DoD M&S Resource Registry (MSRR) system and coordination with

other programs with similar M&S needs. The possibility of satisfying its M&S needs by federating a set of simulations is considered.

4.4.2.C16: The M&S support strategy leverages expertise from other government and industry sources to assist in support planning and training.

4.4.2.C17: The M&S efforts include use of common standards to allow models developed for component or system development to be easily integrated into more complex systems-of-systems simulations.

4.4.2.C18: The program specifies thoroughly in contracts its M&S requirements and constraints, including standards, government rights to the M&S tool and its data, etc.

Focus Questions
[Pertinent criteria numbers follow each question.]

4.4.2.Q1: Does the M&S development plan address the design and analysis with enough detail to determine its schedule, budget and expected level of results for all phases of the program? Is this plan referenced in other program documents such as the TEMP and SEP? [4.4.2.C1]

4.4.2.Q2: How are assumptions and weaknesses inherent to the M&S activities stated? [4.4.2.C1]

4.4.2.Q3: What are the commercial and DoD standards that apply to M&S, including modeling notations, data exchange standards and simulation networking standards? [4.4.2.C2]

4.4.2.Q4: What are the uses, details, and functionality of the M&S on the program? [4.4.2.C3]

4.4.2.Q5: How are the system's operating environments documented? Are there planning scenarios, threat analyses, baselines and reference missions? [4.4.2.C3]

4.4.2.Q6: Are M&S assessments of design merits accomplished in a timely manner? [4.4.2.C3]

4.4.2.Q7: To what extent will the hardware-in-the-loop testing be incorporated in the planned simulations? [4.4.2.C4]

4.4.2.Q8: Does the program have a plan to acquire domain knowledge for each of its intended M&S uses? Does this domain knowledge include a list of entities, attributes and interactions that will be represented to achieve the M&S objectives? Is the necessary level of fidelity and resolution provided? [4.4.2.C5]

4.4.2.Q9: Does the M&S support strategy address M&S requirements across the entire life cycle to include support? [4.4.2.C6]

4.4.2.Q10: How does the contractor development team provide connectivity and compatibility in the use and sharing of development tools, modeling and test results to benefit an integrated design approach? [4.4.2.C7]

4.4.2.Q11: Describe how M&S used during Technology Development (TD) will be validated. [4.4.2.C7]

4.4.2.Q12: What is the program's information-sharing capability that ensures all of its development activities are operating with a consistent understanding of the system and its operating

environment? What are the established data interchange standards? What is the metadata being provided? [4.4.2.C8]

4.4.2.Q13: Does M&S planning include data management, such as a common data repository or archive? [4.4.2.C8]

4.4.2.Q14: What are the strengths and weaknesses for each of the M&S tools selected? What were the overriding criteria for this selection? [4.4.2.C9]

4.4.2.Q15: What is the plan to demonstrate system interoperability? [4.4.2.C10]

4.4.2.Q16: How are M&S tools designed to be MOSA-compliant? [4.4.2.C11]

4.4.2.Q17: What evidence does the program present that it considers constraints such as schedule, allowable response time, run speed, security classification and restrictions, staff limitations, funding limitations, available computing platforms and networks, applicable policies, etc? [4.4.2.C12]

4.4.2.Q18: Has an M&S support plan aligned with the Acquisition Strategy been developed for the program? Does the support strategy address both government and contractor M&S? [4.4.2.C13]

4.4.2.Q19: Does the M&S support strategy address system of systems requirements and how M&S will enable those processes? [4.4.2.C13]

4.4.2.Q20: Does the program follow systems and software engineering best practices for M&S tool development projects? [4.4.2.C14]

4.4.2.Q21: . Do all M&S uses undergo documented VV&A by the government? [4.4.2.C14]

4.4.2.Q22: Is there a risk-based VV&A process for establishing the credibility of M&S use? [4.4.2.C14]

4.4.2.Q23: How did the program decide which M&S tools to employ? [4.4.2.C15]

4.4.2.Q24: Does the M&S support strategy use processes and lessons learned from other government and industry programs in its support planning? [4.4.2.C16]

4.4.2.Q25: Does M&S planning call for common standards, such as HLA? [4.4.2.C17]

4.4.2.Q26: Has the program contracted for M&S by thoroughly specifying its requirements and constraints, including standards, government rights to the M&S tools and its data, etc.? [4.4.2.C18]

Pre-Milestone B and Pre-Milestone C

Criteria

4.4.2.C19: The program has a documented M&S plan with milestones for design and analysis, which covers its purpose and use. All assumptions and weaknesses inherent in the program's M&S activities are made apparent to decision makers. For system of systems/family of systems (SoS/FoS), the plan will describe interoperability and concept of operations (CONOPS) demonstrations. This approach is cross-referenced in the TEMP and SEP.

4.4.2.C20: The program makes logical decisions regarding the use of commercial and DoD standards that apply to M&S, including modeling notations, data exchange standards and simulation networking standards.

4.4.2.C21: The objective of M&S is to design and analyze the system. Simulation modules are integrated, and hardware-in-the-loop is planned for the integration and test facilities to ensure high fidelity results.

4.4.2.C22: The program uses M&S during the System Design and Demonstration (SDD) phase to:

- Perform trade studies by comparing performance, cost, and life cycle issues.
- Define and design system functionality and perform timely assessments of the system's design progress towards meeting requirements (critical technical parameters (CTPs), technical performance measures (TPMs), measures of effectiveness/measures of performance (MOEs/MOPs), and key performance parameters (KPPs)).
- Examine supportability and life cycle implications and design support infrastructure.
- Evaluate reliability, availability, maintainability, transportability, provisioning, total ownership costs and human-machine interface issues.
- Identify and assess the system's performance in its intended operating environment – both physical (mechanical and electromagnetic) and operational (information exchange, threat, etc.) environments.

4.4.2.C23: The program has a plan to acquire domain knowledge for each M&S objective-scenario set. This domain knowledge includes the entities, attributes and interactions that have significant bearing on the objective at the level of resolution and fidelity required for the effort.

4.4.2.C24: . Life cycle simulations are used to derive reliability criteria, material needs, optimized support work, and logistical arrangements.

4.4.2.C25: . Government and contractor use common M&S tools to support both development and test and evaluation. Simulations used to evaluate program performance as part of the test and evaluation process are verified independently from contractor simulations and undergo the same level of VV&A.

4.4.2.C26: Developmental test and evaluation (DT&E), operational test and evaluation (OT&E), live-fire test and evaluation (LFT&E), SoS interoperability testing, information assurance testing, and M&S should be closely integrated and used in an efficient continuum.

4.4.2.C27: The program has a comprehensive information-sharing capability to ensure all program activities, including engineering design and M&S, are operating from a logically consistent understanding of the system and its operating environment. Appropriate data interchange standards are established. Information about data and metadata is provided to allow consumers to understand valid uses of the data.

4.4.2.C28: Each of the M&S tool alternatives is assessed for strengths and shortfalls. Considerations include the tool's satisfaction of the program's M&S requirements and constraints;

its VV&A history; the availability of trustworthy data to initialize/configure the tool(s); and the cost, schedule and risks of renting, procuring, modifying or developing each tool.

4.4.2.C29: Simulations are interfaced with other system simulations to help demonstrate interoperability. Real-time simulations exist to evaluate performance of dynamically interfaced systems and hardware-in-the-loop.

4.4.2.C30: The M&S tools and products are based on MOSA design principles to easily integrate different hardware and software products. All subsystems are pre-certified to avoid integration issues.

4.4.2.C31: In defining its M&S activities, the program considers constraints such as schedule, allowable response time, run speed, security classification and restrictions, staff limitations, funding limitations, available computing platforms and networks, applicable policies, etc.

4.4.2.C32: The Acquisition Strategy encompasses the M&S support strategy and is aligned with the M&S support plan. The M&S support strategy is documented in a plan, which leverages expertise from other government and industry sources to assist in support planning and training. If M&S strategy calls for common use of models and data, the Acquisition Strategy addresses the means to support such use.

4.4.2.C33: The program follows systems and software engineering best practices for M&S tool development projects, with VV&A an inherent quality assurance activity. The program has a policy regarding the VV&A of all other M&S uses. All VV&A investments are optimized to address the greatest risks.

4.4.2.C34: The program identifies any existing M&S tools that could meet the M&S requirements and constraints. Potential commercial sources are examined and a search of potential DoD sources is conducted via the DoD MSRR system and coordination with other programs with similar M&S needs. The possibility of satisfying its M&S needs by federating a set of simulations is considered.

4.4.2.C35: The M&S efforts include use of common standards to allow models developed for component or system development to be easily integrated into more complex SoS simulations.

4.4.2.C36: Simulations are used to evaluate design and support options and changes including configuration change evaluations and test readiness reviews.

4.4.2.C37: A structured simulation-based approach is used for failure analyses and/or problem diagnostics based on test sensor output matched to simulation models.

4.4.2.C38: Simulations used beyond the Critical Design Review (CDR) are validated. A formal or structured validation process is managed as a key issue.

4.4.2.C39: The program specifies its M&S requirements and constraints thoroughly, including standards, government rights to the M&S tool and its data, etc.

4.4.2.C40: The program's M&S tools are refined to increase validity based on empirical data collected during DT&E, OT&E, and operational employment. This provides an increased capability

over the system's lifetime, including use by other programs for SoS integration and interoperability assessments.

4.4.2.C41: The program has an approach to using M&S to predict maintenance and repair activities and to provide training.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.4.2.Q27: Does the M&S development plan address the design and analysis with enough detail to determine its schedule, budget and expected level of results for all phases of the program? Is this plan referenced in other program documents like the TEMP and SEP? [4.4.2.C19]

4.4.2.Q28: How are assumptions and weaknesses inherent to the M&S activities stated? [4.4.2.C19]

4.4.2.Q29: What are the commercial and DoD standards that apply to M&S, including modeling notations, data exchange standards and simulation networking standards? [4.4.2.C20]

4.4.2.Q30: To what extent will the hardware-in-the-loop testing be incorporated in the planned simulations? [4.4.2.C21]

4.4.2.Q31: What are the uses, details, and functionality of the M&S on the program? [4.4.2.C22]

4.4.2.Q32: What are the specific uses of M&S during the SDD phase? [4.4.2.C22]

4.4.2.Q33: . How are the system's operating environments documented? Are there planning scenarios, threat analyses, baselines and reference missions? [4.4.2.C22]

4.4.2.Q34: Are M&S assessments of design merits accomplished in a timely manner? [4.4.2.C22]

4.4.2.Q35: Does the program have a plan to acquire domain knowledge for each of its intended M&S uses? Does this domain knowledge include a list of entities, attributes and interactions that will be represented to achieve the M&S objectives? Is the necessary level of fidelity and resolution provided? [4.4.2.C23]

4.4.2.Q36: Does the M&S support strategy address M&S requirements across the entire life cycle to include support? [4.4.2.C24]

4.4.2.Q37: How does the contractor development team provide connectivity and compatibility in the use and sharing of development tools, modeling and test results to benefit an integrated design approach? [4.4.2.C25]

4.4.2.Q38: How are government simulations planned to be used and verified? [4.4.2.C25]

4.4.2.Q39: How will the M&S plan validate models and simulations used during integration and test? [4.4.2.C25]

4.4.2.Q40: How will the program validate the M&S used during SDD? [4.4.2.C25]

4.4.2.Q41: Are M&S uses in DT&E, OT&E, LFT&E, SoS interoperability testing and information assurance testing integrated in an efficient continuum? [4.4.2.C26]

4.4.2.Q42: What is the program's information-sharing capability that ensures all of its development activities are operating with a consistent understanding of the system and its operating environment? What are the established data interchange standards? What is the metadata being provided? [4.4.2.C27]

4.4.2.Q43: Does M&S planning include data management, such as a common data repository or archive? [4.4.2.C27]

4.4.2.Q44: What are the strengths and weaknesses for each of the M&S tools selected? What were the overriding criteria for this selection? [4.4.2.C28]

4.4.2.Q45: What is the plan to demonstrate system interoperability? Is there a plan to demonstrate system interoperability and joint CONOPS during SDD? [4.4.2.C29]

4.4.2.Q46: How are M&S tools designed to be MOSA-compliant? [4.4.2.C30]

4.4.2.Q47: What evidence does the program present that it considers constraints such as schedule, allowable response time, run speed, security classification and restrictions, staff limitations, funding limitations, available computing platforms and networks, applicable policies, etc? [4.4.2.C31]

4.4.2.Q48: Has an M&S support plan aligned with the Acquisition Strategy been developed for the program? Does the support strategy address both government and contractor M&S? [4.4.2.C32]

4.4.2.Q49: Does the M&S support strategy use processes and lessons learned from other government and industry programs in its support planning? [4.4.2.C32]

4.4.2.Q50: Does the program follow systems and software engineering best practices for M&S tool development projects? [4.4.2.C33]

4.4.2.Q51: Do all M&S uses undergo documented VV&A by the government? [4.4.2.C33]

4.4.2.Q52: Is there a risk-based VV&A process for establishing the credibility of M&S use? [4.4.2.C33]

4.4.2.Q53: How did the program decide which M&S tools to employ? [4.4.2.C34]

4.4.2.Q54: Does the M&S support strategy address system of systems requirements and how M&S will enable those processes? [4.4.2.C35]

4.4.2.Q55: Does M&S planning call for common standards, such as HLA? [4.4.2.C35]

4.4.2.Q56: What M&S is used in the design and support planning? [4.4.2.C36]

4.4.2.Q57: Does a structured simulation-based approach exist for failure analysis and/or problem diagnosis based on test sensor output matched to simulation models? [4.4.2.C37]

4.4.2.Q58: What simulations are to be used past the CDR? How are these validated? [4.4.2.C38]

4.4.2.Q59: Has the program contracted for M&S by thoroughly specifying its requirements and constraints, including standards, government rights to the M&S tools and its data, etc.? [4.4.2.C39]

4.4.2.Q60: Are the program's M&S tools being refined by empirical data collected during testing and operational employment? [4.4.2.C40]

4.4.2.Q61: Does the program have an approach to using M&S to predict maintenance and repair activity and to provide training? [4.4.2.C41]

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Naval Systems Engineering Guide. Department of the Navy, October 2004.

Factor 4.4.3 – Producibility and Production Planning Tools

Pre-Milestone A

Criteria

4.4.3.C1: Preliminary producibility analyses, coordinated with manufacturing engineering, are conducted to influence design trades.

4.4.3.C2: Producibility planning tools provide information using cost and schedule constraints and identify the level of technical and schedule risk.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.4.3.Q1: What are the status and current results of preliminary producibility analyses as reflected in the proposed system design? [4.4.3.C1]

4.4.3.Q2: What is the system engineering process pertaining to design trades to address producibility?

- What are the expected engineering activities needed to address producibility issues? [4.4.3.C2]

4.4.3.Q3: What are the risks associated with production? [4.4.3.C2]

Pre-Milestone B

Criteria

4.4.3.C3: Tools are available to perform detailed producibility analyses and trade studies to influence design trades. Results identify requirements for improvements to existing manufacturing processes to meet cost and schedule requirements.

4.4.3.C4: Producibility considerations are included in product design tools. Changes that affect materials, form, fit, or function of the product are reflected through links to design tools.

4.4.3.C5: Tools are available to evaluate producibility enhancement cost and schedule constraints.

4.4.3.C6: Key manufacturing processes and key characteristics are linked through the integration of engineering and production tools.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.4.3.Q4: What tools are used to perform detailed producibility analyses? How are they used to influence design? [4.4.3.C3]

4.4.3.Q5: What are the current results of producibility analyses that are reflected in the proposed system design? [4.4.3.C3]

4.4.3.Q6: What level of producibility considerations are included in the product design tools? How are changes to form, fit, and function reflected in the linkage between design tools and producibility tools? [4.4.3.C4]

4.4.3.Q7: How do producibility tools evaluate the cost and schedule implications of enhancements? [4.4.3.C5]

4.4.3.Q8: How are the key characteristics defined in product design tools linked to key manufacturing processes defined in production tools? [4.4.3.C6]

Pre-Milestone C

Criteria

4.4.3.C7: Analyses were accomplished to improve the producibility of the system through identification of key manufacturing processes, risks, cost, and other factors. The hardware build and test results have confirmed the system's producibility.

4.4.3.C8: The design disclosure is documented in the form of specifications and drawings, and manufacturing work instructions exist to support production. The completion percentage is consistent with the schedule.

4.4.3.C9: Outstanding form, fit, function, and performance critical design issues have been identified and modeled.

4.4.3C10: Manufacturing processes are modeled and are scheduled to be verified through method prototyping. To the maximum extent feasible, proven manufacturing processes are being applied.

4.4.3.C11: Yield rates for initial and ramp-up to production have been estimated using appropriate tools and models.

4.4.3.C12: A complete end-to-end model showing all processes from material lead-time to final inspection is verified and used to determine the critical path. The ability to insert delays and rework

is incorporated in the model.

4.4.3.C13: An integrated manufacturing/engineering team exists that will be used to solve problems on the factory floor during the transition to production and initial production.

4.4.3.C14: The quality assurance (QA) program is integrated with the manufacturing methods and processes tools planned for production. When appropriate, processes such as Lean Six Sigma and Cost of Quality have been implemented to increase efficiency.

4.4.3.C15: The quality toolset provides for the conduct of trend analyses of rework and repair versus total man-hours or other metrics to track product quality during initial and subsequent production.

4.4.3.C16: Delivery schedules and in-factory material movement and workstation and test flow simulations are planned to predict build time and manpower needs and to evaluate the impact of design changes or alterations to facility configuration.

4.4.3.C17: An inventory control system is in place and verified to support production. This system can accommodate transition to production demands and will preclude supply-related schedule issues.

4.4.3.C18: Production methods tools are used to create manufacturing and assembly instructions and are automatically linked to update instructions in the event of methodology changes.

4.4.3.C19: Production tools exist to determine readiness for initial and full-rate production. This will include design stability, verification of production methods, and manufacturing capacity analysis. Engineering Manufacturing Readiness Level (EMRL) ratings are available.

4.4.3.C20: The production plan provides for the conduct of functional and physical configuration audits to establish the product baseline.

4.4.3.C21: A documented process exists and is adequate for the identification, inspection, storage, and control of incoming material, including government-furnished material/government-furnished equipment (GFM/GFE).

4.4.3.C22: A documented process exists for marking, documenting, and controlling defective incoming products and material and work-in-process. A bar coding or other electronic system is used to track all components. QA monitors this process.

4.4.3.C23: A screening program for electronic components will be applied during initial and subsequent production. A detailed list of screened components will indicate which components will be produced with less than mature production processes.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.4.3.Q9: What analyses were performed on system producibility? What are the results of producibility analyses that were performed during system design? What risks were found using the modeling techniques? Are these risks being actively managed? [4.4.3.C7]

4.4.3.Q10: What documentation has been created to provide a detailed description of the hardware and software specifications, engineering drawing package and manufacturing work instructions that will be used to produce the system? Is the documentation completion percentage consistent with the schedule? [4.4.3.C8]

4.4.3.Q11: Have all form, fit, function and performance critical design issues been identified and modeled for incorporation into the final design description package? What is the schedule and technical risk to resolve these issues? [4.4.3.C9]

4.4.3Q12: Have the manufacturing processes been modeled? What is the schedule for their verification? [4.4.3.C10]

4.4.3Q13: What is the level of fidelity in the modeled yield rates for initial and ramp-up to production? Does this meet schedule requirements? [4.4.3.C11]

4.4.3.Q14: Is the modeled manufacturing process complete from material lead-time to final inspection? Is the model realistic to include material and rework delays? [4.4.3.C12]

4.4.3.Q15: What is the process used to address engineering and manufacturing issues during the initial stages leading up to production? Is this model integrated to allow engineering solutions to be evaluated and incorporated rapidly? [4.4.3C13]

4.4.3.Q16: How is the QA methodology integrated with the production tools? What are the results of any Lean Six Sigma and Cost of Quality assessments? [4.4.3C14]

4.4.3.Q17: What metrics are tracked using the quality toolset? How are these metrics used to improve the process? [4.4.3.C15]

4.4.3.Q18: How do the production tools help manage the manufacturing process? How are the different environmental and entry condition inputs modeled? [4.4.3C16]

4.4.3.Q19: Is a verified inventory control system being used to support production? [4.4.3.C17]

4.4.3.Q20: How are the production methods tools linked to build instructions? What verification process evaluates the changes to build instructions derived from the models? [4.4.3.C18]

4.4.3.Q21: What analysis is available that shows production readiness? Does this analysis produce EMRL ratings? [4.4.3.C19]

4.4.3.Q22: Does the production plan include functional and physical configuration audits prior to establishing a baseline? [4.4.3.C20]

4.4.3.Q23: What is the process for identifying, inspecting, storing, and controlling incoming material, including GFM/GFE? [4.4.3.C21]

4.4.3.Q24: Does a documented process exist that handles all defective material? Is this material tracked using bar codes or some other electronic means? Does QA monitor this process? [4.4.3.C22]

4.4.3.Q25: Is there a screening program for electronic components, which are not mature in the production process? [4.4.3.C23]

References

Aeronautical Systems Center Systems Engineering Guide (Draft), May 2005.

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  Defense Acquisition University,

DoD Directive 5000.59, "DoD Modeling and Simulation Management," August 8, 2007.

DoD Instruction 5000.61, "DoD Modeling and Simulation Verification, Validation, and
  Accreditation," May 13, 2003.

EIA-731, "Systems Engineering Capability Maturity Model."

NASA Systems Engineering Handbook, SP610S, June 1995.

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SUB-AREA 4.5 – SOFTWARE

Description: The percent of functionality provided by software in Department of Defense (DoD) systems has increased over time. As a result, there is an increase in the number of projects that have difficulty completing on time and within budget. The program should manage the software using the Software Development Plan (SDP). Similar to the Systems Engineering Plan, the SDP should be a living document that is updated as needed throughout the program. Estimation should be used by the program to define the initial scope of the effort, and should be used on an ongoing basis to ensure the program is on track as knowledge about the program increases over time. A quality Software Development Plan being used to manage the program and ongoing use of estimation contribute to the successful start and continuing success of a software program.

Scope: This sub-area involves the assessment of key factors that actively contribute to the manner of the analysis and procedures in which the Software Development Plan and software estimation are used to start and guide a program.

Perspective: Ensuring the quality of the implementation and use of the Software Development Plan, the software estimation process, and the use of software estimation to guide the program contribute to a solid foundation for the success of a software program.

Factor 4.5.1 – Software Development Plan

Pre-Milestone A

Criteria
4.5.1.C1: Alignment and connection between the program office and contractor(s) is initiated with program office software processes that will integrate with the contractor at the proper time. If

contractor connections are required prior to Milestone A (e.g., for prototyping or risk reduction), these are initiated and operational.

4.5.1.C2: The software development effort is monitored and tracked at a distinct Work Breakdown Structure (WBS) level, in parallel with hardware. Monitoring of the effort is accomplished within a systems engineering Integrated Process/Process Team (IPT) or an equivalent working group, under the cognizance of the chief engineer. Maturity of the developed software is monitored and reported.

4.5.1.C3: Externally visible properties of the system, manifested in software and hardware, have resulted in requirements and architecture artifacts initially documented in the Concept Definition and preliminary integrated architecture. These are aligned between the program office and contractor.

4.5.1.C4: Software coding and unit test follow a specific process that is described in the Software Development Plan (SDP). This process includes reviews, methods, and tools.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.5.1.Q1: Demonstrate how alignment and connection between the program office and contractors will occur in software, or if needed prior to Milestone A, has occurred, using contractual terms, program processes, memoranda of understanding, and other tools. [4.5.1.C1]

4.5.1.Q2: Has the Software Development Plan (SDP) been updated to support the Technology Development (TD) effort and currently under formal configuration control? Has the updated version been flowed down to the supplier base, and have SDPs from subcontractors been received by the prime? [4.5.1.C2]

4.5.1.Q3: How is the software effort conceptually integrated with the main program, in the Concept Definition and associated artifacts (e.g., preliminary integrated architecture)? [4.5.1.C2]

4.5.1.Q4: Walk through the architecture of the system as known now, and demonstrate alignment between program office and contractor views. Focus on requirements traceability, from initial specification of capabilities to high-level requirements and preliminary architecture. [4.5.1.C3]

4.5.1.Q5: Describe the process to be used during TD to implement the software design in terms of code and unit test. Identify and provide the process description. Describe the methods and tools used to support this process. Describe the reviews involved in code and unit test. Do coding standards address modular development, simplicity, and ease of modifying the software? [4.5.1.C4]

Pre-Milestone B

Criteria

4.5.1.C5: There should be an operational connection between the program office and contractor(s). Information about subcontracts should be articulated and available to the program office. Software

processes should be integrated across the program office and contractor to prevent disconnects in information flow. These include program management, risk management, defect tracking, estimation, and other operational processes.

4.5.1.C6: The software development effort is monitored and tracked at a distinct WBS level, in parallel with hardware. Monitoring of the effort is accomplished within a systems engineering (SE) IPT or an equivalent working group, under the cognizance of the chief engineer. Maturity of the developed software is monitored and reported.

4.5.1.C7: Reuse of software, from existing systems or prior development efforts, has been analyzed for complexity and suitability to meet required functionality, in accordance with accepted software engineering standards.

4.5.1.C8: Externally visible properties of the system, manifested in software and hardware, have resulted in requirements and architecture artifacts that have been carried forward from Milestone A and resulted in plans and technical data that are driving requirements refinement, design, and test development. These plans and data are aligned between the program office and contractor.

4.5.1.C9: The system integration, test, and verification process is defined in a plan and includes analysis, reviews, inspections, demonstration, testing, and modeling and simulation to validate the requirements baseline and ensure that system work products meet their requirements. The process includes an iterative verification that allocated specifications are met by lower-level components, assemblies, and subsystems and then at the system level. Requirements are traceable to specific test/verification events.

4.5.1.C10: Developmental testing should be defined and executed as early as possible, to progressively demonstrate performance against allocated and derived specifications in as realistic an environment as possible. Software coding and unit testing, and successive levels of software testing follow a specific process that should be well documented in a Software Development Plan. A standard procedure for tracking and managing software defects is established.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.5.1.Q6: Demonstrate how software plans and metrics between the program office and contractor(s) are sufficiently comparable, necessarily compatible, and mutually drive the program. [4.5.1.C5]

4.5.1.Q7: How is the software effort integration with the main program, documented in the Systems Engineering Plan (SEP) and Systems Engineering Master Plan (SEMP), and reflected operationally in IPTs, the WBS, risk management, and program processes? [4.5.1.C6]

4.5.1.Q8: Does the Software Development Plan provide for early demonstrations (prior to the Preliminary Design Review (PDR)) of software reuse candidates on system simulations? [4.5.1.C7]

4.5.1.Q9: Walk through the architecture and design of the system as known now, and demonstrate alignment between program office and contractor views. Focus particularly on requirements development and traceability, identifying artifacts and processes that demonstrate ongoing alignment among the program office and contractor, as requirements evolve from externally visible (architecture) properties to internally visible (design) properties. [4.5.1.C8]

4.5.1.Q10: Describe the integration and test process from lower-level components up through system level integration and test. Provide an overview of the integration and test process described in the integration and test plan. How are requirements traced to specific test/verification events? Is the Software Development Plan (SDP) complete and under configuration management? [4.5.1.C9 and 4.5.1.C10]

Pre-Milestone C

Criteria

4.5.1.C11: Software process integration has facilitated timely and efficient program integration. Information flow has not been impeded, and risks traceable to information flow have been perceived and mitigated in a timely fashion. There has been agreement on software metrics and plans between the program office and contractor.

4.5.1.C12: The linkage between software and hardware, manifested in close collaboration in program IPTs, has resulted in a well-integrated system

4.5.1.C13: Software key events and metrics are identified and justified by the contractor to the program office, and tracked in the program master schedule, program critical path, and lower level software development schedules linked to the master schedule.

4.5.1.C14: Software engineering activities are implemented following the SDP. Software engineering and hardware engineering are closely coupled early in the process, and viewed as an integrated engineering activity applied to the system development effort for management purposes.

4.5.1.C15: There has been consistent and continual flow from capabilities, requirements, architecture, design, and test, to the integrated system. Feedback causes refinement of each of these in order to ensure all stakeholders involved with a given aspect or factor of a system have been brought together at the right time. Test development has proceeded into test execution based on rational understanding of each of these, from capabilities through integration. Requirements traceability culminates in verification and validation of the system as needed by the user.

4.5.1.C16: Software code and unit test follow a specific process that is described in the SDP. This process includes reviews, and accepted methods, and tools.

4.5.1.C17: Reuse of software, from existing systems or prior development efforts, has been analyzed for complexity and suitability to meet required functionality, in accordance with accepted

software engineering standards. Pre-Milestone C, this analysis has resulted in documented re-use in line with plans.

4.5.1.C18: The software development has followed a disciplined process documented in the program SDP and related plans. This process includes reviews, design, implementation and integration and test. Reviews have proceeded based on documented entrance and exit criteria and results are captured in minutes and updates to plans, artifacts, design, and code. Tools and facilities exist and are used to execute the software development and verification (testing). The current status of software completion verification testing is consistent with the verification test schedule.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.5.1.Q11: Demonstrate how software plans and metrics between the program office and contractor(s) were sufficiently comparable, necessarily compatible, and mutually drove the program. [4.5.1.C11]

4.5.1.Q12: Demonstrate how program risks and issues involving software and hardware were mitigated and/or resolved, including information from the risk database, problem tracking systems, IPT minutes, etc. [4.5.1.C12]

4.5.1.Q13: Has the Software Development Plan (SDP) been updated to support the SDD effort and currently under formal configuration control? Has the updated version been flowed down to the supplier base, and have updated SDPs from subcontractors been received by the prime? [4.5.1.C13]

4.5.1.Q14: Describe how the software engineering management function is integrated with the SE function. [4.5.1.C14]

4.5.1.Q15: Demonstrate how requirements traceability has culminated in successful T&E and V&V of the system. Show how disconnects in the interpretation of requirements were perceived and resolved. Demonstrate connection between capabilities, requirements, architecture, design, test, and the integrated system. [4.5.1.C15]

4.5.1.Q16: Describe the process used to implement the software design in terms of code and unit test. Identify and provide the process description. Describe the methods and tools used to support this process. Describe the reviews involved in code and unit test. [4.5.1.C16]

4.5.1.Q17: Does the Software Development Plan provide for early demonstrations (prior to PDR) of software reuse candidates on system simulations? Has reuse been demonstrated through SDD, and if reduced over plan, adequately explained? [4.5.1.C17]

4.5.1.Q18: Describe the process used to implement and verify the software design, including the methods and tools, testing, and facilities used to support this process. Include a description of the

reviews involved in the software coding and unit testing interface testing, and interoperability testing. [4.5.1.C18]

4.5.1.Q19 How will software defects be tracked and managed? Describe the process for assigning defect corrections to specific releases and for establishing retest criteria. Have measures of effectiveness been established for software? What is the current status of software verification testing? How does the percent complete compare with the verification test schedule? Show historical and current defect profile, including defect severity and aging. Discuss defect recidivism/fix effectiveness. [4.5.1.C18]

References

Defense Acquisition Guidebook (DAG). Section 4.4.4, "Listing of Software Systems Development Best Practices." Defense Acquisition University, https://akss.dau.mil/dag/.

Software Technology Support Center, Hill Air Force Base. http://www.stsc.hill.af.mil/resources/tech_docs/gsam4.html.

Factor 4.5.2 – Estimation

Pre-Milestone A

Criteria

4.5.2.C1: The program office should be knowledgeable about the cost and schedule estimating process employed. The estimation process should be planned and include the selection of appropriate techniques based on program characteristics, mapping the techniques to program activities, an estimation procedure for generating an estimate, evaluation of the estimate with respect to the quality of the input data, assumptions, and reporting requirements.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.5.2.Q1: How will cost, schedule, and performance be estimated and modeled across the program, including hardware, software, and other elements? How will the program integrate the cost, schedule, and performance estimates, and resulting program plans to ensure an overall feasible program strategy? [4.5.2.C1]

4.5.2.Q2: What estimation tools and methodologies will be used, including industry parametric tools (COCOMO, SEER-SEM, SLIM, etc.) and other techniques (e.g., analogy, cost-estimation relationships, bottom-up)? [4.5.2.C1]

- Describe the sizing methodology used (e.g., source lines of code, feature points, function points)
- Describe the assumptions regarding project unknowns (i.e., program cost drivers)

4.5.2.Q3: How will the various program estimates be vetted? How similar/different are the program's cost and schedule estimates and associated assumptions to other estimates (e.g. the Cost Analysis and Information Group's (CAIG) independent cost estimate (ICE))? How are the differences between all of the estimates associated with the program (program cost estimates, program technical estimates (e.g., software), Cost and Software Data Reporting/Software Resources Data Report (CSDR/SRDR), ICE, etc.) going to be reconciled? [4.5.2.C1]

4.5.2.Q4: As the initial estimates mature over the program life cycle how will estimate refinements/changes be managed? How will discrepancies between the program plan and refined estimates be reconciled? [4.5.2.C1]

4.5.2.Q5: Describe how the estimation process will result in a high confidence, low/moderate risk software contribution to program baselines. [4.5.2.C1]

4.5.2.Q6: Describe how the re-estimation will be handled? [4.5.2.C1]

Pre-Milestone B

Criteria

4.5.2.C2: The program office should be knowledgeable about cost and schedule estimating process employed both internal to the program office and contractor organizations. The estimation process should be planned and include the selection of appropriate techniques based on program characteristics, mapping the techniques to program activities, an estimation procedure for generating an estimate, evaluation of the estimate with respect to the quality of the input data, assumptions, and reporting requirements.

4.5.2.C3: The program office and contractor should follow the reporting requirements of DoD 500.04-M-1 policy. This includes submission of the CSDR Plan (Form DD 2794), the Contractor Cost Data Report (CCDR), and the SRDR (for more information on the DoD 5000.04-M-1 policy, see http://dcarc.pae.osd.mil/Policy/CSDR/csdrReporting.aspx).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.5.2.Q7: How will the impacts on cost, schedule, and performance be estimated and modeled across the program, including hardware, software, and other elements? [4.5.2.C2]

4.5.2.Q8: What estimation tools and methodologies were generated by the contractor in their proposal and by the program office in the Technology Development (TD) phase, including industry parametric tools (COCOMO, SEER-SEM, SLIM, etc.) and other techniques (e.g., analogy, cost-estimation relationships, bottom-up)? [4.5.2.C2]

- Describe the sizing methodology (e.g., source lines of code, feature points, function points).
- Describe the assumptions made regarding project unknowns (i.e., program cost drivers).

- Identify and describe third-party estimates (i.e., Cost Analysis Improvement Group (CAIG)-generated independent cost estimates (ICE)).

4.5.2.Q9: Is the program's CSDR information (Form DD 2794) complete? If applicable, does it fulfill the reporting requirements outlined for CCDR and SRDR? What is the status of Defense Cost and Resource Center (DCARC) acceptance of the program's submissions? [4.5.2.C3]

4.5.2.Q10: How are the various program estimates vetted? How similar/different are the program's cost and schedule estimates and associated assumptions to other estimates (e.g., CAIG ICE)? How will the differences among the estimates (program cost estimates, program technical estimates (e.g., software), CSDR/SRDR, ICE, etc.) be reconciled? [4.5.2.C2]

4.5.2.Q11: As the initial estimates mature over the program life cycle how will the prime and subcontractor communicate estimate refinements/changes? How will discrepancies between the program plan and refined estimates be reconciled? [4.5.2.C2]

4.5.2.Q12: Describe how the estimation process and resulting estimates will be used during System Development and Demonstration (SDD) phase to manage program risk? [4.5.2.C2]

4.5.2.Q13: How will the contractor's proposed software development approach be consistent with a high confidence, low risk approach? [4.5.2.C2]

4.5.2.Q14: Describe how estimates will be generated if the program needs to re-baseline? What tools will be used? How will the original estimation process be modified? How will program performance data be integrated into the estimation process? [4.5.2.C2]

Pre-Milestone C

Criteria

4.5.2.C4: The program office's cost and schedule estimates and reporting should have demonstrated alignment with program cost and schedule performance metrics.

4.5.2.C5: The program office and contractor should follow the reporting requirements of DoD 500.04-M-1 policy. This includes submission of the Cost and Software Data Reporting (CSDR) Plan (Form DD 2794), the Contractor Cost Data Report (CCDR), and the Software Resources and Data Report (SRDR) (for more information on the DoD 5000.04-M-1 policy go to: http://dcarc.pae.osd.mil/Policy/CSDR/csdrReporting.aspx).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.5.2Q.15: How were the impacts on cost, schedule, and performance estimated and modeled across the program, including hardware, software, and other elements? [4.5.2.C4]

4.5.2Q.16: What estimation tools and methodologies were used by both the contractor and program office, including industry parametric tools (COCOMO, SEER-SEM, SLIM, etc.) and other techniques (e.g., analogy, cost-estimation relationships, bottom-up)? [4.5.2.C4]

- Describe the assumptions used to estimate the system software effort and schedule, and their evolution over time.
- Describe how the software sizing measure changed from Milestone A, to Milestone B, to Milestone C (e.g., source lines of code, feature points, function points).
- Describe how well the assumptions in the original estimate reflected reality (i.e., program cost drivers).

4.5.2.Q17: Have the program provide its CSDR (DD 2794) information, including updated and final SRDR (DD 2630). It is possible that the program may have provided only initial and final DD-2630s, or several through the life of the program. [4.5.2.C5]

4.5.2.Q18: How were the various program estimates vetted? How similar/different were the program's cost and schedule estimates and associated assumptions to other estimates (e.g. the Cost Analysis and Information Group's (CAIG) independent cost estimate (ICE))? How were the differences between all of the estimates associated with the program (program cost estimates, program technical estimates (e.g., software), CSDR/SRDR, ICE, etc.) reconciled? [4.5.2.C4]

4.5.2.Q19: As the initial estimates matured over the program life cycle how did the prime and subcontractor communicate estimate refinements/changes? How were discrepancies between the program plan and refined estimates reconciled? [4.5.2.C4]

References

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USC Center for Software Engineering website, COCOMO Estimation Suite: http://sunset.usc.edu/research/cocomosuite/index.html

SUB-AREA 4.6 – DESIGN VERIFICATION

Description: Design verification is achieved through integrated test and evaluation (T&E), modeling and simulation (M&S), and T&E reporting during all phases of the program. Test and evaluation reports provide the program manager (PM) with measured data against documented metrics to verify overall system design performance. These data reports will be used collectively to effectively

manage the program, and to provide decision makers and Congress with the information needed to determine overall operational effectiveness, suitability and survivability of the system.

Scope: The scope of this sub-factor will provide for an assessment of the PM's overall test program as documented in the Test and Evaluation Strategy (TES) and the Test and Evaluation Master Plan (TEMP) to support Milestones A, B, C, and full-rate production (FRP) decisions.

Perspective: Test and evaluation shall be integrated throughout the acquisition process. T&E shall be structured to provide essential information to decision makers, assess attainment of technical performance parameters, and determine whether systems are operationally effective, suitable, survivable, and safe for intended use. The conduct of test and evaluation, integrated with M&S, shall facilitate early learning, assess technology maturity, interoperability, facilitate integration into fielded forces, and confirm performance against documented capability needs and adversary capabilities as described in the system threat assessment report (STAR).

Figure 4-4 shows T&E planning and execution throughout the acquisition process starting from Concept Refinement through Operations and Support. Acquisition phases are separated by key decision points when the Milestone Decision Authority (MDA) reviews the program and authorizes advancement to the next phase. T&E planning and test evaluation reports have a significant role in the MDA review process.
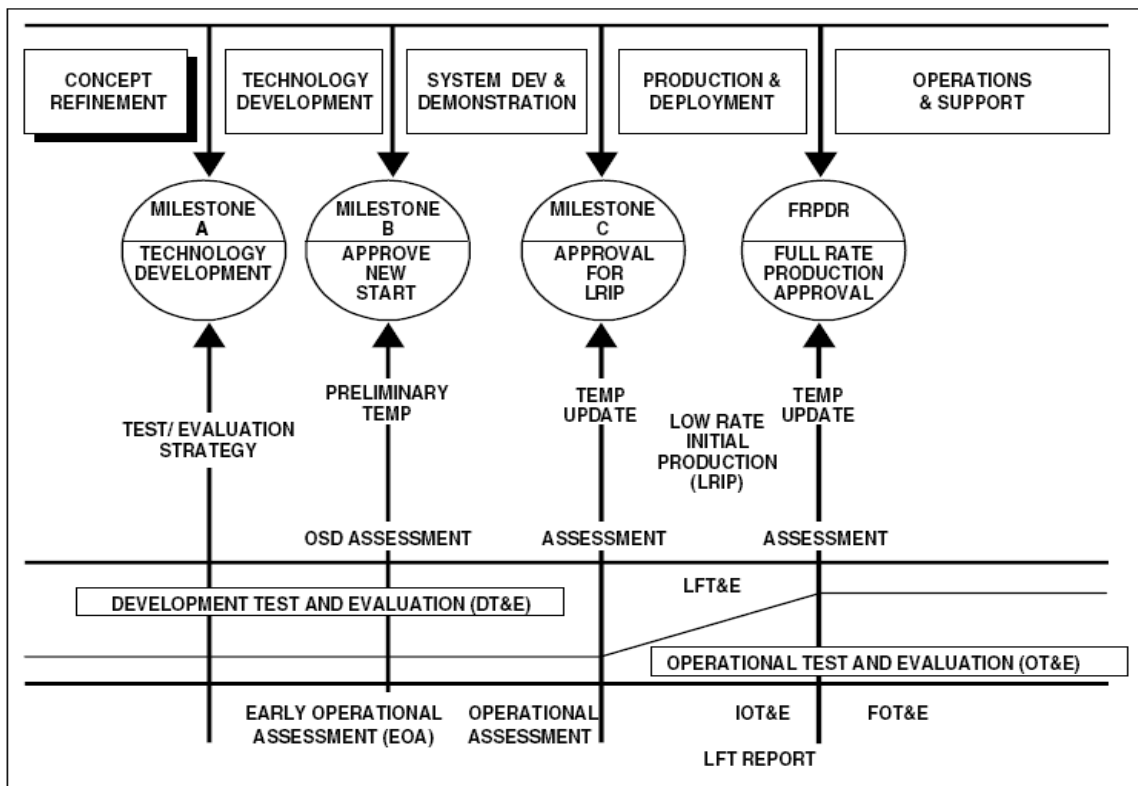
Figure 4-4 Testing and the Acquisition Process

The PM is responsible for all developmental test and evaluation (DT&E), operational test and evaluation (OT&E), and live-fire test and evaluation (LFT&E) planning, scheduling, and execution as documented in the TES and TEMP. However, OT&E must be performed by an independent organization / Command which reports directly to the Service chief. The PM should charter a T&E Working-level Integrated Product Team (T&E WIPT) and in concert with the users and test community develop metrics for hardware and software to use in monitoring program maturity and to support decisions throughout the development cycle. The T&E Strategy should be consistent with the Systems Engineering Plan (SEP). Using the maturing Capabilities Development Document (CDD) as a basis, the T&E WIPT will transform the TES into a more comprehensive plan that is documented in the TEMP. All programs on the Office of the Secretary of Defense (OSD) T&E oversight list will be assessed for technical progress, maturity, risk, and subsequent readiness for Initial Operational Test and Evaluation (IOT&E) prior to FRP.

Factor 4.6.1 – Test and Evaluation Plan

Pre-Milestone A

Criteria
4.6.1.C1: The program manager (PM) shall develop a robust integrated Test and Evaluation Strategy (TES) for all phases of the program, describing developmental test and evaluation (DT&E), operational test and evaluation (OT&E), and live-fire test and evaluation (LFT&E). Without compromising rigor, the program is required to integrate modeling and simulation (M&S) activities into the strategy. The TES should be consistent with and complementary to the Systems Engineering Plan (SEP). The TES should include an event-driven schedule.
4.6.1.C2: The TES should describe all technology development testing required and planned to support the Initial Capabilities Document (ICD) and to support a Milestone B decision.
4.6.1.C3: The system integration, test and evaluation process is defined in the Technology Development Strategy (TDS) and includes analysis, reviews, inspections, demonstrations, testing, and M&S to evaluate the requirements baseline and the system's progress during development to meet the critical technical parameters (CTPs). The TES describes an iterative process by which allocated specifications and CTPs are met by lower-level components, assemblies, subsystems and then at the system level. Requirements are traceable to specific test and evaluation events.
4.6.1.C4: The TD phase testing requirements are defined in the TES to demonstrate performance against allocated and derived specifications and CTPs in as realistic an environment as possible. Software coding and unit testing, and successive levels of software testing follow a specific process that should be well documented. Establish exit criteria for each phase of testing.

4.6.1.C5: Test requirements for the hierarchical system are included in the TES, including component, subsystem, system, and system of system/family of systems (SoS/FoS)-level tests when applicable.

4.6.1.C6: Facilities are available to support TD testing requirements.

4.6.1.C7: Integration test facilities that allow demonstration of hardware and software operation at progressively higher levels of integration are used/planned during TD.

4.6.1.C8: Test plans derived from the TES describe detailed test and evaluation activities that take place during TD. Sufficient time is allotted for test, analyze, fix, and re-test at each level of integration.

4.6.1.C9: Test environment is as close to the anticipated operational environment as feasible.

4.6.1.C10: The standards implemented for key interfaces are verifiable and their implementations are evaluated during testing.

4.6.1.C11: A Failure Reporting, Analysis and Corrective Action System (FRACAS) has been initiated. The systems engineering (SE) process provides tracking between test activities and technical requirements.

4.6.1.C12: Test events should verify the Technology Readiness Level (TRL) of Critical Technology components and subsystems.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.6.1.Q1: Does the T&E Strategy describe testing for all phases of the program? Describe the contractor SE process from lower level components up through system level integration and test. How are requirements, especially CTPs, traced to specific test and evaluation events? [4.6.1.C1]

4.6.1.Q2: What are the exit criteria for the TD phase? [4.6.1.C2]

4.6.1.Q3: Describe the process to implement and verify the software design, including the methods and tools, testing, and facilities used to support this process. Include a description of the process followed to test the software, starting with code and unit test. Is there buy-in among all stakeholders as to these test approaches. [4.6.1.C4]

4.6.1.Q4: Describe the process to implement and verify the hardware design and whether this process involves prototypes and/or modeling and simulation. Include a description of the methods and tools, testing, and facilities used to support this process. [4.6.1.C3]

4.6.1.Q5: Has a FRACAS been initiated? Describe the planned time for root cause analysis and corrective action for hardware and software deficiencies. Describe how the FRACAS provides tracking the deficient test activity back to the requirement for impact assessment. [4.6.1.C11]

4.6.1.Q6: Does the test program schedule incorporate time for test, analysis, and problem correction from the component level to the full-up system? Explain the basis for allocating this time. [4.6.1.C8]

4.6.1.Q7: Describe the level of detail of the test planning in the TES as it reflects the test requirements during TD. [4.6.1.C9]

4.6.1.Q8: Explain how the standards implemented for key interfaces are verified during testing. [4.6.1.C10]

4.6.1.Q9: Are SoS/FoS-level tests addressed within the TES? [4.6.1.C5]

4.6.1.Q10: Describe the facilities planned to support the integration and test activities, including plans to have these facilities in place when needed. Explain how TES exploits T&E synergies with the other SoS/FoS members. [4.6.1.C5]

4.6.1.Q11: Is the test program event driven and guided by interim test measures? Please explain. [4.6.1.C1]

4.6.1.Q12: Are test events used to verify the Technology Readiness Level (TRL) of Critical Technology components and subsystems? [4.6.1.C12]

Pre-Milestone B

Criteria

4.6.1.C13: The PM should charter a T&E Working-level Integrated Product Team (WIPT) with members of the test community to develop metrics for hardware and software, and using the maturing Capabilities Development Document (CDD) shall concurrently transform the TES to a more comprehensive plan documented in the Test and Evaluation Master Plan (TEMP).

4.6.1.C14: The TEMP includes a key performance parameter (KPP), CTP and key system attribute (KSA) matrix that describes the required measurement thresholds and objectives.

4.6.1.C15: Technology Development (TD) phase testing requirements are defined in the T&E Strategy (TES) to demonstrate performance against allocated and derived specifications and CTPs in as realistic an environment as possible. Software coding and unit testing, and successive levels of software testing follow a specific process that should be well documented. Establish exit criteria for each phase of testing.

4.6.1.C16: Test requirements for the hierarchical system are included in the TES, including component, subsystem, system, and SoS/FoS level tests when applicable.

4.6.1.C17: Facilities are available to support TD testing requirements.

4.6.1.C18: Integration test facilities that allow demonstration of hardware and software operation at progressively higher levels of integration are used/planned during TD.

4.6.1.C19: Test plans derived from the TES describe detailed test and evaluation activities that take place during TD. Sufficient time is allotted for test, analyze, fix, and re-test at each level of integration.

4.6.1.C20: Test environment is as close to the anticipated operational environment as possible.

4.6.1.C21: The standards implemented for key interfaces are verifiable and their implementations are evaluated during testing.

4.6.1.C22: A Failure Reporting, Analysis and Corrective Action System (FRACAS) has been initiated. The SE process provides tracking between test activities and technical requirements.

4.6.1.C23: Test events should verify the Technology Readiness Level (TRL) of Critical Technology components and subsystems.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.6.1.Q13: Has the concept for a combined test team/integrated test team been developed?

- Has a T&E WIPT charter been developed to spell out details of roles and responsibilities of the Integrated Test Team/Combined test team?
- Does it emphasize the need for consensus on the T&E approach to prevent changes later? [4.6.1.C13]

4.6.1.Q14: Discuss the level of detail in the "generic TEMP" to support Milestone B.

- What are the plans to update it post Milestone B with the insights from the winning contractor?
- Does the generic TEMP identify the "who," "what," "why," "when," and "where" level insights for each type of planned testing to provide confidence that the TES has been well thought out and resourced?
- Has a breakout of test hours been developed?
- Discuss the level of early user and operational tester inputs in the system design process.
- Have FoS T&E synergies been explored? [4.6.1.C13 and 4.6.1.C14]

4.6.1.Q15: Describe the planned use of the Technology Development Facility or a systems integration laboratory (SIL).

- What modeling and simulation (M&S) is planned? What are the plans to verify, validate, and accredit the M&S?
- How will the information from the SIL support milestone decisions?
- Are there plans to use the SIL to evaluate FoS/SoS interfaces? Are Joint Distributed Engineering Plant (JDEP) linkages planned?
- What is the timeframe for preparing draft tactics, techniques and procedures or Concept of Operations (CONOPS) and demonstrating them in a SIL or intended environment in System Development and Demonstration (SDD)?
- Are there plans to evaluate each Information Exchange Requirement (IER) in the SIL during SDD?
- Is a fully functional land based integration and test facility (system SIL, "Iron Bird") planned to pre-certify all subsystems to prevent integration "unknown unknowns"?

- Is there a plan to demonstrate FoS interoperability and joint CONOPs via JDEP for missions in SDD? [4.6.1.C15, 4.6.1.C16, and 4.6.1.C17]

4.6.1.Q16: Discuss the planned suitability testing in the SDD phase

- Is a Maintenance Engineering Inspection (diagnostics and logistics demonstrations) planned in SDD (e.g., interactive electronic technical manual (IETMs) verification/validation, remove-and-replace procedures, diagnostics/prognostics demo)?
- Discuss the planned SDD reliability growth program. Has a reliability growth curve been developed? What is the planned reliability maturation at key dates (Critical Design Review (CDR), Milestone C, Operational Test Readiness Review (OTRR), Initial Operational Capability (IOC), maturity)?
- Discuss the planned FRACAS program. What is the planned time for root cause analysis and corrective action for major and minor hardware/software deficiencies? [4.6.1.C19, 4.6.1.C20, and 4.6.1.C22]

4.6.1.Q17: Is the PM embracing full Office of the Secretary of Defense (OSD) Developmental Test and Evaluation/Director, Operational Test and Evaluation (DT&E/DOT&E) insight into the test program? [4.6.1.C21 and 4.6.1.C22]

- Are regular (e.g., monthly or quarterly) T&E Working Integrated Process/Product Teams (IPTs) scheduled to update and mature the TES to a post-Milestone B TEMP?
- Will OSD Systems and Software Engineering/Assessments and Support (SSE/AS) and DOT&E be invited to attend significant test events?
- Will T&E status reports be provided to OSD SSE/AS and DOT&E?
- Will OSD have access to the integrated data environment (IDE) for details on test progress, risks and mitigation activities?
- Will OSD SSE/AS and DOT&E have an opportunity to review/comment (not approve) individual test plans?
- Will OSD have access to the risk management database?

4.6.1.Q18: Are test events used to verify the Technology Readiness Level (TRL) of critical technology components and subsystems? [4.6.1.C22]

Pre-Milestone C and FRP

Criteria

4.6.1.C24: The TEMP includes revised performance attributes and an updated KPP, CTP and KSA matrix which describes the required measurement thresholds and objectives synchronized with the maturing Capability Production Document (CPD) planned for T&E in an event-driven schedule.

4.6.1.C25: As part of the entrance criteria for production, prototype systems or engineering development models (EDM) (individually and as part of a greater system of systems, if appropriate)

should demonstrate acceptable performance in DT&E. The system should demonstrate mature software capability, acceptable interoperability, and acceptable operational supportability. Acceptability is determined based on demonstrated progress in achieving criteria such as mission capabilities (including KPPs, MOEs, MOSs), Critical Technical Parameters, Acquisition Decision Memorandum (ADM)-approved SDD exit criteria, software maturity levels, and other metrics.

4.6.1.C26: The results of developmental testing should indicate that the system is ready to enter low-rate initial production (LRIP). If this is not the case, remedial or mitigation plans should be pursued.

4.6.1.C27: The results of the pre-Milestone C operational assessment should indicate that the system has the potential to be operationally effective and operationally suitable when it enters Initial Operational Test and Evaluation (IOT&E). If this is not the case, remedial or mitigation plans should be pursued.

4.6.1.C28: A Failure Reporting, Analysis, and Corrective Action System (FRACAS) is being used and the reporting is current. (A government reliability failure scoring process should be in effect). The process should include representatives from the government program office, user community, and operational test agency to score formally the failures observed in demonstration testing (DT) and operational testing (OT). (An approved failure definition/scoring criteria document should guide this scoring process). 4.6.1.C29: The integration test program schedule incorporates time for test, analyze, and fix from components to the all-up system. Integration testing is on schedule. Additionally, adequate time is allocated after testing is completed to evaluate test results prior to the Milestone C decision.

4.6.1.C30: The existing Test and Evaluation Master Plan (TEMP), is being followed. The government (PM and Operational Test Agency (OTA)) have developed a plan to update the TEMP prior to the MC C decision and Full-Rate Production Decision Review (FRPDR). T&E working-level IPT meetings are scheduled to perform this TEMP update. The status of logistic support test and evaluation is in accordance with the TEMP.

4.6.1.C31: The TEMP contains complete plans, including resource requirements, for Production Qualification Testing of LRIP articles (if LRIP is planned) prior to the FRPDR. Initial Operational Test and Evaluation (IOT&E)/Operational Evaluation (OPEVAL) is performed using production representative or LRIP articles (NA for automated information system (AIS) programs or software-intensive systems with non-developmental hardware) to support the FRPDR. If the program is identified as a covered system under USC Title 10 oversight for live-fire test and evaluation (LFT&E), adequate LFT&E is planned for the production and deployment phase prior to the FRPDR).

4.6.1.C32: The government PM has a plan to obtain Joint Interoperability Test Command (JITC) interoperability/net-ready certification prior to the FRPDR, if appropriate for the type of system.

4.6.1.C33: Subsystems software interfaces follow standards and are complete and verifiable.

Interface testing is on schedule.

4.6.1.C34: For a system of systems (SoS) the TEMP addresses SoS tests, and these tests are budgeted and supported by the program test resources and schedule.

4.6.1.C35: The subsystems and/or components of the system are in compliance with the open interface standards.

4.6.1.C36: The PM has developed reasonable success criteria and IOT&E/OPEVAL entrance criteria being used in assessing technical progress and maturity for operational testing as the system proceeds through its development. These criteria are documented in the TEMP.

4.6.1.C37: Modeling and simulation (M&S) tools that are being used (or will be used) to assess system performance and mission capability are verified and validated, and are being accredited by the intended users of the M&S. Documentation exists on the verification, validation, and accreditation (VV&A) work performed.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.6.1.Q19: Is the system integration, test, and evaluation plan event driven, versus schedule driven? Are there clearly identified objectives and criteria to be met before proceeding from one event to the next? [4.6.1.C24]

4.6.1.Q20: Have prototype systems or engineering development models (EDMs) (individually and as part of a greater system of systems, if appropriate) demonstrated acceptable performance in DT&E, and operational assessment (i.e., operational testing)? What acceptability criteria does the PM use to judge readiness for IOT&E? [4.6.1.C25]

4.6.1.Q21: Outline the planned developmental, operational and live fire testing for the test program at the system and FoS/SoS level

- Is the test program (e.g., System Integration Laboratory (SIL), ground and flight test program) planning to exploit T&E synergies with the other FoS / SoS program members? Discuss the planning.

- Does the SDD phase end when a system is demonstrated in its intended environment? Is the program using the selected prototype? Does it meet approved requirements? Are industrial capabilities reasonably available? Does the system meet or exceed the exit criteria and Milestone C entrance requirements?

- Has successful DT&E been completed to assess technical progress against critical technical parameters? Is an operational assessment planned? Will M&S be used to augment integration and T&E?

- Is there a goal to increase user involvement during DT, integrate DT/OT events, and improve test efficiency and probability of success during IOT&E?

- Has an Operational Test Readiness Review (OTRR) entrance criteria been developed? [4.6.1.C24]

4.6.1.Q22: What are the program's technical performance measures?

- Do the OT measures in the TEMP (MOEs and MOSs) contain measurable criteria that can be used to evaluate the system in the IOT&E?
- Do the DT measures in the TEMP (critical technical parameters (CTPs)) provide measures to evaluate the planned scope of DT&E contained in Part III?
- Is the test program event driven and guided by the achievement of interim measures?
  - Do the CTPs and test plans contain success criteria for each test phase?
  - Does the Integrated Master Plan contain the interim DT&E measures?
  - Are the CTPs traceable to system specifications and the scope of DT (Part III)? Are definitions of these measures included in the TEMP? [4.6.1.C25]

4.6.1.Q23: Discuss the program's Milestone C entrance criteria and the plan for demonstration.

- Has a top-level set of measurable Milestone C entrance criteria been developed, along with details for evaluating the criteria? Are the criteria documented in the TEMP and the Acquisition Strategy?
- Does the program plan to demonstrate:
  - Acceptable performance in development, test and evaluation, and operational assessment; mature software capability; no significant manufacturing risks; manufacturing processes under control (if Milestone C is full-rate production); an approved ICD (if Milestone C is program initiation); an approved Capability Production Document (CPD); acceptable interoperability; acceptable operational supportability; compliance with the DoD Strategic Plan; and demonstration that the system is affordable throughout the life cycle, optimally funded, and properly phased for rapid acquisition?
- What progress toward achieving KPPs will be made by the Milestone C decision? [4.6.1.C25]

4.6.1.Q24: Discuss the planned scope of the operational assessment(s) to support Milestone C.

- Will they leverage DT&E data or reflect standalone OT activities?
- Discuss the OTA's operational assessment (OA) report writing timeframe. Will sufficient insights in the program be obtained prior to having to begin the OA report writing process? Are there plans to expedite the OA report writing process? [4.6.1.C25]

4.6.1.Q25: Do the results of developmental testing indicate that the system is ready to enter LRIP? Have the CTP results tracked according to plan? How is the system performing with regard to the exit criteria? Has the system shown potential to meet the Critical Operational Issues (COIs)? If going directly to full-rate production, what is the predicted performance (based on the results of

DT&E) to be operationally effective and suitable during IOT&E? If the system is not progressing according to plan, what is the remedial or mitigation plan? [4.6.1.C26]

4.6.1.Q26: Do results of Pre-Milestone C operational assessment indicate that the system is likely to be assessed as operationally effective and operationally suitable in IOT&E? If not, have remedial or mitigation plans been developed? [4.6.1.C27]

4.6.1.Q27: Has a Failure Reporting, Analysis, and Corrective Action System (FRACAS) been used? Please provide a summary of the reporting to date. [4.6.1.C28]

4.6.1.Q28: Is a government reliability failure scoring process in effect? Has an approved failure definition/scoring criteria document or analysis methodology document been developed and distributed? Please explain. [4.6.1.C28,29]

4.6.1.Q29: How does the integration test program schedule incorporate time for test, analyze, and fix from components to the all-up system? Does the schedule provide adequate time to evaluate test results prior to a Milestone C decision? Provide the schedule performance of integration testing. [4.6.1.C29]

4.6.1.Q30: Has the TEMP been updated since the Milestone B decision? Please provide the status of logistic support test and evaluation in accordance with the TEMP. [4.6.1.C30]

4.6.1.Q31: Does the TEMP contain complete plans, including resource requirements, for Production Qualification Testing of LRIP articles (if LRIP is planned) prior to the Full-Rate Production Decision Review (FRPDR)? Will IOT&E be performed using production representative or LRIP articles? Is adequate LFT&E planned for the Production and Deployment (P&D) phase prior to the FRPDR (if applicable)? [4.6.1.C31]

4.6.1.Q32: Does the government PM have a plan to obtain JITC interoperability/net-ready certification prior to the FRPDR (if applicable)? [4.6.1.C32]

4.6.1.Q33: Are the software standards for key subsystem interfaces verifiable and their implementation evaluated during testing? Provide the status of interface testing. [4.6.1.C33]

4.6.1.Q34: Are system of systems (SoS)-level tests and support requirements addressed within the TEMP? Is SoS integration testing effort budgeted within the program? [4.6.1.C34]

4.6.1.Q35: Describe the testing process or other mechanisms used by the program to verify claims made by vendors that their products comply with open interface standards and their respective profile. [4.6.1.C35]

4.6.1.Q36: Has the PM developed success criteria and IOT&E/OPEVAL entrance criteria to use in assessing technical progress and maturity for operational testing? [4.6.1.C36]

4.6.1.Q37: Have modeling and simulation (M&S) tools that are being used (or will be used) to assess system performance and mission capability been verified, validated, and accredited by the intended users of the M&S? [4.6.1.C37]

Factor 4.6.2 – Verification Correlation

Pre-Milestone A

Criteria

4.6.2.C1: The Test and Evaluation Strategy (TES) should be in sufficient detail to support the entrance and exit criteria for each phase of development and to proceed to the next phase of development. In addition, the Technology Development Strategy (TDS) provides the test and evaluation (T&E) resource inputs for development of the Cost Analysis Requirements Description (CARD).

4.6.2.C2: The TES fulfills the TDS test planning requirement.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.6.2.Q1: Does the test strategy in the TES reflect all requirements and capabilities? [4.6.2.C1]

4.6.2.Q2: Does the TES depict a plan to assess the system's ability to perform per the Concept of Operations (CONOPS)? [4.6.2.C1]

4.6.2.Q3: Does the TES provide the needed information to enter the TD phase? [4.6.2.C1 and 4.6.2.C2]

4.6.2.Q4: How well does the TES align with the TDS? [4.6.2.C2]

Pre-Milestone B and Pre-Milestone C

Criteria

4.6.2.C3: The T&E Working Integrated Product Team (WIPT) should develop a test matrix, approved by the program manager (PM) to identify verification methods (inspection, analysis, demonstration, test) for each performance requirement written in the system specification, and key tests summarized in the TES.

4.6.2.C4: Critical operational issues (COIs), operational capabilities and requirements are clearly stated in testable terms, (i.e., realistically measurable and demonstration is not precluded due to safety restraints).

4.6.2.C5: Performance metrics clearly describe the necessary degree of mission accomplishment. Critical technical parameters (CTPs) that are directly linked of the COIs are written to adequately measure system maturity during development.

4.6.2.C6: Measures of effectiveness (MOEs) and measures of suitability (MOSs), key performance parameters (KPPs), and CTPs are stated as quantifiable parameters.

4.6.2.C7: MOEs and MOSs are clearly defined (i.e., operating condition or scenario of when the metric is applicable is defined).

4.6.2.C8: Entrance and exit criteria are developed for each phase of developmental testing (i.e., SIL, hardware-in-the-loop (HITL), ground test, open air test) to ensure the system will ultimately meet operational requirements.

4.6.2.C9: The software development has followed a disciplined process documented in the program software development plan (SDP) and related plans. This process includes design, development, implementation, routine reviews, and integration and test. Tools and facilities exist and are used to execute the software development and verification (testing). The current status of software completion verification testing is consistent with the verification test schedule. 4.6.2.C10: The hardware development has followed a disciplined process documented in the program development and test plans. This process includes reviews, design, implementation and integration and test. . Tools and facilities, such as models, simulations and prototypes, exist and are used to execute the hardware development and verification (testing). The current status of hardware completion verification testing is consistent with the verification test schedule.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.6.2.Q5: Describe the process for ensuring timely verification that the system meets requirements/specifications. [4.6.2.C3]

4.6.2.Q6: Provide the specified verification requirements and the current verification test matrix that depicts the planned test methods versus the verification requirements identified in the system specifications.

- Is this described in the TES? Please explain.
- Is this level of detail described in the Test and Evaluation Master Plan (TEMP)? Please explain. [4.6.2.C1]

4.6.2.Q7: Are the operational capabilities and requirements clearly stated in realistically measurable terms? [4.6.2.C4]

4.6.2.Q8: Are there safety restrictions that would preclude demonstrating the described operational capabilities and requirements? [4.6.2.C4]

4.6.2.Q9: Do performance metrics clearly describe the necessary degree of mission accomplishment expected per the CONOPS? Do the CTPs directly measure system performance to satisfy the COIs? [4.6.2.C5]

4.6.2.Q10: Are the MOEs and MOSs stated as quantifiable parameters? Are they sufficient to answer the COIs? [4.6.2.C6]

4.6.2.Q11: Is the expected environment and operating condition of the system clearly stated in the definitions of the MOEs and MOSs? [4.6.2.C7]

4.6.2.Q12: Do all resources necessary to execute the TEMP exist? [4.6.2.C3, 4.6.2.C4, 4.6.2.C7, and 4.6.2.C8]

4.6.2.Q13: Can sufficient data be collected to properly assess system progress during developmental testing? [4.6.2.C8]

4.6.2.Q14: Describe the process used to implement and verify the software design, including the methods and tools, testing, and facilities used to support this process. Include a description of the reviews involved in the software coding and unit testing. What is the current status of software verification testing? How does the percent complete compare with the verification test schedule? [4.6.2.C9]

4.6.2.Q15: Describe the process used to implement and verify the hardware design and whether this process involves prototypes and/or modeling and simulation. Include a description of the methods and tools, testing, and facilities used to support this process. What is the current status of the hardware component and system verification testing? How does actual testing compare with the test schedule? [4.6.2.C10]

References

Test and Evaluation Management Guide. 5th ed. Defense Acquisition University Press, January 2005. http://www.dau.mil/pubs/gdbks/T&E_MgmtGuide.pdf

US Code Title 10, 139 Director of Operational Test and Evaluation

SUB-AREA – 4.7 SUPPORTABILITY PLANNING

Description: Supportability and sustainment are critical components of overall system performance. Historically, system sustainment costs have been shown to represent up to 70 percent of an acquisition's life cycle cost. This cost is largely attributable to design decisions made during the earliest phases of the acquisition process and the cost is typically "locked in" well before "metal is bent" or code is written. Therefore, it is vitally important that DoD acquisitions be planned, designed, developed, and obtained with supportability and sustainment in mind.

Support planning comprises three key areas: acquisition logistics (designing in supportability), performance-based logistics (buying performance), and sustainment.

Acquisition logistics comprises the processes, tools and techniques used to effectively integrate supportability requirements into the systems engineering process in order to optimize the inherent supportability of the design. It also includes the supportability analyses necessary to develop and field an integrated systems support package (e.g. spare and repair parts, support equipment, tech manuals, etc.) – "supporting the design."

Inherent supportability of the design is highly reliant on reliability, availability and maintainability (RAM) but is also influenced by other logistics disciplines. For example, operability affects training

and qualitative manpower requirements; Serialized Item Management and Automatic Identification Technology can reduce downtime and eliminate errors in ordering and data collection.

Acquisition logistics activities start at the beginning of the acquisition, prior to the Concept Decision, with the definition of the supportability objectives. These include specifying objective outcomes, measures, resource commitments, and stakeholder responsibilities. Collaborative efforts to define future support requirements should include planning for future system upgrades, technical insertion/refreshment, obsolescence avoidance and reliability improvements to improve overall performance and reduce ownership costs. During the Concept Refinement phase, the product support capabilities of each of the alternative materiel approaches considered are fully evaluated.

As the acquisition process continues into the Technology Development and System Development and Demonstration phases, acquisition logistics activities intensify. The government/industry team will employ systems engineering and supportability analysis to design or procure systems that provide the Department of Defense (DoD) with the required operational capability. Supportability analyses, participation in Integrated Process/Product Teams (IPTs) and adequate weighting of supportability in trade studies all provide important feedback mechanisms into the design process.

As the acquisition process moves into the Production and Deployment phase, the program manager, in conjunction with users, needs to conduct continuing reviews of system performance, comparing performance expectations against actual performance measures. Acquisition logistics planning will include plan to collect and analyze operational data to identify and correct root causes of down time and cost. Program managers should then revise, correct, and improve sustainment strategies as necessary to meet performance requirements.

Performance-based logistics (PBL) is the purchase of support as an integrated, affordable, performance package designed to optimize system readiness and meet performance goals for a weapons system through long-term support arrangements with clear lines of authority and responsibility. Simply put, performance-based strategies buy outcomes, not products or services. The cornerstone of PBL is the purchase of weapon system sustainment as an affordable, integrated package based on output measures such as weapon system availability, rather than input measures, such as parts and technical services.

PBL is DoD's preferred product support method. PBL is not the same as Contractor Logistics Support (CLS). In the PBL environment, a government/industry team is a key long-term relationship that is developed among public and private stakeholders contractually and/or with performance agreements. The team is based upon a foundation of building trust whereby there is mutual

accountability for achieving the outcome performance goals in managing reliability, supportability, and total ownership cost (TOC) over the life cycle of a weapon system.

Sustainment activities ensure the availability of an effective and efficient support system (e.g. spare and repair parts, special tools and test equipment, tech manuals, training devices, etc.) to support operational testing and system fielding. Sustainment activities rely heavily on acquisition logistics. The timing of development activities for support products is critical. For example, the specific activities necessary for the delivery of a technical manual (development of source data, authoring of text, maintainability demonstrations, validation, verification and final delivery) must be scheduled properly for the technical manual to be completed and delivered to support operational testing and fielding.

Scope: The assessment of this sub-area deals with the adequacy of planning /execution of a supportability and sustainment program that will ensure a supportable design and timely delivery of required support products.

Perspective: A key consideration in the evaluation of this factor is the inclusion of supportability metrics (material availability, materiel reliability, operating and support cost and mean down time) in the requirements documentation and integration into the systems engineering process. Inclusion of these metrics sets the stage for influencing the design process. To successfully meet these requirements supportability must play a significant role in the design process. Supportability personnel must participate in the IPT process and supportability should be part of the trade study methodology.

Supportability analysis activities should be comprehensive enough and conducted early enough to influence the design and to deliver the objective production support system in time to support operational testing and fielding.

The schedule should be carefully scrutinized to identify any deferment acquisition logistics and sustainment activities due to funding issues or other program priorities. Schedules for acquisition logistics and Sustainment activities should be compared to top-level program schedules and key milestones to determine viability. Normally, over the course of a development program, program schedules are revised along with lower-level logistics schedules. If available, these revised schedules should be evaluated over time to identify inappropriate slippage of acquisition logistics and sustainment activities.

PBL activities should be carefully examined to ensure compliance with the DoD 12-step methodology. Schedules for PBL implementation should be consistent with overall program schedules for fielding, Initial Operational Capability (IOC), etc.

Factor 4.7.1 – Acquisition Logistics

Pre-Milestone A

Criteria
4.7.1.C1: The program's overall support strategy is viable (i.e., workable and has real meaning and pertinence). Specific activities that must be performed to ensure a supportable design and to deliver the required support products (technical manuals, support equipment, etc.) in a timely fashion are planned and are appropriate in scope and schedule.

4.7.1.C2: Funding for supportability analyses to be performed during the Technology Development phase (maintenance planning, identification of technological opportunities, comparative analysis, etc.) is clearly identified and is sufficient to cover all requirements.

4.7.1.C3: Analytical activities during the Concept Refinement phase (Analysis of Alternatives (AoA), trade studies, design studies, Alternate System Review (ASR) have adequately considered supportability.

4.7.1.C4: Supportability metrics (including key performance parameters (KPPs) and key system attributes (KSAs)) are included in the requirements documents, APB and in proposed contracts and are directly traceable to the top-level operational capability metrics.

Focus Questions
[Pertinent criteria numbers follow each question.]
4.7.1.Q1: Are the supportability metrics of materiel availability, material reliability, operating and support costs and mean down time included in the requirements document (ICD/draft CDD)? How are they expressed? [4.7.1.C4]

4.7.1.Q2: Show the audit trail tracing operational capability requirements down to reliability, availability, maintainability and logistics downtime metrics in the requirements document/RFP. [4.7.1.C4]

4.7.1.Q3: Were supportability and lifecycle cost weighted considerations in the AoA? Is the Preferred System Concept supportable and sustainable? [4.7.1.C3]

4.7.1.Q4: Has the program performed a detailed analysis of the cost and downtime drivers of the current or predecessor system and to identify systemic or chronic problems and to assess the potential for improvement/elimination in the replacement system? Results? [4.7.1.C3]

4.7.1.Q5: What alternative support concepts have been considered? [4.7.1.C1]

4.7.1.Q6: How will the Supportability requirements in the RFP ensure the level of effort necessary to refine the supportability objectives/constraints, develop the initial product support strategy and influence the initial design/technology? [4.7.1.C1]

4.7.1.Q7: Is the available funding sufficient to fully execute the supportability effort? [4.7.1.C2]

4.7.1.Q8: How is supportability integrated into the systems engineering management process?

- Are supportability requirements/metrics managed through SE?
- Are supportability and sustainment included in technical review planning?
- Is supportability included in the IPT structure/process? [4.7.1.C1]

4.7.1.Q9: Have Trade Study criteria been specified in the RFP and if so, how is supportability weighted (do the trade study criteria reflect relative source selection importance)? [4.7.1.C1]

4.7.1.Q10: What technologies will be examined during the Technology Development phase that may increase the supportability of the new system? [4.7.1.C1]

4.7.1.Q11: What data rights will be acquired (drawings, publications, process data, etc.)? Will the intended data rights support reprocurement of spare and repair parts? [4.7.1.C1]

4.7.1.Q12: What are the mechanisms for Supportability Analysis to interface with the design process? Are Supportability Analyses and demonstrations performed early enough to provide meaningful input to the design process? [4.7.1.C1]

4.7.1.Q13: Are there production and sustainment cost goals established? How were cost goals developed? How are cost goals allocated and performance toward goals tracked? [4.7.1.C1 and 4.7.1C2]

4.7.1.Q14: What are the supportability objectives? Describe the risk factors associated with the proposed support concept and how these risks will be mitigated, and the potential cost and schedule impact. [4.7.1.C1]

Pre-Milestone B

Criteria

4.7.1.C5: The program's overall support strategy continues to be viable (i.e., workable and has real meaning and pertinence). Specific activities that must be performed to ensure a supportable design and to deliver the required support products in a timely fashion are planned and are appropriate in scope and schedule (will provide the objective support system in time to be tested as part of the overall system during operational testing).

4.7.1.C6: Funding for supportability activities to be performed during the System Development and Demonstration phase (maintenance planning, identification of technological opportunities, comparative analysis, task analysis, tech manual development etc.) is clearly identified and is sufficient to cover all requirements.

4.7.1.C7: Analytical activities during the Technology Development phase (AoA, trade studies, design studies, source selection) adequately considered supportability.

4.7.1.C8: Supportability metrics (including KPPs and KSAs) are included in the requirements documents, Acquisition Program Baseline (APB) and in proposed contracts and are directly traceable to the top-level operational capability metrics.

4.7.1.C9: Supportability is included as a critical component of system performance in all key program documentation (Acquisition Strategy, Systems Engineering Plan (SEP), Test and Evaluation Master Plan (TEMP), etc.).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.7.1.Q15: What supportability metrics (materiel availability, material reliability, operating and support costs, and mean down time) are included in the Capabilities Development Document (CDD)? How are they expressed? [4.7.1C8]

4.7.1.Q16: Is there an audit trail tracing operational capability requirements down to reliability, availability, maintainability and logistics downtime metrics in the requirements document and RFP. [4.7.1C8]

4.7.1.Q16: How did supportability influence trade studies performed during the Technology Development phase? Top five examples? [4.7.1C7]

4.7.1.Q17: Have predecessor systems been adequately baselined to identify systemic or chronic problems and to assess the potential for improvement/elimination in the replacement system? Results? [4.7.1C7]

4.7.1.Q18: How will the supportability requirements in the RFP ensure the level of effort necessary to, develop the product support plan, influence the design and begin development of logistics support products? [4.7.1C5]

4.7.1.Q19: Is the available funding sufficient to fully execute the supportability effort? [4.7.1C6]

4.7.1.Q20: How is supportability integrated into the systems engineering (SE) management process?

- Are supportability requirements/metrics managed through SE?
- Are supportability and sustainment included in technical review planning?
- Is supportability included in the Integrated Process/Product Team IPT structure/process? [4.7.1C5 and 4.7.1.C9]

4.7.1.Q21: Have trade study criteria been specified in the RFP and if so, how is supportability weighted (do the trade study criteria reflect relative source selection importance)? [4.7.1C5]

4.7.1.Q22: What supportability testing is included in the TEMP? [4.7.1C5 and 4.7.1C9]

4.7.1.Q23: What data rights do you intend to acquire (drawings, publications, process data, etc.)? Will the intended data rights support reprocurement of spare and repair parts? [4.7.1C5]

4.7.1.Q24: Describe the risk factors associated with the proposed support concept and how these risks will be mitigated, and the potential cost and schedule impact. [4.7.1C5]

Pre-Milestone C

Criteria

4.7.1.C10: The program's overall support strategy continues to be viable (i.e., workable and has real meaning and pertinence). Specific activities that must be performed to ensure a supportable design and to deliver the required support products in a timely fashion are planned and are appropriate in scope and schedule.

4.7.1.C11: : Funding for supportability activities to be performed during the Production and Deployment phase (tech manual updates, data collection and analysis, etc.) is clearly identified and is sufficient to cover all requirements.

4.7.1.C12: Analytical activities during the System Development and Demonstration (SDD) phase (AoA, trade studies, design studies, source selection) adequately considered supportability.

4.7.1.C13: Supportability metrics (including KPPs and KSAs) are included in the requirements documents, APB and in proposed contracts and are directly traceable to the top-level operational capability metrics.

4.7.1.C14: Supportability is included as a critical component of system performance in all key program documentation (Acquisition Strategy, SEP, TEMP, etc.).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.7.1.Q25: What supportability metrics (materiel availability, material reliability, operating and support costs and mean down time) are included in the Capability Production Document (CPD)? How are they expressed? [4.7.1.C13]

4.7.1.Q26: Show the audit trail tracing operational capability requirements down to reliability, availability, maintainability and logistics downtime metrics in the requirements document and RFP. [4.7.1.C13]

4.7.1.Q27: How did supportability influence trade studies performed during SDD?

- Top five examples? [4.7.1.C12]

4.7.1.Q28: How is supportability integrated into the systems engineering (SE) management process?

- Are supportability requirements/metrics managed through SE?
- Are supportability and sustainment included in technical review planning?
- Is supportability included in the IPT structure/process? [4.7.1.C10 and 4.7.1.C14]

4.7.1.Q29: Have trade study criteria been specified in the RFP and if so, how is supportability weighted (do the trade study criteria reflect relative source selection importance)? [4.7.1.C10]

4.7.1.Q30: What supportability testing is included in the TEMP? How will the objective support system (training, supply support, support equipment, publications, etc.) be tested during operational testing? [4.7.1.C10 and 4.7.1.C14]

4.7.1.Q31: Is the available funding sufficient to fully execute the supportability effort? Is the available funding sufficient to procure the full range and depth of support products? [4.7.1.C11]

4.7.1.Q32: How will the Supportability requirements in the RFP ensure the availability of required supportability products to support testing (limited user test (LUT)/Initial Operational Test and Evaluation (IOT&E)) and initial fielding? [4.7.1.C10]

4.7.1.Q33: Describe the risk factors associated with the proposed support concept and how these risks will be mitigated, as well as the potential cost and schedule impact. [4.7.1.C10]

References

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Designing and Assessing Supportability in DoD Weapon Systems. Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, October 2003.

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Factor 4.7.2 – Performance-Based Logistics (PBL)

Pre-Milestone A, Pre-Milestone B

Criteria

4.7.2.C1: Performance-based-logistics (PBL) planning is part of the overall supportability planning from the outset of the program.

4.7.2.C2: A stakeholder team is established to assist in the development, management, and continuing oversight of the PBL strategy

4.7.2.C3: The Technology Development Strategy meets all statutory and regulatory requirements and addresses performance-based logistics (PBL).

Focus Questions

[Pertinent criteria numbers follow each question.]

4.7.2.Q1: What is the schedule for PBL implementation? [4.7.2.C1]

4.7.2.Q2: What is the composition of the PBL stakeholder team? [4.7.2.C2]

4.7.2.Q3: What is the PBL strategy?

- Does the implementation strategy follow the 12-step Office of the Secretary of Defense (OSD) PBL process? [4.7.2.C3 and 4.7.2.C1]

4.7.2.Q4: What system-level performance metrics have been established? [4.7.2.C2]

Pre-Milestone C

Criteria

4.7.2.C4: PBL planning is comprehensive and is part of the overall supportability planning .

4.7.2.C5: Measurable and enforceable performance metrics are established and are linked to warfighter requirements. PBL agreements include a process for monitoring performance against the defined performance outcome metrics.

4.7.2.C6: The PBL strategy represents an optimum balance of organic and contractor capabilities.

4.7.2.C4: A stakeholder team is established to assist in the development, management, and continuing oversight of the PBL strategy and to negotiate the Performance-Based Agreement (PBA).

4.7.2.C5: The Acquisition Strategy meets all statutory and regulatory requirements and includes a sustainment plan that addresses performance-based logistics (PBL) programs.

4.7.2.C6: PBL product support is linked to resources and performance.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.7.2.Q5: What is the schedule for PBL implementation? [4.7.2.C4]

4.7.2.Q6: What alternative PBL strategies are/have been considered?

- What alternatives are included in the Business Case Analysis (BCA)? [4.7.2.C6]

4.7.2.Q7: What is the PBL strategy? [4.7.2.C6 and 4.7.2.C4]

4.7.2.Q8: What support areas are included in the PBL strategy? [4.7.2.C4]

4.7.2.Q9: What system-level performance metrics have been established? [4.7.2.C5]

4.7.2.Q10: How are the system-level performance metrics derived from the operational capabilities in the requirements document? [4.7.2.C5]

4.7.2.Q11: How will the performance metrics be measured? [4.7.2.C5]

4.7.2.Q12: How will the system be baselined? [4.7.2.C4 and 4.7.2.C5]

4.7.2.Q13: Does the PBL strategy include a "cost-plus" baselining period?

- If so, what is the strategy for reducing downtime and operating cost during the baselining period prior to negotiating a firm fixed-price contract? [4.7.2.C4 and 4.7.2.C5]

4.7.2.Q14: What incentives exist for the reduction of downtime and operating cost for any organic or contractor PBL? [4.7.2.C4 and 4.7.2.C5]

4.7.2.Q15: In the event a contractor PBL arrangement is selected but is unsuccessful, what is the exit strategy?

- What contractual provisions exist for the transfer of spare and repair parts, tools and test equipment, technical data, etc.? [4.7.2.C4 and 4.7.2.C6]

4.7.2.Q16: Will PBL contracts be awarded competitively or sole source?

- For any sole source contracts, what efforts are planned or have been made to ensure affordability of the PBL contract? [4.7.2.C4 and 4.7.2.C6]

4.7.2.Q17: Describe how PBL product support is linked to resources and performance [4.7.2.C6]

References

Defense Acquisition Guidebook (DAG). Chapter 5, "Life Cycle Logistics." Defense Acquisition University, https://akss.dau.mil/dag/.

DoDI 5000.2, "Operation of the Defense Acquisition System."

Designing and Assessing Supportability in DoD Weapon Systems.

Performance Based Logistics: A Program Manager's Product Support Guide.

MIL-PRF-49506**.** Logistics Management Information**,** Nov**ember** 1996**.**

Factor 4.7.3 – Sustainment

Pre-Milestone A

Criteria

4.7.3.C1: The program's overall support strategy is viable (i.e., workable and has real meaning and pertinence). Specific activities that must be performed to ensure availability of the required support products in a timely fashion are planned and are appropriate in scope and schedule.

4.7.3.C2: Sustainment activities for the next phase (supportability objectives refinement, product support planning, etc.) are fully funded to the requirement.

4.7.3.C3: Analytical activities during Concept Refinement Phase to determine logistics downtime and operating and support costs were thorough and based on credible inputs.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.7.3.Q1: How is corrosion control integrated into the acquisition and sustainment approach? Any unique incentives; innovative practices? [4.7.1.C1]

4.7.3.Q2: How is the program manager (PM) approaching management of "limited rights" data? (e.g., any use of deferred ordering, priced options for acquiring rights, data escrow)? [4.7.1.C1]

4.7.3.Q3: How is DMSMS (diminishing manufacturing sources and material shortages) /obsolescence planning integrated into the acquisition and sustainment approach? [4.7.1.C1]

4.7.3.Q4: What government-furnished equipment/government-furnished material (GFE/GFM) will be utilized on the program? How will GFE/GFM be managed? Are government resources (required personnel and funding) in place to manage GFE/GFM? [4.7.1.C3]

4.7.3.Q5: Is unique identification (UID) being implemented on the system? How is the program planning to leverage UID/radio-frequency ID (RFID) technology in sustainment? How will the program approach the what to mark, how to mark, where to mark decision process. Will marking information be included on drawings? [4.7.1.C1]

Pre-Milestone B

Criteria

4.7.3.C4: The program's overall support strategy is viable (i.e., workable and has real meaning and pertinence). Specific activities that must be performed to ensure availability of the required support products in a timely fashion are planned and are appropriate in scope and schedule.

4.7.3.C5: Sustainment activities for the next phase (provisioning, tech manual development, repair analysis, manpower, personnel and training planning, etc.) are fully funded to the requirement.

4.7.3.C6: Analytical activities during Technology Development to determine the product support strategy and to assess alternative support options were thorough and based on credible inputs.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.7.3.Q6: What is the schedule for the development, production and delivery of sustainment support products (spare repair parts, training material, aids and devices, special tools and test equipment, etc. [4.7.1.C4 and 4.7.3.C5]

4.7.3.Q7: What is the delivery schedule for delivery, validation, verification and updating of technical manuals? [4.7.1.C4]

4.7.3.Q8: How is corrosion control integrated into the acquisition and sustainment approach? Identify any unique incentives; innovative practices? [4.7.1.C4]

4.7.3.Q9: Has a Depot Source of Repair (DSOR) analysis been conducted? What was its result? If not, who will perform the DSOR and what is the schedule for its performance? [4.7.1.C4 and 4.7.3.C6]

4.7.3.Q10: What is the schedule for establishment of each level of maintenance capability? [4.7.1.C4]

4.7.3.Q11: How is DMSMS/obsolescence planning integrated into the acquisition and sustainment approach? [4.7.1.C4]

4.7.3.Q12: What GFE/GFM will be utilized on the program?

- How will GFE/GFM be managed?
- Are government resources (required personnel and funding) in place to manage GFE/GFM? [4.7.1.C4]

4.7.3.Q13: Is UID being implemented on the system?

- How is the program planning to leverage UID/RFID/IUID technology in sustainment?

- How will the program approach the what to mark, how to mark, where to mark decision process.
- Will marking information be included on drawings? [4.7.1.C4]

4.7.3.Q14: Has any analysis been performed on the supply chain?

- Are the lead times used in provisioning calculations supported by lead times through the supply chain? Are they similar to comparable components?
- Are planning lead times consistent with experience to date?
- Does the contractor perform supply chain management or supplier management?

Pre-Milestone C

4.7.3.C7: The program's overall support strategy is viable (i.e., workable and has real meaning and pertinence). Specific activities that must be performed to ensure availability of the required support products in a timely fashion are planned and are appropriate in scope and schedule.

4.7.3.C8: Sustainment activities for the next phase(spare and repair parts procurement, tech manual development/procurement, training aids and devices procurement, test support, etc.) are fully funded to the requirement.

4.7.3.C9: Analytical activities during System Development and Demonstration (SDD) to determine the requirements of support products (spare repair parts, special tools and test equipment, etc.) were thorough and based on credible inputs.

4.7.3.C10: (Customer and developer): The PM's life cycle support strategy pursues the development of improved maintenance practices and technologies throughout the product life cycle. Technology refreshment is planned to increase reliability and/or reduce operating and support cost.

Focus Questions

[Pertinent criteria numbers follow each question.]

4.7.3.Q15: What is the schedule for the development production and delivery of sustainment support products (spare and repair parts, special tools and test equipment, etc. [4.7.3.C7]

4.7.3.Q16: Will the components of the production configuration sustainment system be available to be tested as part of the full weapon system during operational testing? [4.7.3.C7]

4.7.3.Q17: How will the Supportability requirements in the Request for Proposal (RFP) ensure the availability of required supportability products to support testing and initial fielding? [4.7.3.C7]

4.7.3.Q18: What is the schedule for delivery of training system components (programs of instruction, training aids, and devices)?

- To what extent is there a plan to use the production training system to support operational testing? [4.7.3.C7]

4.7.3.Q19: What is the delivery schedule for delivery, validation, verification and updating of technical manuals?

- How complete is the technical data? [4.7.3.C7]

4.7.3.Q20: What technical manuals will not be available for Initial Operational Test and Evaluation (IOT&E)? [4.7.3.C7]

4.7.3.Q21: How is corrosion control integrated into the acquisition and sustainment approach? Any unique incentives; innovative practices? [4.7.3.C7]

4.7.3.Q22: How is the PM approaching management of "limited rights" data (e.g., any use of deferred ordering, priced options for acquiring rights, data escrow)? [4.7.3.C7 and 4.7.3.C10]

4.7.3.Q23: Has a DSOR analysis been conducted?

- What was its result?
- If not, who will perform the DSOR and what is the schedule for its performance?
- What is the schedule for establishment of depot capability? [4.7.3.C7 and 4.7.3.C9]

4.7.3.Q24: What is the schedule for establishment of each level of maintenance capability? [4.7.3.C7]

4.7.3.Q25: How is DMSMS/obsolescence planning integrated into the acquisition and sustainment approach? [4.7.3.C7]

4.7.3.Q26: What GFE/GFM will be utilized on the program? [4.7.3.C7]

4.7.3.Q27: What is the sensitivity of spares requirements to variations in reliability, maintainability (especially diagnostics/prognostic accuracy)? How do you mitigate the risk? [4.7.3.C7 and 4.7.3.C9]

4.7.3.Q28: Is UID being implemented on the system? How is the program planning to leverage UID/RFID/IUID technology in sustainment? How will the program approach the what to mark, how to mark, where to mark decision process. Will marking information be included on drawings? [4.7.3.C7]

4.7.3.Q29: Has any analysis been performed on the Supply Chain?

- Are the lead times used in provisioning calculations supported by lead times through the supply chain? Are they similar to comparable components?
- Are planning lead times consistent with experience to date?
- Does the contractor perform supply chain management or just supplier management? [4.7.3.C7 and 4.7.3.C9]

4.7.3.Q30: What is the logistics funding profile? Is the available funding sufficient to procure the full range and depth of support products? What was the basis for the operation and maintenance (O&M) budget projections? [4.7.3.C8]

4.7.3.Q31: What is the advanced procurement budget to support long lead time spares procurement? [4.7.3.C8]

4.7.3.Q32: What is the configuration control concept for training aids and devices? How will their configuration be kept current with the production baseline? [4.7.3.C7]

References

Defense Acquisition Guidebook (DAG). Chapter 5, "Life Cycle Logistics." Defense Acquisition University, https://akss.dau.mil/dag/.

Designing and Assessing Supportability in DoD Weapon Systems

DoDI 5000.2. "Operation of the Defense Acquisition System," May 12, 2003.

MIL-PRF-49506 Logistics Management Information

Performance Based Logistics: A Program Manager's Product Support Guide

5.0 PERFORMANCE

SUB-AREA 5.1 – EFFECTIVENESS

Description: Effectiveness is the overall degree of mission accomplishment of a system when used by representative personnel in the planned or expected environment for operational employment of the system considering organization, doctrine, tactics, survivability, vulnerability, and threat.

Scope: This sub-area involves the assessment of key parameters that directly contribute to the ability of the weapon system to meet effectiveness in its intended operational environment under realistic conditions.

Perspective: The Joint Capabilities Integration and Development System (JCIDS) implements a capabilities-based approach to identify improvements to existing capabilities and to develop new warfighting capabilities. A capability is the ability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. JCIDS documents (Initial Capabilities Document (ICD), Capabilities Development Document (CDD), Capability Production Document (CPD)) support the implementation of non-materiel solutions and the development and production of materiel solutions. The evaluation of operational effectiveness is linked to the mission accomplishment of those materiel solutions.

The program manager (PM) is ultimately responsible for all aspects of the system development, including testing. The system evaluator and testers, in coordination with other members of the test and evaluation working-level integrated product team (T&E WIPT), should develop the test procedures and effectiveness measures based on the requirements and expected concepts of operations for the systems.

Test and evaluation (T&E) is conducted to ensure that a weapon system meets the validated requirements of the user. Operational tests are focused on operational requirements, effectiveness, and suitability. Critical operational issues (COIs) are the operational effectiveness and suitability issues the program must examine during the operational test (OT) to demonstrate the system's capability to perform its mission in a realistic scenario. Measures of effectiveness (MOEs) serve to demonstrate the system's capabilities and functions in response to critical operational issues. Operational effectiveness is linked to mission accomplishment by representative personnel in the environment planned or expected for operational employment of the system.

Factor 5.1.1 – Design Capabilities Assessment

Pre-Milestone A

None.

Pre-Milestone B and Milestone C

Criteria

5.1.1.C1: The Capabilities Development Document (CDD) and Capability Production Document (CPD) contain sufficient key performance parameters (KPPs) to capture the minimum operational effectiveness, suitability, and sustainment attributes needed to achieve the overall desired capabilities for the system.

5.1.1.C2: System level specifications, including KPPs, are established and are directly traceable to user requirements using established systems engineering methods and tools. A linkage exists between measure of effectiveness (MOE)/measure of suitability (MOS) (Analysis of Alternatives (AoA) and system evaluation plan), system requirements (CDD/CPD and specifications), and test and evaluation (T&E) (critical operational issues (COIs) and critical technical parameters (CTPs)). The linkage allows for evaluation of whether the system remains cost and operationally effective when performance shortfalls are found during T&E.

5.1.1.C3: Technical performance measures (TPMs) are used by the developer and program management office (PMO) to track the key indicators of system performance: the actual versus planned progress of KPPs and other key effectiveness measures. System technical performance requirements are compatible (i.e., executable within the program cost, schedule, and risk).

5.1.1.C4: A technical performance baseline is in place down to the subsystem level, from which the system performance thresholds can be compared and tracked.

5.1.1.C5: The Test and Evaluation Master Plan (TEMP) contains COIs that establish the final standards of performance for the system. The COIs serve as criteria that cover a system's minimum needs for operational effectiveness, suitability, and survivability. There is compatibility between the COIs and the system specifications.

5.1.1.C6: Sufficient CTPs are identified in the TEMP and measure critical system characteristics that, when achieved, allow the attainment of desired operational performance capabilities. With each technical parameter, thresholds are identified for each stage of development. The listed thresholds reflect growth as the system progresses toward achieving the desired capabilities. Developmental test events measure the performance of the system as it matures. Failure to achieve a CTP is considered a reliable indicator that the system is behind in the planned development schedule or will likely not achieve an operational requirement.

5.1.1.C7: Sufficient testing is planned to verify effectiveness. Testing is planned early enough to affect design. Each requirement at each level of development is verifiable. Methods of verification include examination, demonstration, analysis, and testing. Verified and validated modeling and simulation (M&S), supported by validated test data, is used to support the testing process to evaluate the performance and maturity of the technology under development.

5.1.1.C8: A development test has verified that the design solution meets the system technical requirements and the system is prepared for successful Operational Test and Evaluation (OT&E). Testing activities have/will assess progress toward resolving critical operational issues, the validity of cost-performance tradeoff decisions, the mitigation of acquisition technical risk, and the achievement of system maturity.

5.1.1.C9: A "how-to" test matrix has been developed to identify verification (inspection, analysis, demonstration, test) methods for each test requirement.

5.1.1.C10: The program manager (PM) has developed metrics (hardware and software), in the form of T&E success criteria and OT&E entrance criteria in consultation with the Office of Technology Assessment (OTA), to use in monitoring program maturity and to support decisions to progress through the development cycle.

5.1.1.C11: The system is planned to be stressed under test to at least the limits of the Operational Mode Summary/Mission Profile, and for some systems, beyond the normal operating limits to ensure the robustness of the design. This ensures that expected operational performance environments can be satisfied.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.1.1.Q1: Did the CDD/CPD capture those requirements needed to adequately define the system?

- Are requirements captured in a requirements traceability program such as DOORS?
- Are any requirements orphans, or do they all have parents? [5.1.1.C1 and 5.1.1.C2]

5.1.1.Q2: Provide and describe your system and lower-level specifications of the performance and verification requirements.

- Include traceability to user requirements. [5.1.1.C2]

5.1.1.Q3: Explain how it has been determined that the technical performance requirements are executable within the program baselines. [5.1.1.C3 and 5.1.1.C4]

5.1.1.Q4: Describe the effectiveness of COIs and their related MOEs. [5.1.1.C5]

5.1.1.Q5: Do the CTPs have intermediate success criteria associated with a particular stage of development?

- How are failures of a CTP during a stage handled?
- Identify any performance parameter that has not demonstrated its threshold requirement. [5.1.1.C6]

5.1.1.Q6: Provide the specified verification requirements and the current verification test matrix that depicts the planned test methods versus the verification requirements identified in the system and lower-level specifications. [5.1.1.C7]

5.1.1.Q7: Have you formed a senior program leaders' integrated process/product team (IPT)?

- Describe the membership, function, and responsibilities of this IPT.
- What part did the test and **e**valuation working-level integrated product team (T&E WIPT) have in planning to verify effectiveness? [5.1.1.C8 and 5.1.1.C9]

5.1.1.Q8: Was testing planned as integrated test and evaluation to include the program office, developer, and operational testing agency?

- Were OT&E entrance criteria planned in consultation with the OTA? [5.1.1.C10]

5.1.1Q9: What environment will the system be used in?

- Was testing planned and conducted in this environment?
- Was the testing successful? [5.1.1.C11]

References

DoD Instruction 5000.2. "Operation of the Defense Acquisition System," May 12, 2003.
CJCSM 3170.01C. "Operation of the Joint Capabilities Integration and Development System," May 2007.
Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.
Systems Engineering Fundamentals, 2001.
Test and Evaluation Management Guide, January 2005.

SUB-AREA 5.2 – SUITABILITY

Description: The ultimate goal of an acquisition program is to produce a system that is effective for its intended purpose, suitable for use in the anticipated environment, and affordable to acquire and operate. Acceptable suitability requires the system to be reliable during use (mission reliability), ready when needed (operational availability), have a low overall failure rate (logistics reliability and materiel availability), be easy to repair (maintainability), and require minimal support (reduced logistics footprint).

Scope: The evaluation of this sub-area involves determining the adequacy and depth of the program's plans for reliability, availability, and maintainability (RAM) during concept development; ensuring that requirements are reasonable, achievable, effective for the warfighter, and affordable during Technology Development; evaluating the achieved RAM or establishing a process to achieve the necessary RAM during system development and demonstration; assessing actual RAM achieved, while implementing any corrective actions necessary to ensure that the system is

suitable for use, during production and deployment; and ultimately collecting data and performing analyses to calculate actual in-service RAM performance attained.

Perspective: The program manager (PM) should establish RAM objectives early in the acquisition cycle and address them as a design parameter throughout the acquisition process. The PM develops RAM system requirements based on the Initial Capabilities Document or Capabilities Development Document and total ownership cost (TOC) considerations, and states them in quantifiable, operational terms, measurable during Development Test and Evaluation (DT&E) and Operational Test and Evaluation (OT&E). RAM system requirements address all elements of the system, including support and training equipment, technical manuals, spare parts, and tools. These requirements are derived from and support the user's system readiness objectives. Reliability requirements address mission reliability and logistics reliability. The former addresses the probability of carrying out a mission without a mission critical failure. The latter is the ability of a system to perform as designed in an operational environment over time without any failures. Availability requirements address the readiness of the system. Availability is a function of the ability of the system to perform without failure (reliability) and to be quickly restored to service (a function of both maintainability and the level and accessibility of support resources).

Maintainability requirements address the ease and efficiency with which servicing and preventive and corrective maintenance can be conducted; that is, the ability of a system to be repaired and restored to service when maintenance is conducted by personnel of specified skill levels and prescribed procedures and resources. Application of RAM and producibility activities during design, development, and sustainment is guided by a concise understanding of the concept of operations, mission profiles (functional and environmental), and desired capabilities. These are, in turn, invaluable to understanding the rationale behind RAM and producibility activities and performance priorities, and pave the way for decisions about necessary trade studies between system performance, availability, and system cost, with impact on the cost-effectiveness of system operation, maintenance, and logistics support. The focus on RAM should be complemented by emphasis on system manufacturing and assembly, both critical factors related to the production and manufacturing, and to the sustainment cost of complex systems. The PM plans and executes RAM design, manufacturing development, and test activities so that the system elements, including software, that are used to demonstrate system performance before the production decision reflect a mature design. Initial Operational Test and Evaluation (IOT&E) uses production representative systems, actual operational procedures, and personnel with representative skill levels. To reduce testing costs, the PM should utilize modeling and simulation (M&S) in the demonstration of RAM requirements, wherever appropriate. (See DoD 3235.1-H.)

An additional challenge associated with RAM is the stochastic nature of the performance parameter. Typically, a large proportion of system requirements is deterministic and can be easily and repeatedly measured; for example, the weight of an item is easily measured and can be repeated on a consistent basis. By contrast, a test of the reliability of an item is an evaluation of a sample, from which the population performance is inferred. The item may be performing to its average reliability requirement as specified, but the sample may return a higher or lower value. Repeated or more extensive samples would provide greater information about the underlying performance. The true reliability of the item is never really known until the item has completed its service. Until that point, the performance may be sampled, and confidence bounds determined for the population performance. Development of RAM requirements and the associated demonstration methods needs to consider the stochastic nature of these parameters.

Factor 5.2.1 – Reliability Assessment

Pre-Milestone A

Criteria

5.2.1.C1: Reliability requirements must meet user's needs and expectations while also being achievable, reasonable, measurable, and affordable.

5.2.1.C2: Materiel reliability (a sustainment key system attribute (KSA)) consists of two parts for which requirements will be indentified/established:

1. Mission reliability: Defined as the probability that the system will operate as intended without mission critical failure throughout a specified mission.
2. Logistics reliability: The mean time between failures (MTBF) of any type whether mission critical or not.

Note: Mission reliability is thus a subset of logistics reliability. Mission reliability is measured using mean time between mission affecting failures (MTBMAF), mean time between critical failures (MTBCF), mean time between system aborts (MTBSA), or other similar conditional MTBFs as required.

5.2.1.C3: Ownership cost (a sustainment KSA) is directly affected, through maintenance and support costs, by a system's logistics reliability. The relationship between the logistics reliability requirements and ownership cost must be considered from the earliest program stages.

5.2.1.C4: The level of system reliability achieved must be demonstrated during the Technology Development (TD) and System Development and Demonstration (SDD) phases to support Low-Rate Initial Production (LRIP) and Full-Rate Production (FRP) decisions. Planning for, and funding of, the demonstration efforts start during the earliest program stages.

5.2.1.C5: Assumptions made when determining reliability requirements must be documented (in the Reliability, Availability, Maintainability–Cost (RAM-C) Report and the Reliability Case) and revised as necessary throughout the program's life cycle.

5.2.1.C6: Reliability related risks must be identified, documented, and mitigated throughout the program's life cycle.

5.2.1.C7: Achieved mission reliability is dependent on how the system is used. Early determination of the Operational Mode Summary/Mission Profile (OMS/MP), Operations Tempo (OPTEMPO), and related definitions of operating hours are required for effective reliability planning to occur.

5.2.1.C8: Reliability alternatives must be investigated in order to optimize system materiel availability, operational availability, and life cycle cost (LCC).

5.2.1.C9: Reliability metrics (MTBF, MTBMAF, MTBCF, etc.), either predicted or measured, are invariably estimates requiring that stochastic (i.e., confidence interval) considerations be included.

5.2.1.C10: The effect on support approaches, LCC, and ownership cost of varying reliability values must be considered throughout the program life cycle.

Note: Availability is measured using some form of the equation:

$$Availability = \frac{Uptime}{Uptime + Downtime}$$

Determination of the uptime required (MTBF) requires understanding that the uptime and downtime required are proportional for any given value of availability. Thus availability may be improved by improving the uptime, reducing the downtime, or a combination of both.

5.2.1.C11: The goals of early determination of reliability thresholds and objectives are to help set the trade-space between LCC and logistics footprint reductions. Elements to consider are increased design and acquisition costs versus reduced operating and support costs.

5.2.1.C12: The Analysis of Alternatives (AoA) performed during the Concept Development phase must include evaluation and optimization of the relationships between availability, reliability, support, and LCC (including ownership cost) at a rough level for all candidate approaches until the preferred approach is selected. The analysis of the preferred approach is then further refined and included in program documentation (Initial Capabilities Document (ICD), RAM-C Report, etc.) as required.

5.2.1.C13: The program manager (PM) is responsible for ensuring that established reliability requirements are met. The PM also is responsible for evaluating the achieved level of reliability throughout the program's life cycle.

Note: Some ways for the PM to ensure that the requirements are met include:

- *A robust systems engineering process throughout the life cycle*
- *Reliability experts involved throughout the life cycle*
- *A corrective action system in place*

- *Development testing at the component, subsystem, and system levels*
- *A reliability growth program*
- *Reliability enhancement testing (Highly Accelerated Life Testing (HALT), Accelerated Life Testing (ALT), etc.)*
- *Modeling and simulation (M&S)*

Some ways for the PM to evaluate the achieved level of reliability include:

- *Reliability demonstration testing*
- *Operational testing*
- *Data collection and analysis (Data Collection Analysis and Corrective Action System (DCACAS)/Failure Reporting, Analysis and Corrective Action System (FRACAS))*
- *Updated reliability modeling and analysis throughout the life cycle*

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.1.Q1: How does the mission reliability requirement meet the user's needs? [5.2.1.C1]

5.2.1.Q2: What mission reliability needs have been identified (thresholds and objectives) and incorporated into the ICD? [5.2.1.C2]

5.2.1.Q3: What logistics reliability requirements have been identified (thresholds and objectives) and incorporated into the ICD? [5.2.1.C2]

5.2.1.Q4: What rationale forms the basis for mission and logistics reliability requirements? [5.2.1.C2]

5.2.1.Q5: How does the logistics reliability requirement affect the planned support system and ownership cost? [5.2.1.C3]

5.2.1.Q6: What reliability cost drivers are incorporated into the Cost Analysis Requirements Description (CARD) (or CARD-like document)? [5.2.1.C3]

5.2.1.Q7: What validation plans are in place to evaluate the reliability requirements? [5.2.1.C4]

5.2.1.Q8: What are the reliability related assumptions and supporting rationale? [5.2.1.C5]

5.2.1.Q9: What are the identified reliability risks and mitigations of those risks? [5.2.1.C6]

5.2.1.Q10: What is the expected OMS/MP? [5.2.1.C7]

5.2.1.Q11: What OPTEMPO is being planned for? [5.2.1.C7]

5.2.1.Q12: How are operating hours documented? [5.2.1.C7]

5.2.1.Q13: What reliability alternatives were investigated? [5.2.1.C8]

5.2.1.Q14: How has the probabilistic nature of reliability been accommodated in the requirements? [5.2.1.C9]

5.2.1.Q15: How have the reliability requirements been incorporated into the support plans? [5.2.1.C10]

5.2.1.Q16: What are the rough estimates for cost-to-design in various levels of reliability? [5.2.1.C11]

5.2.1.Q17: What are the estimated reductions in life cycle costs and logistics footprint for the chosen level of reliability? [5.2.1.C11]

5.2.1.Q18: How were reliability considerations incorporated into the AoA? [5.2.1.C12]

5.2.1.Q19: How does the PM ensure that the reliability requirements are achievable and verifiable within program schedule and budget?

- How does the PM ensure that reliability experts are involved throughout the life cycle?
- What is the planned corrective action system?
- What development test events are anticipated?
- What M&S work is planned? [5.2.1.C13]

5.2.1.Q20: How does the PM plan to evaluate the achieved reliability of the system?

- What reliability demonstration test (DT) events are planned?
- How will DT and operational test (OT) event results be used to update reliability analyses?
- What is the program's plan for collecting data to evaluate reliability?
- What analyses are planned to ensure that reliability meets requirements? [5.2.1.C13]

Pre-Milestone B

Criteria

5.2.1.C15: The Request for Proposal (RFP) includes contractual language related to reliability. *Note: Contractual reliability requirements must be translated from the user's stated requirements. For example, if the user's mission reliability requirement is "…a 90% chance of completing a 10-hour mission without a mission affecting failure," the required MTBMAF is found by solving*

$$0.90 = e^{-\frac{10 hours}{MTBMAF}} \text{ for MTBMAF. The translation is } MTBMAF = -\frac{10\,hours}{\ln 0.90} = 94.91\,hours\,.$$

5.2.1.C16: Reliability requirements must be allocated from the system level down to the subsystem, assembly, sub-assembly, and component levels for any repairable or replaceable parts. These allocations start with the major subsystems during the Technology Development (TD) phase and are refined to lower levels as applicable during the System Development and Demonstration (SDD) phase.

5.2.1.C17: Department of Defense (DoD) policy mandates a robust reliability program, including reliability growth, throughout TD, SDD, and Production and Deployment (PD) phases to ensure that

reliability is mature at the FRP decision. A robust reliability program includes ongoing analysis of reliability demonstrated to date.

5.2.1.C18: The reliability program is documented in a reliability program plan. The Reliability Program Plan describes in detail all reliability activities anticipated, including schedules, relating to evaluating and enhancing system reliability.

5.2.1.C19: Reliability activities are documented in the Systems Engineering Plan (SEP).

5.2.1.C20: M&S is used to evaluate predicted system reliability throughout the life cycle.

5.2.1.C21: All test event data are assessed and, where appropriate, incorporated into the reliability analyses.

5.2.1.C22: The supplier has a valid reliability program approach as demonstrated by past performance and their program specific reliability approach.

5.2.1.C23: Poor manufacturing processes can degrade the system's inherent reliability, so the PM must plan to evaluate supplier production processes and controls in order to support reliability risk management efforts.

5.2.1.C24: Human systems integration (HSI) must be addressed in order to minimize the probability of:

- Failures induced during system maintenance, operation, and handling
- Operator errors leading to mission failures

5.2.1.C25: Environmental and stress loads affect achieved reliability—which is especially true for commercial-off-the-shelf (COTS) and non-developmental items (NDI)—so the program performs lower-level stress analyses (including measurement of actual stresses when possible) in order to support reliability risk management efforts.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.1.Q21: What contractual reliability requirements have been established and incorporated into the RFP? [5.2.1.C15]

5.2.1.Q22: How are incentives for achieved reliability incorporated into the contract? [5.2.1.C15]

5.2.1.Q23: How do the contractual reliability requirements support the user's reliability requirements (i.e., what translations were performed)? [5.2.1.C15]

5.2.1.Q24: How are the reliability requirements documented in the system specifications? [5.2.1.C15]

5.2.1.Q25: How have the reliability requirements been allocated to lower levels? [5.2.1.C16]

5.2.1.Q26: What reliability assessment and growth program approach is included in the RFP? [5.2.1.C17]

5.2.1.Q27: What are the evaluation criteria for growth program progress? [5.2.1.C17]

5.2.1.Q28: How does the program intend to demonstrate achieved reliability with an associated confidence level? [5.2.1.C17]

5.2.1.Q29: What are the program's phased exit criteria for demonstrated reliability? [5.2.1.C17]

5.2.1.Q30: What is the reliability program plan and how is it documented? [5.2.1.C18]

5.2.1.Q31: What reliability engineering and physics of failure (PoF) processes have been initiated (DCACAS/FRACAS, sneak circuit analysis, reliability enhancement testing, finite element analysis, thermal analysis, etc.)? [5.2.1.C18]

5.2.1.Q32: How is reliability incorporated into the SEP? [5.2.1.C19]

5.2.1.Q33: How has the program incorporated reliability M&S? [5.2.1.C20]

5.2.1.Q34: How has the DT plan incorporated reliability-relevant environments? [5.2.1.C21]

5.2.1.Q35: How is the reliability program evaluated (suggest using the reliability program scoring template)? [5.2.1.C22]

5.2.1.Q36: How does the program plan to evaluate production processes to ensure that the inherent reliability of the design is maintained throughout production? [5.2.1.C23]

5.2.1.Q37: How have HSI concerns been addressed to mitigate induced failures? [5.2.1.C24]

5.2.1.Q38: What component load and environmental analyses have been performed to ensure that subsystem environmental concerns are known? [5.2.1.C25]

Pre-Milestone C

Criteria

5.2.1.C26: Lessons learned during the TD and SDD phases must be fed back into the program's documentation, especially where support strategies, operational approaches, and LCC are involved.

5.2.1.C27: Reliability models must be updated throughout the development and fielding of the system in order to fully support tradeoffs, system performance analyses, and system optimization efforts. Fielded reliability achieved must be evaluated and documented to allow updating of system support approaches, cost assessments, and improvement efforts.

5.2.1.C28: Reliability test results—including growth testing—must be evaluated in real time to ensure that achieved reliability is sufficient to support the FRP decision and Initial Operational Capability (IOC)/Full Operational Capability (FOC) phases.

5.2.1.C29: Proper reliability risk management requires evaluation of planned versus achieved results throughout the program's life cycle.

5.2.1.C30: Ongoing evaluation of the actual in-service environment, OPTEMPO, and achieved reliability is required to ensure that the OMS/MP and failure definitions (FD)/scoring criteria (SC) are up to date and accurately support system reliability and test analyses.

5.2.1.C31: Reliability testing during DT and Director, Operational Test and Evaluation (DOT&E) events must be planned, reviewed, documented, and the results evaluated for inclusion into the program's reliability documentation.

5.2.1.C32: Poor manufacturing processes can degrade the system's inherent reliability, so the program must plan to evaluate supplier production processes and controls in order to support reliability risk management efforts.

5.2.1.C33: The PM is responsible for ensuring that established reliability requirements are met. The PM also is responsible for evaluating the achieved level of reliability throughout the program's life cycle.

Note: Some ways for the PM to ensure that the requirements are met include:

- A robust systems engineering process throughout the life cycle
- Reliability experts involved throughout the life cycle;
- A corrective action system in place
- Development testing at the component, subsystem, and system levels
- A reliability growth program
- Reliability enhancement testing (HALT, ALT, etc.)
- M&S

Some ways for the PM to evaluate the achieved level of reliability include:

- Reliability demonstration testing
- Operational testing
- Data collection and analysis (DCACAS/FRACAS)
- Updated reliability modeling and analysis throughout the life cycle

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.1.Q39: How have reliability lessons learned been incorporated into the SEP and the Reliability Program Plan? [5.2.1.C26]

5.2.1.Q40: How have the outputs of engineering and PoF analyses been used to improve the achieved reliability of the system? [5.2.1.C26]

5.2.1.Q41: What are the updated reliability estimates, risks, and mitigations? [5.2.1.C27]

5.2.1.Q42: What is the demonstrated reliability (system, subsystem, or components) to date and documented in the Capability Production Document (CPD)? [5.2.1.C27]

5.2.1.Q43: What are the results of updated reliability M&S? [5.2.1.C27]

5.2.1.Q44: How have updated reliability models been incorporated into the supportability analysis? [5.2.1.C27]

5.2.1.Q45: What are the results of all completed reliability tests, and do they support the planned reliability? [5.2.1.C28]

5.2.1.Q46: What additional reliability testing is planned? [5.2.1.C28]

5.2.1.Q47: What is the status of the reliability growth program? [5.2.1.C28]

5.2.1.Q48: What rationale supports the analysis of the reliability growth program? [5.2.1.C28]

5.2.1.Q49: What logistics footprint reductions have been realized? [5.2.1.C29]

5.2.1.Q50: What is the evaluation of the contractor's reliability program (suggest using the reliability program scoring template)? [5.2.1.C29]

5.2.1.Q51: What is the in-service environment? [5.2.1.C30]

5.2.1.Q52: How was the in-service environment characterized? [5.2.1.C30]

5.2.1.Q53: How has the OMS/MP been affected by the in-service environment? [5.2.1.C30]

5.2.1.Q54: What are the documented FD/SC? [5.2.1.C30]

5.2.1 Q55: How is reliability testing addressed in the Test and Evaluation Master Plan (TEMP)? [5.2.1.C31]

5.2.1.Q56: How will maintenance be performed during system DT/OT? [5.2.1.C31]

5.2.1.Q57: What are the planned reliability assessment methods for DT/OT? [5.2.1.C31]

5.2.1.Q58: How are the test requirements related to user needs (i.e., is there a traceability matrix)? [5.2.1.C31]

5.2.1.Q59: How does operationally realistic subsystem and system testing support the reliability growth assessment? [5.2.1.C31]

5.2.1.Q60: What are the key manufacturing factors affecting reliability? [5.2.1.C32]

5.2.1.Q61: What manufacturing optimization efforts are under way? [5.2.1.C32]

5.2.1.Q62: What have been the results of pilot manufacturing line efforts? [5.2.1.C32]

5.2.1.Q63: What evidence of manufacturing capability and process maturity has been developed? [5.2.1.C32]

5.2.1.Q64: How are DCACAS/FRACAS and Test, Analyze, and Fix (TAAF) resourced throughout production? [5.2.1.C33]

Post-Milestone C

Criteria

5.2.1.C34: Under the concept of total life cycle planning, the PM is responsible for evaluating how the system performs once fielded.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.1.Q65: How does the system's Initial Operational Test and Evaluation (IOT&E) performance compare with user requirements (OT report, reliability case, updated risk management, etc.)?

[5.2.1.C34]

5.2.1.Q66: What reliability risk mitigation plans are in place? [5.2.1.C34]

5.2.1.Q67: What are the in-service reliability monitoring and trend analyses results? [5.2.1.C34]

5.2.1.Q68: What is the program plan for obsolescence? [5.2.1.C34]

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Factor 5.2.2 – Availability Assessment

Pre-Milestone A

Criteria

5.2.2.C1: Materiel availability, the sustainment key production parameter (KPP), is primarily defined as:

$$A_M = \frac{Number\ of\ Systems\ Operational}{Total\ Population\ of\ Systems\ Acquired}$$

Unlike traditional measures of operational availability, materiel availability systems that are not operationally assigned (at depot for repair, in a float condition, reserved as spares, etc.) are considered to be "down" until operationally tasked.

5.2.2.C2: Evaluation of materiel availability (and operational availability for that matter) requires a full understanding of the Operational Mode Summary/Mission Profile (OMS/MP), Operations Tempo (OPTEMPO), the probabilistic measures of reliability and maintainability, and a clear definition of operating hours.

5.2.2.C3: Operational availability, while not a KPP, is an important measure of system suitability for a defined mission. Operational availability values for a given system will vary depending on the mission profile, critical function requirements, and frequency, so operational availability thresholds and objectives must be established for each mission in the OMS/MP.

5.2.2.C4: Generally, achieved availability is a function of the system's uptimes (mean time between failure (MTBF)) and maintenance down times (MDT). Availability can be increased by increasing reliability (with a requisite increase in acquisition costs), decreasing MDT (which will increase support costs), or a combination of the two approaches.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.2.Q1: What is the total number of systems planned to be acquired? [5.2.2.C1]

5.2.2.Q2: How will the acquired systems be apportioned between operational assignments and non-operational ones (spares, float, reserve, etc.)? [5.2.2.C1]

5.2.2.Q3: What materiel availability requirements and rationale have been established? [5.2.2.C1]

5.2.2.Q4: What is the expected OMS/MP? [5.2.2.C2]

5.2.2.Q5: What OPTEMPO is anticipated? [5.2.2.C2]

5.2.2.Q6: How has the probabilistic nature of reliability and maintainability measures been accommodated in the requirements? [5.2.2.C2]

5.2.2.Q7: How are operating hours documented? [5.2.2.C2]

5.2.2.Q8: What operational availability requirements have been established for the missions covered in the OMS/MP? [5.2.2.C3]

5.2.2.Q9: How does the planned support structure ensure that availability requirements, both materiel and operational, will be met given the planned logistics reliability and maintenance approaches? [5.2.2.C4]

5.2.2.Q10: What are the anticipated drivers of system downtime (failures, preventive maintenance, overhaul, etc.)? [5.2.2.C4]

Pre-Milestone B

Criteria

5.2.2.C5: Measurable materiel availability (A_M) requirements are included in the Request for Proposal (RFP) along with the anticipated availability assessment approach.

5.2.2.C6: Materiel availability exit criteria, covering all major systems engineering events, must be developed early in the program and evaluated/updated as necessary.

Note: Demonstration test (DT) and Director, Operational Test and Evaluation *(DOT&E) events rarely use a realistic support structure, so availability estimates may not be possible based on test results alone. As such, modeling and simulation (M&S) for reliability, availability, and maintainability (RAM) should be used to determine predicted and/or achieved availability throughout the system life cycle.*

5.2.2.C7: The program must have a process in place to monitor, evaluate, score, and initiate corrective action when required for all system downtime events.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.2.Q11: What contractual materiel availability requirements have been established? [5.2.2.C5]

5.2.2.Q12: What availability assessment approach is included in the RFP? [5.2.2.C5]

5.2.2.Q13: What are the program's phased exit criteria for demonstrated availability (either materiel or operational)? [5.2.2.C6]

5.2.2.Q14: How has the program incorporated RAM M&S?[5.2.2.C6]

5.2.2.Q15: What is the program's approach to evaluating operational availability during test and maintenance demonstration events? [5.2.2.C6]

5.2.2.Q16: How has the DT plan incorporated relevant environments? [5.2.2.C6]

5.2.2.Q17: What is the program's approach to measuring system downtime events? [5.2.2.C7]

Pre-Milestone C

Criteria

5.2.2.C8: The materiel availability KPP requires evaluation of the demonstrated and estimated values achieved throughout the program. Materiel availability risk assessment must be performed and documented continuously (in the Reliability, Availability, Maintainability-Cost (RAM-C) Report, risk management plan, Initial Capabilities Document (ICD)/Capabilities Development Document (CDD)/Capability Production Document (CPD), Systems Engineering Master Plan (SEMP), etc.) throughout the life cycle in order to support achievement of the estimated values.

5.2.2.C9: The RAM M&S effort must be updated with all relevant data throughout the program's life cycle.

5.2.2.C10: Detailed analysis of the actual in-service environment, OMS/MP, and OPTEMPO is required for accurate RAM assessment and prediction.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.2.Q18: What is the demonstrated availability (system, subsystem, or components) to date documented in the CPD? [5.2.2.C8]

5.2.2.Q19: What are the updated availability estimates, risks, and mitigations? [5.2.2.C8]

5.2.2.Q20: What are the results of all completed test events, and do they support the planned operational and materiel availability requirements? [5.2.2.C8]

5.2.2.Q21: What additional testing is planned? [5.2.2.C8]

5.2.2.Q22: What rationale supports the analysis of the achieved availability? [5.2.2.C8]

5.2.2.Q23: What are the results of updated availability M&S? [5.2.2.C9]

5.2.2.Q24: What is the in-service environment? [5.2.2.C9]

5.2.2.Q25: How was the in-service environment characterized? [5.2.2.C10]

5.2.2.Q26: How has the OMS/MP been affected by the in-service environment? [5.2.2.C10]

5.2.2.Q27: What are the updated operational availability values based on lessons learned? [5.2.2.C12]

Post-Milestone C

Criteria

5.2.2.C11: The program must constantly evaluate actual RAM performance throughout the Production and Deployment (PD) phase in order to demonstrate that the metrics have been met.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.2.Q28: What is the system's fielded availability (materiel and operational)? [5.2.2.C11]

5.2.2.Q29: What are the in-service availability monitoring and trend analyses results? [5.2.2.C11]

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Factor 5.2.3 – Maintainability Assessment

Pre-Milestone A

Criteria

5.2.3.C1: Evaluation of the ownership cost key system attribute (KSA) requires a full understanding of the Operational Mode Summary/Mission Profile (OMS/MP), Operations Tempo (OPTEMPO), the probabilistic measures of reliability and maintainability, and a clear definition of operating hours.

The program's technical baseline must be sufficient to support valid cost estimates, with the appropriate level of fidelity, from the earliest stages of program development and planning.

5.2.3.C2: Maintainability requirements must meet user's needs and expectations while also being achievable, reasonable, measurable, and affordable. The probabilistic nature of maintainability requirements (i.e., confidence levels) must be included to ensure the requirement is completely specified.

5.2.3.C3: The reliability, availability, and maintainability (RAM) requirements must be evaluated for consistency once established, and then whenever any significant change is made.

5.2.3.C4: The program manager (PM) is accountable for the system's RAM performance throughout the program life cycle. The PM's duties include ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, and the program is properly staffed for RAM throughout the life cycle; tracking and mitigating RAM risks; and verifying RAM performance throughout the life cycle.

Focus Questions
[Pertinent criteria numbers follow each question.]

5.2.3.Q1: How does the planned sustainment approach support program cost estimates (life cycle costs (LCC), ownership cost (OC), etc.)? [5.2.3.C1]

5.2.3.Q2: What maintainability cost drivers (spares, planned maintenance, unplanned maintenance, transportation, personnel, and facility needs, etc.) have been identified? [5.2.3.C1]

5.2.3.Q3: What are the system level maintainability requirements? [5.2.3.C2]

5.2.3.Q4: How do the maintainability requirements incorporate thresholds/objectives and probabilistic concerns? [5.2.3.C2]

5.2.3.Q5: How does the program ensure that the established maintainability requirements meet the customer's needs and expectations? [5.2.3.C2]

5.2.3.Q6: How does the program ensure that the RAM requirements are correctly stated to meet program objectives while being consistent with one another? [5.2.3.C3]

5.2.3.Q7: How does the PM ensure that maintainability experts are included in all major program decisions throughout the system's life cycle? [5.2.3.C4]

5.2.3.Q8: What is the rationale for the chosen supportability approach? [5.2.3.C4]

5.2.3.Q9: What maintainability risks, including any related to the use of non-developmental items (NDI)/commercial-off-the-shelf (COTS) items, have been identified, documented, and mitigated? [5.2.3.C4]

5.2.3.Q10: How were maintainability tradeoffs included in the Analysis of Alternatives (AoA) to support selection of the preferred system approach? [5.2.3.C4]

5.2.3.Q11: What maintainability requirements and agreements (performance-based logistics (PBLs), incentives, etc.) are included in the Request for Proposal (RFP)? [5.2.3.C4]

Pre-Milestone B

Criteria

5.2.3.C5: Maintainability requirements must meet user's needs and expectations while also being achievable, reasonable, measurable, and affordable. The probabilistic nature of maintainability requirements (i.e., confidence levels) must be included to ensure that the requirement is completely specified.

5.2.3.C6: Evaluation of the ownership cost KSA requires a full understanding of the OMS/MP, OPTEMPO, the probabilistic measures of reliability and maintainability, and a clear definition of operating hours. The program's technical baseline must be sufficient to support valid cost estimates, with the appropriate level of fidelity, from the earliest stages of program development and planning.

5.2.3.C7: The RAM requirements must be evaluated for consistency once established, and then whenever any significant change is made.

5.2.3.C8: The PM is accountable for the system's RAM performance throughout the program life cycle. The PM's duties include ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, and the program is properly staffed for RAM throughout the life cycle; tracking and mitigating RAM risks; and verifying RAM performance throughout the life cycle.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.3.Q12: What are the maintainability measures (mean down time (MDT), mean time to repair (MTTR), administrative delay time (ADT), logistics delay time (LDT), etc.), with confidence levels, derived for each mission in the OMS/MP? [5.2.3.C5]

5.2.3.Q13: What is the updated ownership cost KSA estimate and rationale? [5.2.3.C6]

5.2.3.Q14: What is the rationale for ensuring that the maintainability measures are reasonable, cost-effective, and consistent (maintenance demos, modeling and simulation (M&S), historical data, etc.)? [5.2.3.C7]

5.2.3.Q15: What are the maintainability risks identified, documented, and mitigated? [5.2.3.C8]

5.2.3.Q16: What maintainability requirements and incentives are included in the contract? [5.2.3.C8]

5.2.3.Q17: How has the support plan been updated with lessons learned during Technology Development? [5.2.3.C8]

Pre-Milestone C

Criteria

5.2.3.C9: Evaluation of the ownership cost KSA requires a full understanding of the OMS/MP, OPTEMPO, the probabilistic measures of reliability and maintainability, and a clear definition of operating hours. The program's technical baseline must be sufficient to support valid cost estimates, with the appropriate level of fidelity, from the earliest stages of program development and planning.

5.2.3.C10: Maintainability requirements must meet user's needs and expectations while also being achievable, reasonable, measurable, and affordable. The probabilistic nature of maintainability requirements (i.e., confidence levels) must be included to ensure that the requirement is completely specified.

5.2.3.C11: The RAM requirements must be evaluated for consistency once established, and then whenever any significant change is made.

5.2.3.C12: The PM is accountable for the system's RAM performance throughout the program life cycle. The PM's duties include ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, and the program is properly staffed for RAM throughout the life cycle; tracking and mitigating RAM risks; and verifying RAM performance throughout the life cycle.

5.2.3.C13: Production-induced quality issues, or simply poor design for producibility, can adversely affect the maintainability of the system in the field. As such, the PM must ensure that proper production processes and controls are in place.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.3.Q18: What is the program's ownership cost estimate, rationale, and relationship to the requirements? [5.2.3.C9]

5.2.3.Q19: What is the program's assessment (with rationale) of achieved maintainability demonstrated to date? [5.2.3.C10]

5.2.3.Q20: How is the support plan updated with lessons learned? [5.2.3.C11]

5.2.3.Q21: What effects attributable to refinements of estimated use environments, the OMS/MP, OPTEMPO, testability, etc., have been documented? [5.2.3.C11]

5.2.3.Q22: How is maintainability M&S incorporated into the system approach? [5.2.3.C11]

5.2.3.Q23: How has the program included the planned support activities, with maintainability measures, in system documentation (Systems Engineering Plan (SEP), Reliability, Availability, Maintainability-Cost (RAM-C), stand-alone plan, etc.)? [5.2.3.C12]

5.2.3.Q24: What is the program's maintainability model and allocation to the repairable/removable component level? [5.2.3.C12]

5.2.3.Q25: How has the program flowed down maintainability requirements to suppliers as required? [5.2.3.C12]

5.2.3.Q26: What is the program's assessment of testability needs and achievements? [5.2.3.C12]

5.2.3.Q27: What maintainability risks are identified, documented, and mitigated? [5.2.3.C12]

5.2.3.Q28: What maintainability resources have been identified for support of demonstration test (DT)/Director, Operational Test and Evaluation (DOT&E) events? [5.2.3.C12]

5.2.3.Q29: How has the program ensured that the needed resources are available when and where needed to support DT/DOT&E events? [5.2.3.C12]

5.2.3.Q30: What are the maintainability processes documented for supporting DT/DOT&E events? [5.2.3.C12]

5.2.3.Q31: What is the program's achieved maintainability assessment methodology for each DT/DOT&E event planned? [5.2.3.C12]

5.2.3.Q32: What production-related maintainability risks and mitigations, key factors affecting component maintainability, and production optimization strategies are being pursued? [5.2.3.C13]

5.2.3.Q33:? How does the program ensure that maintainability experts are included in all major program decisions throughout the system's life cycle? [5.2.3.C13]

Post-Milestone C

Criteria

5.2.3.C14: The PM is accountable for the system's RAM performance throughout the program life cycle. The PM's duties include ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, and the program is properly staffed for RAM throughout the life cycle; tracking and mitigating RAM risks; and verifying RAM performance throughout the life cycle.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.2.3.Q34: What was the observed maintainability during DT/(Initial Operational Test and Evaluation (IOT&E) events, and how does this compare with the requirements? [5.2.3.C14]

5.2.3.Q35: What are the maintainability risks identified, documented, and mitigated? [5.2.3.C14]

5.2.3.Q36: How is the system performing in-service monitoring, trend analysis, and documentation updates throughout the system's life cycle? [5.2.3.C14]

5.2.3.Q37: What are the current achieved maintainability values, and how do they meet program needs? [5.2.3.C14]

References

Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.

Designing and Assessing Supportability in DOD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint, October 2003.

Independent Logistics Assessment, Version 1.0, January 2006.

DoD Guide for Achieving Reliability, Availability, and Maintainability, August 2005.

DoD Directive 5000.1, "Defense Acquisition System," May 2003.

DoD Instruction 5000.2, "Operation of the Defense Acquisition System," May 12, 2003.

CJCSM 3170.01C, Operation of the Joint Capabilities Integration and Development System," May 2007.

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SUB-AREA 5.3 – SURVIVABILITY

Description: Survivability is the capability of a system and its crew to avoid or withstand a man-made hostile environment without suffering an abortive impairment of its ability to accomplish its designated mission.

Scope: This sub-area involves the assessment of key actions that directly contribute to the development and design of system and crew survivability performance capabilities.

Perspective: The program manager (PM) should fully assess system and crew survivability against all anticipated threats at all levels of conflict early in the program, but in no case later than entering the System Demonstration and Demonstration (SDD) phase. This assessment also considers fratricide and detection. Unless waived by the Milestone Decision Authority, mission-critical systems, including crew, regardless of acquisition category, should be survivable to the threat levels anticipated in their projected operating environment as portrayed in the System Threat Assessment. Design and testing ensure that the system and crew can withstand man-made hostile environments without the crew suffering acute chronic illness, disability, or death.

If the system or program has been designated by the Director, Operational Test and Evaluation (DOT&E), for Live Fire Test and Evaluation (LFT&E) oversight, the PM should integrate the test and evaluation (T&E) used to address crew survivability issues into the LFT&E program supporting the Secretary of Defense LFT&E Report to Congress.

The PM should address Nuclear, Biological and Chemical (NBC) and High Altitude Electromagnetic Pulse (HEMP) cost-effective survivability techniques and plan for the validation and confirmation of NBC and HEMP survivability.

The PM should establish and maintain a survivability program throughout the system life cycle to attain overall program objectives. The program should stress early investment in survivability enhancement efforts that improve system operational readiness and mission effectiveness by:

- Providing threat avoidance capabilities (low susceptibility)
- Incorporating hardening and threat tolerance features in system design (low vulnerability)
- Providing design features to reduce personnel casualties resulting from damage to or loss of the aircraft (casualty reduction)
- Maximizing wartime availability and sortie rates via operationally compatible threat damage tolerance and rapid reconstitution (reparability) features
- Minimizing survivability program impact on overall program cost and schedule
- Ensuring protection countermeasures and systems security applications are defined for critical component's vulnerability to validated threats for systems survivability, including conventional or nuclear advanced technology weapons; nuclear, biological, or chemical contamination; and electronic warfare threats.

Factor 5.3.1 – Live Fire Test and Evaluation Assessment

Pre-Milestone A

Criteria

5.3.1.C1: The Live Fire Test and Evaluation (LFT&E) program supports a thorough assessment of the vulnerability/lethality of a system as it progresses through the Technology Development (TD) phase.

5.3.1.C2: Sufficient planning (the study of the mission, desired performance capabilities, employment concept, and studies such as Assessments of Alternatives (AoAs)) has been conducted leading to a set of critical operational issues and critical LFT&E issues whose satisfactory resolution contributes to the system's survivability/vulnerability/lethality evaluations.

5.3.1.C3: LFT&E of the system is predicated on an official assessment from the Department of Defense (DoD) intelligence community of the principal threat systems and capabilities an adversary might reasonably bring to bear in an attempt to defeat or degrade the system as described in the validated threat document.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.3.1.Q1: How have critical vulnerability and/or lethality issues been identified? [5.3.1.C2]

5.3.1.Q2: What is the program management office's (PMO's) general understanding of the resources required, including the system hardware and threat or threat surrogate requirements? *Note: Many threat or threat surrogates require long lead times to procure or develop.* [5.3.1.C2]

5.3.1.Q3: Has the LFT&E working-level integrated product team (WIPT) been formed?

- Who are the members? *Note: The principal membership typically includes system developer, combat developer, system evaluators, vulnerability/lethality analysts, testers, medical community, intelligence community, and system contractor (as required). Office of the Secretary of Defense (OSD)* Director, Operational Test and Evaluation *(DOT&E) should be invited to attend because it has oversight responsibilities.* [5.3.1.C2]

5.3.1.Q4: What component test and evaluation (T&E) events are planned in the TD phase as part of the "building-block" approach to LFT&E (i.e., early component level T&E, to subsystem/system level T&E, and culminating in a limited series of full-up system level (FUSL) live fire tests)? [5.3.1.C1]

5.3.1.Q5: At what point was the LFT&E program initiated to allow the results to affect system design prior to full-rate production or major modification? [5.3.1.C1]

5.3.1.Q6: What is the DoD intelligence community's official assessment of the principal threat systems and capabilities an adversary might reasonably bring to bear in an attempt to defeat or degrade the system as described in the validated threat document? [5.3.1.C3]

Pre-Milestone B

Criteria

5.3.1.C4: The LFT&E program supports a thorough assessment of the vulnerability/lethality of the system as it progresses through the System Development and Demonstration (SDD) phase.

5.3.1.C5: The LFT&E Strategy is of sufficient quality to ensure a realistic LFT&E program resulting in a disciplined and realistic approach that assesses the system's vulnerability and lethality; enables design changes resulting from that testing and analysis to be incorporated into the system at the earliest possible date; and supports the decision-making process.

5.3.1.C6: The LFT&E Strategy, via the Test & Evaluation Master Plan (TEMP), is approved by DOT&E prior to the program entering the SDD phase.

Focus Questions

[Pertinent criteria listed after each question.]

5.3.1.Q7: How does the LFT&E Strategy adequately demonstrate system (or munition, if applicable) capabilities to provide battle-resilient survivability or lethality, and provide insights into the principal damage mechanisms and failure modes occurring as a result of the munition/target

interaction, as well as into techniques for reducing personnel casualties or enhancing system survivability/lethality? [5.3.1.C5]

5.3.1.Q8: How does the LFT&E Strategy ensure that all LFT&E information is based on valid and accredited modeling and simulation (M&S), and actual system testing under realistic conditions?

- Is it integrated with Development, Test and Evaluation (DT&E) and Operational Test and Evaluation (OT&E) to optimize test scope and minimize costs? [5.3.1.C5]

5.3.1.Q9: How has the PMO planned, programmed, and budgeted for LFT&E resources, including test articles, facilities, manpower, instrumented threats, and targets?

- Is this reflected in the LFT&E Strategy? [5.3.1C4, 5.3.1.C5]

5.3.1.Q10: Are the sub-elements of LFT&E identified correctly in the strategy?

- How does the lethality LFT&E address both the ability to perforate or breach the target and to do significant damage to the target?

- How does the vulnerability LFT&E address being protected against lethal mechanisms and minimizing damage to the crew and hardware given an impact or breach by a lethal mechanism?

- How does the vulnerability LFT&E address the survivability of the system, subsystems, and components?

- How does the vulnerability LFT&E address recoverability from the combat damage (as another element of survivability)? [5.3.1.C5]

5.3.1.Q11: Are the following elements and stipulations, at a minimum, adequately presented in the LFT&E Strategy?

- Critical evaluation issues –
  - Vulnerability, to include: crew, hardware and system vulnerability; known vulnerabilities and vulnerability-reduction techniques; potential vulnerability-reduction techniques; and processes, provisioning, repair times, and training required for battle damage and repair (BDAR)?

- Critical evaluation issues –
  - Lethality, to include: ability to perforate or breach the protection of the threat system; ability to significantly degrade the combat/mission functions of the threat system; and potential lethality improvements. Additionally, the strategy should provide valuable inputs and basis for refinement and calibration of lethality models and databases?

- The relationship of the LFT&E issues to the required technical and operational characteristics?

- Planned LFT&E, to include a discussion of the amount and type of LFT&E that will be performed to support each program decision point?

- A description of the shot selection process?

- The LFT&E planning matrix covering the tests, their schedules, the issues that they will address, and which planning documents will be proposed for submission to DOT&E for approval or for review and comment?
- How schedule, resource, or budget constraints, if any, will affect the adequacy of planned LFT&E?
- How the M&S strategy includes LFT&E?
- Identification of LFT&E resource requirements (including test articles instrumentation that must be acquired)? [5.3.1.C5]

5.3.1.Q12: As part of the TEMP approval process, did DOT&E approve the adequacy of the LFT&E Strategy? [5.3.1.C6]

5.3.1.Q13: How is the program driven by the LFT&E issues identified in the strategy? *Note: This should be evidenced by the schedule and performance requirements.* [5.3.1.C5]

5.3.1.Q14: At what level(s) does the LFT&E Strategy include testing, as well as information/data gathered from design analyses, M&S, combat data, and related sources such as analyses of safety and mishap data? [5.3.1.C4, 5.3.1.C5]

5.3.1.Q15: Does the program's TEMP address waivers and the use of alternative LFT&E, when applicable? *Note: 10 USC 2366 requires an LFT&E program to include full-up, system-level testing unless a waiver is granted. The LFT&E Strategy shall include full-up, system-level testing (i.e., realistic survivability or lethality testing) unless the Under Secretary of Defense (USD), Acquisition, Technology and Logistics (AT&L) for Acquisition Category (ACAT) ID programs, or the Computer-Aided Engineering (CAE) for less-than ACATID programs, as delegated by the Secretary of Defense (SECDEF), waives such testing. Waiver requests shall include an alternative LFT&E Strategy, jointly reviewed by DOT&E and USD(AT&L), and approved by DOT&E. This alternative shall include LFT&E of components, sub-assemblies, or subsystems; and appropriate, additional design analysis, M&S, and combat data analysis. The waiver should state that full-up, system-level testing would be unreasonably expensive and impracticable. Waivers cannot be granted after Milestone B (or equivalent point, except through legislative relief).* [5.3.1.C5]

5.3.1.Q16: What is the systems of systems (SoS) approach to LFT&E as described in the LFT&E Strategy? [5.3.1.C4, 5.3.1.C5]

5.3.1.Q17: How are force protection requirements taken into consideration as part of the LFT&E Strategy? [5.3.1.C4, 5.3.1.C5]

5.3.1.Q18: What are LFT&E test events and milestones on the Integrated T&E Master Schedule and the Integrated Master Schedule (IMS)? [5.3.1.C4, 5.3.1.C5]

5.3.1.Q19: What is the extent of M&S supporting LFT&E? [5.3.1.C5]

Pre-Milestone C (and/or Full-Rate Production (FRP) Decision)

Criteria

5.3.1.C7: The LFT&E program supports a thorough assessment of the vulnerability/lethality of the system as it progresses through the Production and Deployment (PD) phase.

5.3.1.C8: The system will proceed beyond Low-Rate Initial Production (LRIP) (or equivalent point) only after LFT&E is completed and the prescribed Congressional committees have receive the required LFT&E report.

Focus Questions

[Pertinent criteria listed after each question.]

5.3.1.Q20: How effective was the execution of the LFT&E Strategy to adequately demonstrate system (or munitions, if applicable) capabilities to provide battle resilient survivability or lethality?

- What are the insights into the principal damage mechanisms and failure modes occurring as a result of the munitions and target interaction?
- What are the insights into the techniques for reducing personnel casualties or enhancing system survivability/lethality? [5.3.1.C7]

5.3.1.Q21: Was all the LFT&E information collected during TD and SDD based on valid and accredited M&S, as well as actual system testing under realistic conditions?

- Why or why not? [5.3.1.C7]

5.3.1.Q22: How has the PMO planned, programmed, and budgeted for LFT&E resources, including test articles, facilities, manpower, instrumented threats, and targets for LFT&E events before the FRP decision and for follow-on LFT&E? [5.3.1C7]

5.3.1.Q23: Were the following sub-elements of LFT&E addressed correctly before the FRP decision?

- How does the lethality LFT&E address the ability to perforate or breach the target and to do significant damage to the target?
- How does the vulnerability LFT&E address being protected against lethal mechanisms and minimizing damage to the crew and hardware given an impact or breach by a lethal mechanism?
- How does the vulnerability LFT&E address the survivability of the system, subsystems, and components?
- How does the vulnerability LFT&E address recoverability from the combat damage (as another element of survivability)? [5.3.1.C7]

5.3.1.Q24: As part of the TEMP approval process, did DOT&E approve the adequacy of the LFT&E Strategy? [5.3.1.C8]

5.3.1.Q25: How does the LFT&E Strategy for after FRP include testing at the component, sub-assembly, subsystem, and system levels, as well as information/data gathered from design analyses, M&S, combat data, and related sources such as analyses of safety and mishap data? [5.3.1.C7]

5.3.1.Q26: Was a waiver to FUSL requested and approved prior to Milestone B?

- If so, how was the alternate LFT&E program executed in accordance with the approved strategy? [5.3.1.C7]

5.3.1.Q27: How were pretest predictions executed during the LFT&E program? [5.3.1.C7]

5.3.1.Q28: Was a Real Time Casualty Assessment (RTCA) conducted during IOT&E, coordinated with LFT&E to ensure that assumptions supporting the RTCA are consistent with LFT&E results? [5.3.1.C7]

5.3.1.Q29: Did the PMO provide weapons effectiveness data for weapons in the acquisition process to DOT&E for use in the Joint Munitions Effectiveness Manuals? *Note: This will be provided prior to the weapon achieving initial operational capability, and shall prepare the data in coordination with the Joint Technical Coordinating Group for Munitions Effectiveness.* [5.3.1.C7, 5.3.1.C8]

5.3.1.Q30: How were deficiencies in system design found by LFT&E corrected prior to FRP?

- How did the results of the LFT&E program feed the system design? [5.3.1.C8]

References
DoD Instruction 5000.2, "Operation of the Defense Acquisition System," May 12, 2003.
Introduction to Acquisition Management, DAU, September 2005.
Defense Acquisition Guidebook (DAG). Defense Acquisition University, https://akss.dau.mil/dag/.

SUB-AREA 5.4 – PRODUCTION

Description: The ultimate goal of an acquisition program is to produce the system that meets design requirements within operational and environmental standards and regulations. This is accomplished by creating an effective and efficient production process that takes advantage of continuous improvement to maintain the ability to not only produce the system according to its Acquisition Strategy, but also to accommodate incremental system upgrades and updated production methods. Limitations imposed by manufacturing methods must be identified early and addressed through development of more effective methods (preferred) or design changes to the system (potentially more costly).

With the emphasis on more contracted schedules, early effort to transition technology from the Technology Development phase onto the factory floor and into the field is a significant enabler for

acquisition. It is critical to start manufacturing readiness at those early stages. This effort begins properly during development and typically continues well after a system has been in the field. Manufacturing readiness, like technology readiness, is critical to the successful introduction of new products and technologies. Manufacturing Readiness Levels (MRLs) represent an effective tool for the acquisition community to address this requirement.

The Manufacturing Readiness Assessment (MRA) Deskbook breaks the assessment into MRL threads, which provide subject areas that constitute the MRA. MRL threads are categorized as:

- Technology and the Industrial Base – requires analysis of the technology and industrial base to support all phases of the program
- Design – requires analysis of the maturity and stability of the evolving design
- Materials – requires analysis of the risks associated with materials development and acquisition
- Cost and Funding – requires analysis of the adequacy of funding to achieve manufacturing maturity levels
- Process Capability and Control – requires analysis of the risk that the manufacturing processes aren't able to reflect the design intent of key characteristics
- Quality Management – requires analysis of the management effort to control quality
- Manufacturing Personnel – requires analysis of the required skill level and number of personnel
- Facilities – requires analysis of the capability and capacity of key manufacturing facilities
- Manufacturing Management – requires analysis of the management of the diverse elements necessary to translate the design into an integrated and fielded system

MRLs are designed to assess the maturity and risk of a given technology, weapon system, or subsystem from a manufacturing perspective and to guide risk mitigation efforts. MRLs also are intended to provide decision makers at all levels with a common understanding of the relative maturity and attendant risks associated with manufacturing technologies, products, and processes being considered to meet Department of Defense (DoD) requirements. They provide specific criteria to support decision making based on knowledge of manufacturing status and risk.

Typical approaches do not place significant emphasis on manufacturing risk reduction until the System Development and Demonstration (SDD) phase of acquisition. The key to acquisition program success depends on manufacturing risk management being active in every phase of acquisition from early concept evaluations through production. Manufacturing risk management is an integral element in the development of hardware-intensive weapon system technologies to provide timely and cost-effective transition of technology.

Figure 5-1 indicates the nominal relationship between a specific MRL and the acquisition life cycle as well as between MRLs and Technology Readiness Levels (TRLs).
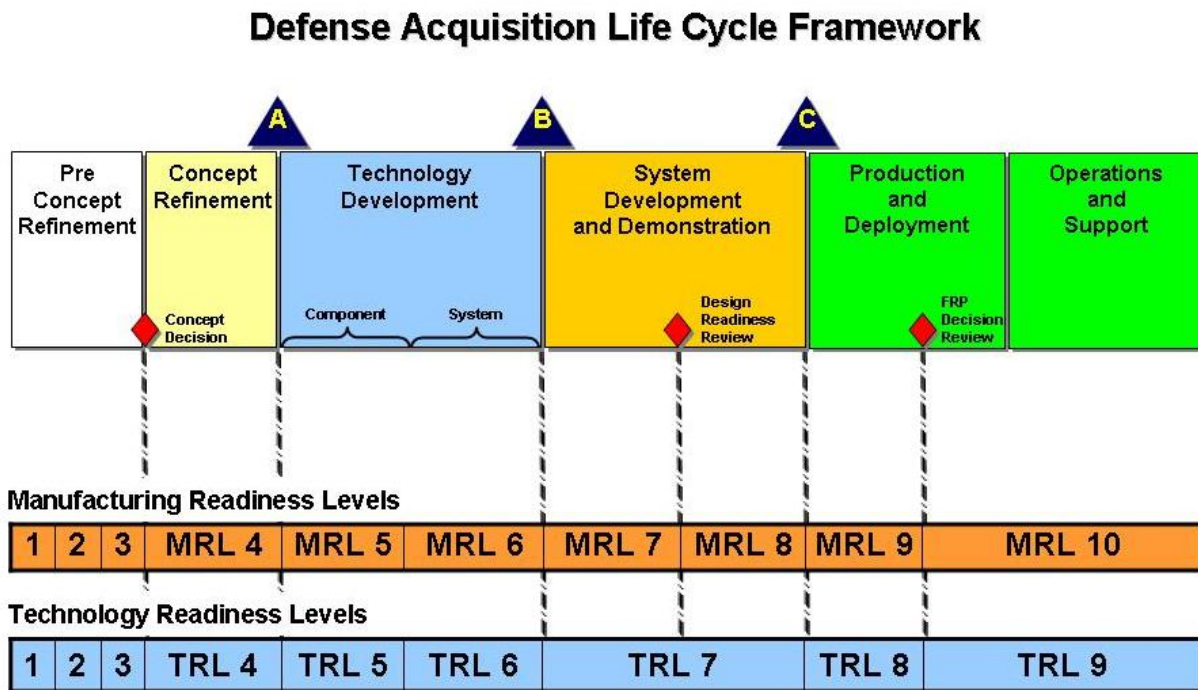
Figure 5-1 Relationship of MRLs to System Milestones and TRLs

Likewise, the production process is controlled primarily by monitoring and improving the quality of the process. This is accomplished by analyzing the key characteristics of the design and creating manufacturing processes that control these characteristics during production. By developing a value stream of the production process and inserting monitoring points throughout, quality can be added more readily. The role of continuous improvement is vitally important to having an effective process over the system's lifetime, as changes in manufacturing technology and knowledge need to be reflected in the production processes.

Scope: This assessment includes all aspects of production from early evaluation of risk during concept development to lean principles during full-rate production. An early consideration of manufacturability and production processes provides the first indication of product feasibility. Evaluation of the program should include whether this consideration is taking place in a formal process. Identification of cost drivers, risks, and capacity requirements along with the conceptual design are vital to assessing the ability and preparedness of the program to enter into production and maintain production capability through process improvements and technology changes. The

readiness to produce the system has an equivalent effect on the program as the technology maturity and design maturity.

Quality areas to be cognizant of include:

- Organizational Structure
- Communications
- Continuous Improvement Activities
- Quality Management Tools

Absence of these or weaknesses in their application can be a sign of an ineffective quality process.

Perspective: The government has insight to the level of analysis completed by the contractor on manufacturability and production readiness levels. The government must be able to assess the MRLs using a knowledge-based approach. The development of MRLs and the deployment of MRAs will provide the government program managers (PMs) the necessary tools to help them evaluate their program's progress and manage their risks prior to production.

The contractor has in-depth knowledge and experience in working with production methods and assessment of MRLs. The contractor has intimate knowledge of the cost and schedule drivers in production, as well as a grasp of lean and quality processes. Cost reporting will reflect proposed savings from producibility trades that are coupled with fabrication and assembly of the system concept. The contractor develops and presents production and quality in the same manner as the system performance. The contractor's approach to concurrent product and process development is integrated into the systems engineering process. Contractor policies embrace continuous improvement as evidenced in past program performance.

Factor 5.4.1 – Assessed Manufacturing

Pre-Milestone A

Criteria

5.4.1.C1: Labor standards are considered when planning manufacturing facilities and equipment to ensure efficient utilization rates and overall productivity of the workforce.

5.4.1.C2: Environmental and safety regulations and standards are compliant with federal, state, and contractor statutes and laws. Their effect on the cost of Technology Development (TD) testing baseline is evaluated.

5.4.1.C3: The identification and planned use of existing contractor assets and government-owned resources are supported by the confirmed availability of the resources. Resource sharing between

programs is on a non-competing basis.

5.4.1.C4: The TD plan provides for scheduled and unscheduled maintenance with little disruption to the demonstration schedule.

5.4.1.C5: Make/buy decisions are consistent with contractor policy and reflect a rationale that meets the planned schedule and offers the best value to the government.

5.4.1.C6: The contractor ensures that adequate production test infrastructure, resources, and facilities are available.

5.4.1.C7: Government and contractor's manufacturing facility space are adequate to perform the TD activities without interference.

5.4.1.C8: Any new manufacturing facility plans are part of the overall management plan.

5.4.1.C9: The manufacturing facilities schedule is consistent with the TD activities. Manufacturing facilities are not on the program critical path.

5.4.1.C10: Existing test and training facilities are adequate to support the TD test program.

5.4.1.C11: Government-furnished items (GFI) (equipment, software, or data) will be confirmed by the program management office (PMO) to meet system requirements and to be available, complete, and supportable.

5.4.1.C12: Planned non-developmental items (NDI) or commercial-off-the-shelf (COTS) items have been determined to meet program system performance and sustainment requirements through a defined acceptance process.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.4.1.Q1: How are labor standards considered when developing production facilities and equipment requirements? [5.4.1.C1]

5.4.1.Q2: What are the safety, health, and environmental standards considered in the analysis of facilities and equipment requirements?

- How are these considerations factored into the facilities and equipment plans for the TD?
- How do these standards comply with federal, state and contractor requirements?
- What is the cost impact on the TD strategy? [5.4.1.C2]

5.4.1.Q3: What are the existing contractor and government-owned resources, including facilities, tooling, and equipment available that will be used for the TD?

- What are the procedures used to ensure accountability of government-owned resources? [5.4.1.C3]

5.4.1.Q4: How is scheduled and unscheduled maintenance on facilities, equipment, and tools addressed in the TD strategy? [5.4.1.C4]

5.4.1.Q5: What is the contractor make/buy policy for test equipment?

- What is the status of make/buy for all major tools and test equipment?

- What percentage of tooling and test equipment requirements is available to the program? [5.4.1.C5]

5.4.1.Q6: What is the process used to ensure that adequate production test infrastructure, resources, and facilities are available? [5.4.1.C6]

5.4.1.Q7: Is there additional manufacturing facility space needed to execute the program?

- If so, what are the plans to acquire it? [5.4.1.C7]

5.4.1.Q8: What are the new facilities required? [5.4.1.C8]

5.4.1.Q9: What is the master schedule for new and existing facilities relative to program milestones? [5.4.1.C9]

5.4.1.Q10: Are the existing test and training ranges adequate to support the planned TD test program? [5.4.1.C10]

5.4.1.Q11: What process is being used to ensure that GFI being provided to the contractor is complete, available, conforming, and supportable? [5.4.1.C11]

5.4.1.Q12: What are the NDI or COTS items being used in the TD?

- What are the sources of these items?
- How have these items been determined to meet intended program performance requirements? [5.4.1.C12]

Pre-Milestone B

Criteria

5.4.1.C13: The fundamental manufacturing development tools are in place and integrated to support the development effort.

5.4.1.C14: The integration and test benches, laboratories, and other facilities are/will be in place consistent with the integration and test schedule.

5.4.1.C15: Tooling and test equipment, such as those used for environmental stress testing, screening, and qualification, are available and qualified to support prototype testing.

5.4.1.C16: Equipment that has been proven, such as environmental chambers, is available.

5.4.1.C17: Shared production facilities and test equipment can be scheduled without conflict.

5.4.1.C18: Progress of tooling and test equipment plans are on track with the critical path of the hardware build and test.

5.4.1.C19: Production test instrumentation is adequate to measure and collect the data needed to evaluate the system's as-built performance against the manufacturing process.

5.4.1.C20: Existing manufacturing facility space is adequate or new facility plans are part of the overall management plan.

5.4.1.C21: The production facilities include the resources to support large-scale avionics and electronics integration efforts.

5.4.1.C22: A manufacturing facilities schedule exists consistent with the program. Manufacturing facilities are on the program critical path.

5.4.1.C23: GFI has been confirmed by the PMO to meet system requirements and to be available, complete, and supportable.

5.4.1.C24: Planned NDI and COTS items have been determined to meet program system performance and sustainment requirements through a defined acceptance process.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.4.1.Q13: What are the manufacturing development tools needed to accomplish the development effort?

- Are they in place or planned? [5.4.1.C13]

5.4.1.Q14: What are the integration and test benches, laboratories, and facilities planned or in place to support integration and test? [5.4.1.C14]

5.4.1.Q15: What tooling and test equipment is required to support the program?

- What new tooling and test equipment will be required?
- What are the specific plans and provisions to ensure that new tooling and test equipment is in place when required? [5.4.1.C15]

5.4.1.Q16: What is the existing test equipment that will be used on the program? [5.4.1.C16]

5.4.1.Q17: How will manufacturing facilities and test equipment be shared with other programs?

- How will this equipment be allocated and managed? [5.4.1.C17]

5.4.1.Q18: What is the plan to ensure that tooling and test equipment being developed and built on the program will be in place when needed? [5.4.1.C18]

5.4.1.Q19: Is the accuracy and availability (reliability, scheduling, etc.) of production test instrumentation adequate to measure and collect the data needed to evaluate the system's as-built performance? [5.4.1.C19]

5.4.1.Q20: How much additional manufacturing facility space is needed to execute the program?

- What new manufacturing facilities and equipment must be developed? [5.4.1.C20]

5.4.1.Q21: Do production integration facilities exist?

- What are the plans to develop such facilities or ensure that the existing facilities meet program requirements? [5.4.1.C21]

5.4.1.Q22: What is the schedule for new/modified manufacturing facilities relative to program milestones? [5.4.1.C22]

5.4.1.Q23: What process is used to ensure that GFI is complete and available, meets the requirements, and is supportable? [5.4.1.C23]

5.4.1.Q24: What NDI and COTS items are being used in the system development?

- What are the sources of these items?

- How have these items been determined to meet intended program performance and sustainment requirements? [5.4.1.C24]

Pre-Milestone C

Criteria

5.4.1.C25: Labor standards are considered a key aspect of production planning and important in workforce projection. These standards also are considered when planning facilities and equipment to ensure efficient utilization rates and overall productivity of the workforce.

5.4.1.C26: Environmental and safety regulations and standards are an integral part of the production planning and are compliant with federal, state, and industry standards and laws. Their effects on the cost of production operations are known.

5.4.1.C27: The production facilities and equipment planning include all key functional groups that play a role in production operations.

5.4.1.C28: Tradeoff analyses are documented and provide an optimized solution that is the basis for the production planning effort. The analyses are based on established modeling tools and factor in the current capabilities and experience of the contractor. Cost optimization is a significant factor.

5.4.1.C29: The identification and planned use of existing contractor assets and government-owned resources are supported by the confirmed availability of the resources. Resource sharing between programs is on a non-competing basis.

5.4.1.C30: The acquisition of production tooling and equipment is based on a schedule that represents reasonable acquisition lead times, installation and setup, training, etc., that is coordinated with the overall schedule and presents contingency plans that address any schedule risks.

5.4.1.C31: The production plan provides for scheduled and unscheduled maintenance with little disruption to the production schedule.

5.4.1.C32: Make/buy decisions are consistent with contractor policy and reflect a rationale that meets the planned schedule and offers the best value to the government.

5.4.1.C33: The contractor has established procedures for management of company and GFI assets that support the needs of the program.

5.4.1.C34: The program verifies procedures for ensuring functional compliance and calibration of all tooling and test equipment.

5.4.1.C35: The program ensures that adequate production test infrastructure, resources, and facilities are available.

5.4.1.C36: A detailed allocation of production space and equipment is described, along with the factors used in developing the plan. The status of design and acquisition of production equipment is tracked in the schedule. Equipment cost, efficiency, and availability (maintenance or repair

downtime) are reflected in the planning process.

5.4.1.C37: Maintenance of production equipment translates to downtime and is accounted for in determining the availability of the equipment and contingency plans.

5.4.1.C38: Production equipment, processes, and facilities with utilization rates below 80 percent are analyzed to determine whether lower cost alternatives to produce the hardware are available.

5.4.1.C39: A detailed layout of production facilities from studies on material flow optimization and manufacturing operation capacity represents the optimal solution for the production program and provides a graphical depiction of the production plan.

5.4.1.C40: Production planning uses the systems engineering process by involving in the planning all functional disciplines that have a stake in the production program. The material supply and inventory control program is a key aspect of the production plan and is addressed in the early planning process.

5.4.1.C41: The choice of facilities is flexible enough to accommodate growth and avoid relocation of production operations that could negatively affect the transition to full-rate production. The choice of investment in new facilities factors in the impact of government changes in inventory objectives that often result in sustained low production rates for the life of the program. This type of contingency planning is considered in the manufacturing facility planning effort.

5.4.1.C42: GFI is confirmed by the PMO to meet system requirements and to be available, complete, and supportable.

5.4.1.C43: Planned NDI or COTS items have been determined to meet program system performance and sustainment requirements through a defined acceptance process.

5.4.1.C44: Foreign ownership, control, and influence have been taken into account in the selection of commercial products and custom development.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.4.1.Q25: How are labor standards considered when developing facilities and equipment requirements? [5.4.1.C25]

5.4.1.Q26: What are the safety, health, and environmental standards considered in the analysis of facilities and equipment requirements?

- How are these considerations factored into the facilities and equipment plans for the production program?
- How do these standards comply with federal, state, and industry requirements?
- What is the cost impact on the production plan? [5.4.1.C26]

5.4.1.Q27: How are the selection of production facilities and capital equipment coordinated with program production functional elements, for example, manufacturing, tooling and test, manpower and personnel, etc? [5.4.1.C27]

5.4.1.Q28: How do the facilities and capital equipment plans provide the optimal solution to the requirements of the production program?

- What were the tradeoff analyses used to arrive at the selected plan? [5.4.1.C28]

5.4.1.Q29: What existing contractor and government-owned resources, including facilities, software integration labs (SWILs), tooling, and equipment, will be used for the production program?

- What procedures will be used to ensure accountability of GFI? [5.4.1.C29]

5.4.1.Q30: What planning and scheduling for the acquisition of equipment, tooling and test equipment, and GFI is required to support initial and full-rate production?

- How will these schedules coordinate with the current program schedule for the transition to production? [5.4.1.C30]

5.4.1.Q31: How will scheduled and unscheduled maintenance on facilities, equipment, and tools be addressed in the production plan? [5.4.1.C31]

5.4.1.Q32: What is the contractor's make/buy policy for system parts, components, subsystems, and support items?

- What are some examples of make/buy analysis and results? [5.4.1.C32]

5.4.1.Q33: What is the contractor's make/buy policy and status for tooling and test equipment?

- What percentage of tooling and test equipment requirements is already available to the program? [5.4.1.C32]

5.4.1.Q34: What are the procedures that govern the storage, maintenance, repair, and overhaul of tooling and test equipment? [5.4.1.C33]

5.4.1.Q35: What are the procedures used to ensure that tooling and test equipment meet production specifications? [5.4.1.C34]

5.4.1.Q36: What is the process used to ensure that adequate production test infrastructure, resources, and facilities are available? [5.4.1.C35]

5.4.1.Q37: How were facilities and equipment allocated to support the production program?

- How does this allocation ensure that the plans will satisfy the requirements of the initial production schedule, including the design status and equipment acquisition?
- How will the capability be expanded to support follow-on production and unplanned surge requirements? [5.4.1.C36]

5.4.1.Q38: How were provisions for facilities and equipment maintenance factored into the utilization plan? [5.4.1.C37]

5.4.1.Q39: What are the expected utilization rates for facilities and capital equipment to support planned production rates?

- What economic utilization rate threshold was used for production capability planning?
- What are the results of production rate capability analyses?
- What alternatives were considered? [5.4.1.C38]

5.4.1.Q40: How were planned workloads, production rates, and workflow major considerations in the utilization plans? [5.4.1.C38]

5.4.1.Q41: What is the physical layout of the production facilities dedicated to the program, including the flow of material, components, and product?

- How does the layout plan maximize efficiency, safety, and productivity in an environment of cost-reduction emphasis?
- How were computer-aided manufacturing tools used to design the manufacturing plant layout? [5.4.1.C39]

5.4.1.Q42: What was the process for determining the plant layout?

- What internal disciplines within the company participated in the effort?
- Does the program plan to use the "just-in-time" material supply approach?
- How would this affect the plant layout? [5.4.1.C40]

5.4.1.Q43: How will the manufacturing facility accommodate growth or decreases in production rates? [5.4.1.C41]

5.4.1.Q44: What process is used to ensure that GFI being provided to the contractor is complete, available, meets the requirements, and is supportable? [5.4.1.C42]

5.4.1.Q45: What NDI or COTS items are being used in the system development?

- How have these items been determined to meet intended program performance and sustainment requirements? [5.4.1.C43]

5.4.1.Q46: What components were considered to be critical to this system?

- Which of these are owned, controlled, or influenced by foreign entities? [5.4.1.C44]

References

GAO 05-301, "Defense Acquisitions: Assessments of Selected Major Weapon Programs," March 2005.
MRL Guide, "Joint Defense Manufacturing Technology Panel," February 2007.
DoD Manufacturing Readiness Assessment Deskbook, May 2008.

Factor 5.4.2 – Assessed Quality

Pre-Milestone A

Criteria

5.4.2.C1: Process improvement is an ongoing activity within the contractor's organization. Processes to be used in support of the Technology Development (TD) phase will be assessed for maturity and improvement.

5.4.2.C2: Programmatic data on process execution and effectiveness, including metrics, will be collected and provided to the contractor's organizational process improvement group.

5.4.2.C3: Quality goals and objectives, responsibilities, and authority for implementing quality are clearly defined and understood by all employees. The contractor provides the necessary resources for maintaining and improving quality.

5.4.2.C4: The costs and benefits of quality will be identified for producibility trade analyses as they are monitored and reported.

5.4.2.C5: Input and output of each systems engineering process (e.g., requirements definition, requirements flow-down, design activities, test and integration, modeling and simulation (M&S), etc.) are measured for quality.

5.4.2.C6: Documented procedures exist and are adequate to identify process control capability and to verify the relationship between process control variables and final product characteristics for existing programs.

5.4.2.C7: Management is aware of work center productivity and acts on the information to support continuous improvement.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.4.2.Q1: What are the contractor's process improvement activities (planned and ongoing), both internal to the TD effort and on other programs?

- Have processes being used during TD been assessed by independent assessors relative to any established process models? [5.4.2.C1]

5.4.2.Q2: What are the processes used to collect data to support process improvement? [5.4.2.C2]

5.4.2.Q3: What are the specific quality goals and objectives assigned to technical supervisors within the organization?

- What are the metrics and time frame allotted to achieve them? [5.4.2.C3]

5.4.2.Q4: What is the funding for quality activities on the program?

- How are the funds allocated? [5.4.2.C3]

5.4.2.Q5: What quality reports have been generated that depict the cost and benefits of process and product improvement initiatives, including for prior programs? [5.4.2.C4]

5.4.2.Q6: What quality metrics are used for each systems engineering process, and how they are measured? [5.4.2.C5]

5.4.2.Q7: What quality engineering and quality assurance tools and methods (e.g., design of experiments, house of quality, statistical analysis tools, M&S, etc.) are used for improving quality of products and processes? [5.4.2.C6]

5.4.2.Q8: What are the metrics that enable management to review the productivity of different work centers that support the program? [5.4.2.C7]

Pre-Milestone B

Criteria

5.4.2.C8: Process improvement is an ongoing activity both within the program (for large extended development programs) and within the contractor's organization. Contractor's processes being applied on the program have been assessed as mature and continue to be improved.

5.4.2.C9: Programmatic data on process execution and effectiveness, including metrics, are collected and provided to the contractor's process improvement group.

5.4.2.C10: Quality goals and objectives, responsibilities, and authority for implementing quality are clearly defined and understood by all employees. The contractor provides the necessary resources for maintaining and improving quality.

5.4.2.C11: The costs and benefits of quality will be identified for producibility trade analyses as they are monitored and reported.

5.4.2.C12: Input and output of each systems engineering process (e.g., requirements definition, requirements flow-down, design activities, test and integration, M&S, etc.) are measured for quality.

5.4.2.C13: Documented procedures exist and are adequate to identify process control capability and to verify the relationship between process control variables and final product characteristics for existing programs.

5.4.2.C14: Management is aware of work center productivity and acts on the information to support continuous improvement.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.4.2.Q9: What are the process improvement activities both internal to the TD effort and on other programs in the contractor's organization?

- Have processes used during TD been assessed by independent assessors relative to any established process models? [5.4.2.C8]

5.4.2.Q10: What are the processes used to collect data to support process improvement? [5.4.2.C9]

5.4.2.Q11: What are the specific quality goals and objectives assigned to technical supervisors within the organization?

- What are the metrics and time frame allotted to achieve them? [5.4.2.C10]

5.4.2.Q12: What is the funding for quality on the program?

- How are the funds allocated? [5.4.2.C10]

5.4.2.Q13: What quality reports have been generated that depict the cost and benefits of process and product improvement initiatives, including for prior programs? [5.4.2.C11]

5.4.2.Q14: What quality metrics are used for each systems engineering process?

- How they are measured? [5.4.2.C12]

5.4.2.Q15: What quality engineering and assurance tools and methods (e.g., design of experiments, house of quality, statistical analysis tools, M&S, etc.) are used for improving quality of products and processes? [5.4.2.C13]

5.4.2.Q16: What are the metrics that enable management to review the productivity of different work centers that support the program? [5.4.2.C14]

5.4.2.Q17: What are recent examples of actual processes that were improved?

- How was it determined that the changes introduced actually improved process performance? [5.4.2.C14]

Pre-Milestone C

Criteria

5.4.2.C15: The quality assurance (QA) organization structure is appropriate to accomplish the QA function and responsibilities on the program.

5.4.2.C16: The QA organization is the central office for managing quality, disseminating quality-related information, and collecting current information on status of quality activities. Quality programs differentiate requirements for the production system and the product.

5.4.2.C17: Staffing of the QA organization is planned and is consistent with the required effort on the program.

5.4.2.C18: The quality program is visible to company management, and quality objectives and requirements are flowed down to subcontractors and suppliers.

5.4.2.C19: Quality policy, plans, procedures, and manuals are current. They explain the quality system and product quality requirements and how they can be met.

5.4.2.C20: The QA plan exists and is being followed. QA is being properly applied to the inspection and acceptance of hardware, software, and support products.

5.4.2.C21: Internal quality audits are periodically conducted on the program.

5.4.2.C22: Documented procedures exist to ensure that factory work instructions comply with inspection and test requirements for the hardware and software.

5.4.2.C23: Metrics that track product defects, corrective actions, and acceptance and rejection percentages are maintained.

5.4.2.C24: Management has used the documented quality program results to correct product and process deficiencies.

5.4.2.C25: Metrics to track the cost of quality deficiencies are maintained and provided to the customer.

5.4.2.C26: The QA organization has an appropriate role in the oversight of tooling and test equipment maintenance and calibration. A process to determine repair/replacement of support

equipment exists.

5.4.2.C27: Contractor policy addresses use of personally owned tools and measuring devices and how the quality of such tools is ensured.

5.4.2.C28: Documented procedures exist that define the duties and responsibilities of source inspectors.

5.4.2.C29: Process improvement is an ongoing activity both within the government program management office (PMO) (for large extended development programs) and with the contractor. Contractor processes being applied on the program have been assessed as mature and continue to be improved.

5.4.2.C30: Programmatic data on process execution and effectiveness, including metrics, are collected and provided to the contractor process improvement group.

5.4.2.C31: Quality goals and objectives, responsibilities, and authority for implementing quality are clearly defined and understood by all participants. The contractor provides the necessary resources for maintaining and improving quality.

5.4.2.C32: The costs and benefits of quality are identified for each process and product improvement initiative. They are monitored and reported.

5.4.2.C33: Input and output of each systems engineering process (e.g., requirements definition, requirements flow-down, design activities, test and integration, M&S, etc.) are measured for quality.

5.4.2.C34: Documented procedures exist and are adequate to identify process control capability and to verify the relationship between process control variables and final product characteristics. Quality metrics for each process control capability are measured and reported using statistical methods and tools.

5.4.2.C35: Management is actively aware of work center productivity and acts on the information to support continuous improvement.

Focus Questions

[Pertinent criteria numbers follow each question.]

5.4.2.Q18: What is the organizational structure of the QA function that supports the program?

- What are the responsibilities and authority of the key personnel? [5.4.2.C15]

5.4.2.Q19: How are specific quality requirements disseminated and data collected for quality-related activities? [5.4.2.C16]

5.4.2.Q20: How will the staffing of the QA department be managed to address the initial production program and the buildup to full-rate production? [5.4.2.C17]

5.4.2.Q21: What is the visibility of the quality program to company management external to the program?

- How are the objectives of the quality program flowed down to major subcontractors and suppliers that support the program? [5.4.2.C18]

5.4.2.Q22: What are the quality documents used to manage quality initiatives on the program?

- What is the difference between quality of processes and quality of products? [5.4.2.C19]

5.4.2.Q23: What is the role of the QA function in the inspection and acceptance of software? [5.4.2.C20]

5.4.2.Q24: What is the contractor's policy on the conduct of internal quality audits of the program during production? [5.4.2.C21]

5.4.2.Q25: What are the documented procedures that ensure that factory work instructions comply with inspection and test requirements for the hardware and software? [5.4.2.C22]

5.4.2.Q26: What is the documentation being used to record product defects, corrective actions, acceptance and rejection percentages, etc? [5.4.2.C23]

5.4.2.Q27: How has management used quality-related documentation to correct product and process deficiencies? [5.4.2.C24]

5.4.2.Q28: What system is being used to track the cost of quality deficiencies?

- Is this information shared with the government? [5.4.2.C25]

5.4.2.Q29: What is the role of quality in the oversight of tooling and test equipment maintenance and calibration?

- What is the decision-making process for repair/replacement of this support equipment? [5.4.2.C26]

5.4.2.Q30: What is the contractor's policy on the use of personally owned tools and measuring devices?

- How is the quality of such tools ensured? [5.4.2.C27]

5.4.2.Q31: What are the written procedures that show the duties and responsibilities of source inspectors? [5.4.2.C28]

5.4.2.Q32: What are the process improvement activities, both internal to the program and at the contractor facilities?

- What are the program processes that have been assessed by independent assessors relative to any established process models? [5.4.2.C29]

5.4.2.Q33: What is the process to collect data to support process improvement? [5.4.2.C30]

5.4.2.Q34: What are the specific quality goals and objectives assigned to manufacturing supervisors?

- What are the metrics and time frame allotted to achieve these goals? [5.4.2.C31]

5.4.2.Q35: What is the funding for quality on the program?

- How are these funds allocated? [5.4.2.C31]

5.4.2.Q36: Do quality reports exist that depict the cost and benefits of process and product improvement initiatives? [5.4.2.C32]

5.4.2.Q37: What quality metrics are used for each systems engineering process?

- How they are measured? [5.4.2.C33]

5.4.2.Q38: What quality engineering and QA tools and methods are being used on the program for improving products and processes?

- How many specific process control capabilities are identified and monitored for the program? [5.4.2.C34]

5.4.2.Q39: How are changes in the process control capability traceable to changes in product quality? [5.4.2.C34]

5.4.2.Q40: What are the metrics that enable management to review the productivity of different work centers that support the program? [5.4.2.C35]

References

DoD Manufacturing Readiness Assessment Deskbook, May 2008.

ISO 9001, "Quality Management Systems—Requirements." International Organization for Standardization, 2000.

ISO 9004:4, "Guidelines for Creating Quality Improvements." International Organization for Standardization, 1993.

6.0   SPECIAL INTEREST AREAS

SUB-AREA 6.1 – READINESS LEVELS

Description: Readiness levels have been established to assist program managers and the Department of Defense (DoD) leadership to apply quantifiable metrics as a means to measure the maturity of program acquisition activities as they progress through the acquisition life cycle. Technology maturity and manufacturing maturity are two important measures to ensure that technical and manufacturing risks have been mitigated to an acceptable level that will allow programs to proceed to the next acquisition phase of the life cycle. For this purpose, Technology Readiness Levels (TRLs) and Manufacturing Readiness Levels (MRLs) have become part of the entrance and exit criteria applied to programs as a management tool to assist the decision makers and program managers in making key acquisition decisions.

Scope: This sub-area provides the defined metrics and criteria that are used in TRLs, Engineering Manufacturing Readiness Levels (EMRLs), and MRLs (successor to EMRL).

Perspective: Readiness metrics are most effectively used to measure the progress of programs as they proceed through the acquisition life cycle. Quantitative measures of technology maturity and manufacturing maturity help to determine acceptable levels of risk in proceeding through decision points and are effectively used as entrance and exit criteria by the decision makers within the Office of the Secretary of Defense and the Services. MRL criteria are still evolving and will be updated periodically to reflect the latest version approved by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics.

Readiness Level Criteria

Technology Readiness Levels (TRLs) are a systematic metric/measurement system that supports assessments of technology maturity and the consistent comparison of maturity between different types of technology. The TRL approach has been used for many years in NASA space technology planning and as described in the June 2001 updated DoD Regulation 5000.2R. Table 6-1 describes the DoD TRLs. Table 6-2 describes the DoD EMRLs. EMRLs provide the framework with specific criteria and metrics to capture the design and manufacturing knowledge for product development, demonstration and production. Table 6-3 illustrates the points in the acquisition life cycle at which the MRLs are measured. DoD Manufacturing Readiness Levels (MRLs) evolved from EMRLs are designed to be measures used to assess the maturity of a given technology, component or system from a manufacturing prospective.

Table 6-1 DoD Technology Readiness Levels

Technology Readiness Level	Description
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into technology's basic properties.
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in simulated environment. Examples include "high fidelity" laboratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond the breadboard tested for level 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated operational environment.
7. System prototype demonstration in an operational environment.	Prototype near or at planned operational system. Represents a major step up from level 6, requiring the demonstration of an actual system prototype in an operational environment. Examples include testing the prototype in a test bed aircraft.
8. Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this level represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.
9. Actual system proven through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.

Table 6-2 Engineering Manufacturing Readiness Levels

Design Producibility	Producibility Program	Initial producibility evaluation on design initiated.	Producibility Engineering & Planning (PEP) activities (including DFMA) programmed. Producibility is part of design process. Initial trade studies conducted - performance vs. producibility.	Producibility analysis & DFMA activities complete. Process and design producibility improvements implemented	Design Producibility improvements demonstrated in LRIP. Process producibility improvements ongoing.	Design Producibility improvements demonstrated in FRP. Process producibility improvements ongoing.
	Form, Fit, & Function	Form, Fit, & Function packaging constraints identified.	Packaging plan to meet requirements completed. Repackaging plans require no new technology or adverse impacts on producibility.	Verified that HW meets packaging plan reqts on pilot line. Packaging changes pose no adverse impact on schedule or producibility.	Verified that HW meets packaging plan reqts in LRIP. Packaging changes pose no adverse impact on schedule or producibility.	Verified that HW meets packaging plan reqts in FRP. No packaging changes required.
	Custom Components	Custom components identified.	Custom Component issues identified. Plans completed to address custom component issues. Use of custom components requires no new process/material technology.	Custom Component plan implemented. Custom Component fabrication/assy is stable and proven on pilot line. Plan established to address any fab/assy issues.	Custom Components have no fab/assy/rate issues adversely affecting production.	Program is in FRP with no custom components required.
	Key Characteristics	Key Characteristics (KC) identified.	KC evaluated & tolerances impact on producibility considered (Sensitivity to tolerance based on design model evaluation).	Pilot line build verifies that KC can be met with mfg processes. No mfg issues associated with meeting KC.	All KC are controlled in production to 3-sigma or other appropriate quality level.	All KC are controlled in production to 6-sigma or other appropriate quality level.
Materials	Maturity	Completed survey to determine if materials has been used before.	Maturity has been assessed on similar materials in production. Specific programs identified.	Materials proven and validated on pilot line.	Material is proven and controlled in LRIP.	Material is proven and controlled in FRP.
	Availability	ID use of Exotic/critical/ hazardous materials, and associated lead times.	ID availability issues. Complete a plan to address availability issues. ID long lead items.	Availability issues addressed. Long Lead procurement initiated for LRIP. No availability issues pose significant impact on LRIP.	Availability issues addressed. Long Lead procurement initiated for FRP. No availability issues pose significant impact on FRP.	Program is in FRP with no availability issues.
	Sources	ID sole source/single source/foreign source vendors.	Complete a plan that minimizes sole/single/ foreign sources. Need for Sole/Single/ Foreign source justified. ID potential alternative sources.	Sole/Single/Foreign sources stability is assessed/monitored & sufficient to meet LRIP. Potential alternate sources being developed as necessary.	Sole/Single/Foreign sources stability is assessed/monitored. Sources available, multi-sourcing where possible. Delivery schedules demonstrated to support LRIP build.	Sole/Single/Foreign sources stability is assessed/monitored. Sources available for all items. Delivery schedules demonstrated to support FRP builds.
	Materials Planning	Parts lists available with associated lead times.	Make/Buy evaluations initiated. BOM initiated.	Make/Buy decisions & BOM complete to support LRIP.	Make/Buy decisions & BOM complete to support FRP.	Program is in FRP with no make/buy or BOM changes.
	Special Handling	ID special handling reqts (i.e. shelf life, HMMP, HAZMAT, storage environment, etc.)	Special handling issues identified. Complete a plan to address special handling issues.	Special handling procedures implemented on pilot line build. No special handling issues to impact LRIP.	Special handling procedures demonstrated in LRIP. No special handling issues to impact FRP.	Special handling procedures demonstrated in FRP.
IB/Facilities	Industrial Base (IB)/Facilities	Facility requirements/needs identified. Survey IB.	IB exists for similar components or plan developed for developing facilities.	Specific facilities in place & validated. Production flow defined.	Rate projections refined and estimated capacities meet FRP requirements. Any facilities or production line changes are validated. Facilities demonstrated to be adequate in LRIP.	Production facilities in place and capacity demonstrated to meet maximum FRP rate requirements.

Source: Developed by the Production Engineering Division, Aviation & Missile Research, Development, & Engineering Center, U.S. Army Aviation & Missile Command, Redstone Arsenal, AL, POC: Steve Watts, 256-876-3244

Table 6-3 Manufacturing Readiness Levels

Version 6.3 25-Mar-08										
DoD Manufacturing Readiness Levels (MRLs)										
S&T Phase		6.1 Basic Research	6.2 Applied Research	6.2 / 6.3	6.3 / 6.4	6.3 / 6.4 / 7.8	6.4 / 6.8 / 7.8	7.8	7.8	7.8	7.8 Title III
Acq Phase		Pre CR	Pre CR	Pre CR	CR-MSA	TD	MS B	SDD	MS C	LRIP - FRP	FRP
Thread	Sub-Thread	MRL 1	MRL 2	MRL 3	MRL 4	MRL 5	MRL 6	MRL 7	MRL 8	MRL 9	MRL 10
Technology & Industrial Base	Technology Maturity	Should be assessed at TRL 1.	Should be assessed at TRL 2.	Should be assessed at TRL 3.	Should be assessed at TRL 4.	Should be assessed at TRL 5.	Should be assessed at TRL 6.	Should be assessed at TRL 7	Should be assessed at TRL 7.	Should be assessed at TRL 8.	Should be assessed at TRL 9.
	Technology Transition to Production	Technology feasibility assessed.	New technology approaches defined.	Potential manufacturing sources identified for technology needs. (Commercial / Government, Domestic/ Foreign)	Industrial Base capabilities and gaps/risks identified for key technologies, components, and/or key processes.	Industrial Base assessed to identify potential manufacturing sources.	Industrial Capability Assessment (ICA) for MS B has been completed. Industrial capability in place to support mfg of development articles. Plans to minimize sole/foreign sources complete. Need for sole/foreign sources justified. Potential alternative sources identified.	Industrial capability to support production has been analyzed. Sole/foreign sources stability is assessed/moni-tored. Developing potential alternate sources as necessary.	Industrial Capability Assessment (ICA) for MS C has been completed. Industrial capability is in place to support LRIP. Sources are available, multi-sourcing where cost-effective or necessary to mitigate risk.	Industrial capability is in place to support start of FRP.	Industrial capability supports FRP. Industrial capability assessed to support mods, upgrades, surge and other potential manuf-acturing require-ments.
	Manufacturing Technology Develop-ment	Manufactur-ing feasibility assessed.	New manu-facturing approaches defined.	Initial demon-stration of manufactur-ing concept conducted.	Mfg Science & Advanced Mfg Technology requirements identified	Required manufacturing technology development efforts initiated.	Manufacturing technology efforts continuing. Required manufacturing technology development solutions demonstrated in a production relevant environment.	Manufacturing technology efforts continuing. Required manufacturing technology development solutions demonstrated in a production representative environment.	Manufacturing technology efforts continuing. Required manufacturing technology solutions validated on a pilot line.	Manufacturing technology efforts continuing. Manufacturing technology process improvements efforts initiated for FRP.	Manufacturing technology efforts continuing. Manufacturing technology continuous process improvements ongoing.

						DoD Manufacturing Readiness Levels (MRLs)					

Thread	Sub-Thread	6.1 Basic Research	6.2 Applied Research	6.2 / 6.3	6.3 / 6.4	6.3 / 6.4 / 7.8	6.4 / 6.8 / 7.8	7.8	7.8	7.8	7.8 Title III
S&T Phase						TD		SDD			
Acq Phase		Pre CR	Pre CR	Pre CR	CR-MSA		MS B		MS C	LRIP - FRP	FRP
		MRL 1	MRL 2	MRL 3	MRL 4	MRL 5	MRL 6	MRL 7	MRL 8	MRL 9	MRL 10
Design	Producibility Program	Feasibility of materials/ processes assessed.	Relevant material/process requirements defined.	Relevant materials/ processes for manufac-turability & producibility evaluated.	Producibility & Manufacturability assessment of design concepts completed. Results guide selection of design concepts and key components/ technologies for Technology Development Strategy. Manufacturing Processes assessed for capability to test and verify in production, and influence on O&S.	Producibility & Manufacturability assessments of key technologies and components initiated. Systems Engineering Plan (SEP) requires validation of design choices against manufacturing process and industrial base capability constraints.	Producibility assessments of key technologies/ components and producibility trade studies (performance vs. producibility) completed. Results used to shape System Development Strategy and plans for SDD or technology insertion programs phase.	Detailed producibility trade studies using knowledge of key design characteristics and related manufacturing process capability completed. Producibility enhancement efforts (e.g., DFMA) initiated.	Producibility improvements implemented on system. Known producibility issues have been resolved and pose no significant risk for LRIP.	Prior producibility improvements analyzed for effectiveness during LRIP. Producibility issues/risks discovered in LRIP have been mitigated and pose no significant risk for FRP.	On-going producibility improvements analyzed for effectiveness. Producibility refinements continue. All mods, upgrades, DMSMS, and other changes assessed for producibility.
	Design Maturity	Top level trade-offs in design options assessed.	Maturity goals defined.	Product life cycle requirements and product performance requirements evaluated.	Systems Engineering Plans and the Test and Evaluation Strategy recognize the need for the establishment/ validation of manufacturing capability and management of manufacturing risk for the product life cycle. Initial Key Performance Parameters (KPPs) identified.	Identification of enabling/critical technologies and components is complete and includes the product lifecycle. Evaluation of design Key Characteristics (KC) initiated.	Basic system design requirements defined. All enabling/critical technologies/ components have been tested and validated. Product data required for prototype manufacturing released. A preliminary performance as well as focused logistics specification is in place. Key Characteristics and tolerances have been established.	Product requirements and features are well enough defined to support detailed systems design. All product data essential for manufacturing of component design demonstration released. Potential KC risk issues have been identified and mitigation plan is in place. Design change traffic may be significant.	Detailed design of product features and interfaces is complete. All product data essential for system manufacturing released. Major product design features are sufficiently stable such that key LRIP manufacturing processes will be representative of those used in FRP. Design change traffic does not significantly impact LRIP. Key characteristics are stable and have	Major product design features are stable and LRIP produced items are proven in product testing. Design change traffic is limited to minor configuration changes. All KC's are controlled in production to three sigma or other appropriate quality levels.	Product design is stable. Design changes are few and generally limited to those required for continuous improvement or in reaction to obsolescence. All KCs are controlled to Six Sigma or other appropriate quality levels.

Version 6.3 25-Mar-08											
DoD Manufacturing Readiness Levels (MRLs)											
S&T Phase		6.1 Basic Research	6.2 Applied Research	6.2 / 6.3	6.3 / 6.4	6.3 / 6.4 / 7.8	6.4 / 6.8 / 7.8	7.8	7.8	7.8	7.8 Title III
Acq Phase		Pre CR	Pre CR	Pre CR	CR-MSA	TD	MS B	SDD	MS C	LRIP - FRP	FRP
Thread	Sub-Thread	MRL 1	MRL 2	MRL 3	MRL 4	MRL 5	MRL 6	MRL 7	MRL 8	MRL 9	MRL 10
									been demonstrated in SDD or technology insertion program.		

Acronyms

ACAT	Acquisition Category
ADM	Acquisition Decision Memorandum
ADT	Administrative Delay Time
AIT	automatic identification technology
ALT	Accelerated Life Testing
A_m	materiel availability
AMA	Analysis of Materiel Approaches
AO	action officer
AoA	Analysis of Alternatives
AOTR	Assessment of Operational Test Readiness
APB	Acquisition Program Baseline
AS	Assessments and Support
AS	Acquisition Strategy
ASD	Assistant Secretary of Defense
ASR	Alternative System Review
AT	anti-tamper
AT&L	Acquisition, Technology and Logistics
ATO	assemble to order
BCA	Business Case Analysis
BDAR	battle damage and repair
BIT	Built-In-Test
BPC	Best Practices Clearinghouse
C4I	Command, Control, Communications, Computers, and Intelligence
CAD	computer-aided design
CAE	Computer-Aided Engineering
CAIG	Cost Analysis Improvement Group
CAIV	cost as independent variable
CARD	Cost Analysis Requirements Description
CBA	Capabilities-Based Assessment
CCDR	contractor cost data reporting
CDD	Capabilities Development Document
CDR	Critical Design Review
CDRL	Contract Data Requirement List
CLS	contractor logistics support
CM	configuration management
COCOM	combatant commanders
COI	critical operational issue
CONOPS	Concept of Operations
COTS	commercial-off-the-shelf

CPAT	Corrosion Prevention Action Team
CPCP	Corrosion Prevention and Control Plan
CPD	Capability Production Document
CPI	critical program information
CR	Concept Refinement (phase)
CSDR	cost and software data reporting
CTE	critical technology element
CTP	critical technical parameter
DAB	Defense Acquisition Board
DAES	Defense Acquisition Executive Summary
DAG	Defense Acquisition Guidebook
DAMS	Defense Acquisition Management System
DAPS	Defense Acquisition Program Support
DAS	Defense Acquisition System
DCACAS	Data Collection Analysis and Corrective Action System
DCARC	Defense Cost and Resource Center
DDMS	DoD Discovery Metadata Standard
DDR&E	Director, Defense Research and Engineering
DIA	Defense Intelligence Agency
DISN	Defense Information Systems Network
DMS	diminished manufacturing sources
DoD	Department of Defense
DoDAF	Department of Defense Architecture Framework
DOT&E	Director, Operational Test and Evaluation
DOTMLPF	Doctrine, Training, Materiel, Leadership, Personnel, and Facilities
DPAP	Defense Procurement and Acquisition Policy
DSOR	depot source of repair
DT	demonstration test
DT	developmental test(ing)
DT&E	developmental test and evaluation
DUSD/S&T	Deputy Under Secretary of Defense for Science and Technology
E3	electronic environmental effect
ECP	Engineering Change Proposal
EDM	engineering development model
EMDD	Engineering, Manufacturing Development and Demonstration (phase)
EMRL	Engineering Manufacturing Level
EOA	Early Operational Assessment
ESOH	environment, safety, and occupational health
EVM	earned value management
EVMS	Earned Value Management System
FAA	Functional Area Analysis

FCA	Functional Configuration Audit
FD	failure definition
FD/SC	failure definitions/scoring criteria
FFRDC	Federally Funded Research and Development Center
FNA	Functional Needs Analysis
FOC	Full Operational Capability (phase)
FoS	family of systems
FOUO	For Official Use Only
FRACAS	Failure Reporting Analysis and Corrective Action System
FRP	full-rate production
FRPDR	Full-Rate Production Decision Review
FRR	Flight Readiness Review
FSA	Functional Solutions Analysis
FUSL	full-up system level
FYDP	Future Years Defense Program
GCCS	Global Command and Control System
GCSS	Global Combat Support System
GFE/GFM	government-furnished equipment/government-furnished material
GFI	government-furnished items
GIG	Global Information Grid
HALT	Highly Accelerated Life Testing
HEMP	High Altitude Electromagnetic Pulse
HFE	human factors engineering
HHA	health hazards analysis
HITL	hardware-in-the-loop
HSI	human systems integration
IATO	interim authority to operate
IBR	Integrated Baseline Review
ICD	Initial Capabilities Document
ICE	independent cost estimate
ID	identification
IDA	integrated data environment
IER	Information Exchange Requirement
IETM	interactive electronic technical manual
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IOC	Initial Operational Capability (phase)
IOT&E	Initial Operational Test and Evaluation
IPT	Integrated Process/Product Team
ISP	Information Support Plan
ISP	In-Service Review

IT	information technology
ITA	Independent Technical Assessment
ITR	Initial Technical Review
ITS	information technology system
IV&V	Independent Verification and Validation
JCD	Joint Capabilities Document
JCIDS	Joint Capabilities Integration and Development System
JDEP	Joint Distributed Engineering Plan
JFC	Joint Functional Concept
JIC	Joint Integration Concept
JITC	Joint Integration Test Command
JITC	Joint Interoperability Test Certification
JOC	Joint Operational Concept
JROC	Joint Requirements Oversight Council
JTRS	Joint Tactical Radio System
KPP	key performance parameter
KSA	key system attribute
LCC	life cycle cost
LDT	logistics delay time
LFT&E	Live Fire Test and Evaluation
LRIP	low-rate initial production
LUT	limited user test
M&S	modeling and simulation
MAIS	Major Automated Information System
MCEB	Military Communications-Electronics Board
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MDT	maintenance down times
MNS	Mission Needs Statement
MOA	Memorandum of Agreement
MOE	measure of effectiveness
MOP	measure of performance
MOS	measure of suitability
MOS	military occupation specialty
MOSA	Modular Open Systems Approach
MRA	Manufacturing Readiness Assessment
MRL	Manufacturing Readiness Level
MSRR	Modeling and Simulation Resource Registry
MT	mission task
MTBAF	mean time between mission-affecting failures
MTBCF	mean time between critical failures

MTBF	mean time between failures
MTBSA	mean time between system aborts
MTTR	mean time to repair
NBC	nuclear, biological and chemical
NCES	Net-Centric Enterprise Services
NCOW RM	Net-Centric Operations Warfare Reference Model
NDI	non-developmental items
NII	Networking, Information, and Integration
NR-KIP	Net-Ready Key Interface Profile
NR-KPP	Net-Ready Key Performance Parameter
NSS	National Security Strategy
NSS	National Security System
O&M	operation and maintenance
O&S	Operations and Support (phase)
O&SHA	Operating and Support Hazard Analysis
OA	operational assessment
OC	ownership cost
OE	operational evaluator
OIPT	Overarching Integrated Product Team
OMS/MP	Operational Mode Summary/Mission Profile
OPEVAL	Operational Evaluation
OPTEMPO	Operations Tempo
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OT	operational test(ing)
OT&E	operational test and evaluation
OTA	Office of Technology Assessment
OTA	Operational Test Agency
OTB	over target baseline
OTRR	Operational Readiness Test Review
OUSD	Office of the Under Secretary of Defense
OV	Operational View
OV-1	high-level Operational View
PA&E	Program Analysis and Evaluation
PBA	Performance-Based Agreement
PBA	Program Budget Authority
PBL	performance-based logistics
PCA	Physical Configuration Audit
PD	Production and Deployment (phase)
PDR	Preliminary Design Review
PESHE	Programmatic Environment, Safety, and Occupational Health Evaluation

PHL	Preliminary Hazards List
PM	program manager
PMB	Performance Measurement Baseline
PMO	program management office
PoF	physics of failure
POM	Program Objective Memorandum
PPBES	Planning, Programming, Budgeting and Execution System
PPP	Program Protection Plan
PRR	Production Readiness Review
PSC	preferred system concept
PSR	Program Support Review
PST	Program Support Team
QA	quality assurance
R&D	research and development
R&M	reliability and maintainability
RAM	reliability, availability, and maintainability
RAM-C	reliability, availability, and maintainability-cost
RDD	requirement-driven design
RDT&E	Research, Development, Test and Evaluation
RF	radio frequency
RFA	Request for Action
RFID	radio-frequency ID
RFP	request for proposal
ROM	rough order of magnitude
RTCA	Real Time Casualty Assessment
S&T	Science and Technology (office); science and technology
SAR	Selection Acquisition Report
SC	scoring criteria
SCS	System Capabilities Specifications
SDD	System Development and Demonstration (phase)
SDP	Software Development Plan
SE	systems engineering
SECDEF	Secretary of Defense
SEMP	Systems Engineering Master Plan
SEP	Systems Engineering Plan
SETA	Systems Engineering Technical Assistance
SFR	System Functional Review
SWIL	software integration lab
SME	subject matter expert
SOO	Statement of Objectives
SoS	system of systems

SOW	Statement of Work
SRDR	Software Resources Data Report
SRR	System Requirements Review
SSE	Systems and Software Engineering
SSE/AS	Systems and Software Engineering/Assessments and Support
STAR	System Threat Assessment Report
SV	System View
SV-1	System Interface Description
SVR	System Verification Review
T&E	test and evaluation
T&E WIPT	Test and Evaluation Working-Level Integrated Product Team
TAAF	test, analyze, and fix
TAD	Target Audience Description
TD	Technology Development (phase)
TDP	technical data package
TDS	Technology Development Strategy
TEMP	Test and Evaluation Master Plan
TES	Test and Evaluation Strategy
TOC	total ownership cost
TPM	technical performance measure
TRA	Technical Review Authority
TRL	Technology Readiness Level
TRR	Test Readiness Review
TV	Technical View
UML	Unified Modeling Language
USD	Under Secretary of Defense
V&V	verification and validation
VE	Value Engineering
VV&A	verification, validation and accreditation
WBS	Work Breakdown Structure
WIPT	Working-Level Integrated Product Team

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About the Systems and Software Engineering/Assessments and Support Directorate

The Assessments and Support (AS) deputy directorate within the Systems and Software Engineering (SSE) directorate of the Office of the Deputy Under Secretary of Defense for Acquisition and Technology provides systems engineering and test and evaluation support to the Department of Defense (DoD) acquisition community. Specifically, AS supports the acquisition management system through the following:

- *Acquisition Decision Process.* Presentation of findings, both strengths and risk areas, and recommendations from multiple reviews of programs to oversight boards at all levels of the acquisition decision-making process in their formulation of program decisions, guidance, and recommendations. These include the Defense Acquisition Board, Overarching Integrated Process Teams, and Integrated Process/Product Teams (IPTs).

- *Monitoring of Program Status.* SSE/AS members participate in systems engineering IPTs and test and evaluation IPTs, observe test events, attend program and design reviews, maintain continuous dialogue with program management offices (PMOs) and Component counterparts, and review all program-related documentation available to the Office of the Secretary of Defense (OSD) to maintain cognizance of program status. Based on this direct involvement, SSE/AS members can offer viable and valuable advice and recommendations from an OSD perspective to the PMOs, as well as provide independent assessments to the Defense Acquisition Executive Summary.

- *Best Practices.* SSE is extensively involved in the definition, implementation, and deployment of the DoD Best Practices Clearinghouse (BPCh). The BPCh is the single authoritative source for information about validated practices, lessons learned, and avoidable program risks. It provides tools to help find, select, and implement practices appropriate to specific programs.

- *Systemic Analysis.* SSE/AS analyzes findings from multiple reviews to identify systemic or recurring problems across DoD acquisition programs and to identify best practices. The systemic analysis process searches for root causes in program management and acquisition functional areas. Results are used to identify both best practices and lessons learned, and to inform recommendations for changes to defense policy, guidance, and training.

For additional information, visit the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD(AT&L)) web site (ATLnet) (https://portal.acq.osd.mil/).

Defense Acquisition Program Support (DAPS) Methodology

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