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 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 should establish RAM objectives early in the acquisition cycle and address them as a design parameter throughout the acquisition process. The program manager develops RAM system requirements based on the Initial Capabilities Document or Capability Development Document and total ownership cost (TOC) considerations, and states them in quantifiable, operational terms, measurable during DT&E and 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; i.e., 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 paves 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 program manager 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. IOT&E uses production representative systems, actual operational procedures, and personnel with representative skill levels. To reduce testing costs, the program manager 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; e.g., 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 need to consider the stochastic nature of these parameters.

Top-Level Questions:

What steps is the program taking to assess Suitability?

How are reliability, availability, and maintainability (RAM) planned and assessed throughout the system life-cycle?

Has the program established realistic and achievable RAM metrics?

Are the RAM metrics consistent with each other?

Have user needs for Logistics Reliability been considered along with system requirements for Mission Reliability?

Have system needs for Operational Availability been considered along with system requirements for Materiel Availability?

Factor 5.2.1 – Reliability Assessment

<u>Pre-MS A</u>

<u>Criteria:</u>
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 KSA) consists of two parts for which requirements should 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 and System Development and Demonstration phases to support LRIP and FRP decisions. Planning for, and funding of, the demonstration efforts must start during the earliest program stages.
5.2.1.C5: Assumptions made when determining reliability requirements must be documented (in the 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 Mission Summary/Mission Profile (OMS/MP), Operational 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 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 vs. 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 (ICD, RAM-C Report, etc.) as required.

5.2.1.C13: The Program Manager is responsible for ensuring that established reliability requirements are met. The Program Manager is also 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:

1. A robust systems engineering process throughout the life-cycle;
2. Reliability experts are involved throughout the life-cycle;
3. A corrective action system is in place;
4. Development testing at the component, sub-system, and system levels;
5. A Reliability growth program;
6. Reliability enhancement testing (HALT, ALT, etc.)
7. Modeling and Simulation

Some ways for the PM to evaluate the achieved level of reliability include:

1. Reliability demonstration testing;
2. Operational testing;
3. Data collection and analysis (DCACAS/FRACAS);
4. Updated reliability modeling and analysis throughout the life-cycle

<u>Sample Questions:</u>

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 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 operational mission summary and mission profile (OMS/MP) {5.2.1.C7}
5.2.1.Q11: What operational tempo 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 Analysis of Alternatives (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 program ensure reliability experts are involved throughout the life-cycle?
- What is the planned corrective action system?
- What development test events are anticipated?
- What modeling and simulation 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 events are planned?

- How will DT and 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 reliability meets requirements? {5.2.1.C13}

Pre-MS B

Criteria:

5.2.1.C15: The RFP should include 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 $0.90 = e^{-\frac{10\,hours}{MTBMAF}}$ 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 sub-system, assembly, sub-assembly, and component levels for any repairable or replaceable parts. These allocations should start with the major sub-systems during the Technology Development (TD) phase and should be refined to lower levels as applicable during the System Development and Demonstration (SDD) phase.
5.2.1.C17: DoD policy mandates a robust reliability program, including reliability growth, throughout TD, SDD, and Production and Deployment (PD) phases to ensure reliability is mature at the Full Rate Production (FRP) decision. A robust reliability program includes ongoing analysis of reliability demonstrated to date.
5.2.1.C18: The reliability program should be documented in a reliability program plan. The reliability program plan should describe in detail all reliability activities anticipated, including schedules, relating to evaluating and enhancing system reliability.
5.2.1.C19: Reliability activities should be documented in the SEP.
5.2.1.C20: Modeling and simulation should be used to evaluate predicted system reliability throughout the life-cycle.
5.2.1.C21: All test event data should be 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 program 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 COTS and NDI items—so the program should perform lower-level stress analyses (including measurement of actual stresses when possible) in order to support reliability risk management efforts.

Sample Questions:

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 is 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? {2.1.1.C18}
5.2.1.Q31: What reliability engineering and physics of failure 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 Systems Engineering Plan (SEP)? {5.2.1.C19}
5.2.1.Q33: How has the program incorporated reliability modeling and simulation? {5.2.1.C20}
5.2.1.Q34: How has the Demonstration Test (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 the inherent reliability of the design is maintained throughout production? {5.2.1.C23}
5.2.1.Q37: How have Human Systems Integration (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 subsystem environmental concerns are known? {5.2.1.C25}

Pre-MS 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 trade-offs, 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 IOC/FOC phases.
5.2.1.C29: Proper reliability risk management requires evaluation of planned vs. 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 the OMS/MP and FD/SC are up to date and accurately support system reliability and test analyses.
5.2.1.C31: Reliability testing during DT and 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 Program Manager is responsible for ensuring that established reliability requirements are met. The Program Manager is also 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:

1. A robust systems engineering process throughout the life-cycle;
2. Reliability experts are involved throughout the life-cycle;
3. A corrective action system is in place;
4. Development testing at the component, sub-system, and system levels;
5. A Reliability growth program;

6. Reliability enhancement testing (HALT, ALT, etc.)
7. Modeling and Simulation

Some ways for the PM to evaluate the achieved level of reliability include:

1. Reliability demonstration testing;
2. Operational testing;
3. Data collection and analysis (DCACAS/FRACAS);
4. Updated reliability modeling and analysis throughout the life-cycle

<u>Sample Questions:</u>

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 CPD? {5.2.1.C27}
5.2.1.Q43: What are the results of updated reliability modeling and simulation? {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 Failure Definitions and Scoring Criteria? {5.2.1.C30}
5.2.1 Q55: How is reliability testing addressed in the 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 underway? {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 is DCACAS/FRACAS and TAAF resourced throughout production? {5.2.1.C33}

<u>Post-MS C</u>

<u>Criteria:</u>

5.2.1.C34: Under the concept of total life-cycle planning, the PM is responsible for evaluating how the system performs once fielded.

<u>Sample Questions:</u>

5.2.1.Q65: How does the system's IOT&E performance compare to 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}

References:

1. Defense Acquisition Guidebook
2. Designing and Assessing Supportability in DOD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint, October 24, 2003
3. Independent Logistics Assessment, Version 1.0, January 2006
4. DOD GUIDE FOR ACHIEVING RELIABILITY, AVAILABILITY, AND MAINTAINABILITY, August 3, 2005
5. DoD Directive 5000.1 Defense Acquisition System, May 12, 2003
6. DoD Directive 5000.2 Operation of the Defense Acquisition System, May 12, 2003
7. CJCSM 3170.01C OPERATION OF THE JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM, 1 May 2007
8. CJCSI 3170.01M JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM, 1 May 2007

Factor 5.2.2 – Availability Assessment

Pre-MS A:

Criteria:

5.2.2.C1: Materiel Availability, the sustainment KPP, is primarily defined as:

$$A_M = \frac{Number\ of\ Systems\ Operational}{Total\ Population\ of\ Systems\ Acquired}$$

Unlike in traditional measures of Operational Availability, when evaluating 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 OMS/MP, 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 should be established for each mission in the OMS/MP.
5.2.2.C4: Generally, achieved availability is a function of the system's uptimes (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.

Sample Questions:

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 (spares, float, reserve, etc.) ones? {5.2.2.C1}
5.2.2.Q3: What Materiel Availability requirement and rationale have been established? {5.2.2.C1}
5.2.2.Q4: What is the expected operational mission summary and mission profile (OMS/MP) {5.2.2.C2}
5.2.2.Q5: What operational tempo 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-MS B:

Criteria:

5.2.2.C5: Measurable Materiel Availability (A_M) requirements should be included in the RFP along with the anticipated availability assessment approach.
5.2.2.C6: Materiel Availability exit criteria, covering all major systems engineering events, should be developed early in the program and evaluated/updated as necessary.
Note: DT and 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 for 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.

Sample Questions:

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 modeling and simulation?{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 Demonstration Test (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-MS 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 continuously be performed and documented (in the RAM-C Report, risk management plan, ICD/CDD/CPD, SEMP, etc.) throughout the life-cycle in order to support achievement of the estimated values.
5.2.2.C9: The RAM modeling and simulation effort should 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.

Sample Questions:

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 modeling and simulation? {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-MS C

Criteria:
5.2.2.C11: The program must constantly evaluate actual RAM performance achieved throughout the Production and Deployment phase in order to demonstrate that the metrics have been met.

Sample Questions:

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}

References:

1. Defense Acquisition Guidebook
2. Designing and Assessing Supportability in DOD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint, October 24, 2003
3. Independent Logistics Assessment, Version 1.0, January 2006
4. DOD GUIDE FOR ACHIEVING RELIABILITY, AVAILABILITY, AND MAINTAINABILITY, August 3, 2005
5. DoD Directive 5000.1 Defense Acquisition System, May 12, 2003
6. DoD Directive 5000.2 Operation of the Defense Acquisition System, May 12, 2003
7. CJCSM 3170.01C OPERATION OF THE JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM, 1 May 2007
8. CJCSI 3170.01M JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM, 1 May 2007

Factor 5.2.3 – Maintainability Assessment

Pre-MS A:

<u>Criteria:</u>

5.2.3.C1: 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.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 that the requirement is completely specified.
5.2.3.C3: The availability, reliability, and maintainability requirements must be evaluated for consistency once established and then whenever any significant change is made.
5.2.3.C4: The program manager is accountable for the system's RAM performance throughout the program life-cycle. Included in this is ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, ensuring the program is properly staffed for RAM throughout the life-cycle, tracking and mitigating RAM risks, and verifying RAM performance throughout the life-cycle.

<u>Sample Questions:</u>

5.2.3.Q1: How does the planned sustainment approach support program cost estimates (LCC, 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 each other? {5.2.3.C3}
5.2.3.Q7: How does the program ensure 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 NDI/COTS items, have been identified, documented, and mitigated? {5.2.3.C4}
5.2.3.Q10: How were maintainability tradeoffs included in the AoA to support selection of the preferred system approach? {5.2.3.C4}
5.2.3.Q11: What maintainability requirements and agreements (PBAs, PBLs, incentives, etc.) are included in the RFP? {5.2.3.C5}

<u>Pre-MS B</u>

<u>Criteria:</u>

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 availability, reliability, and maintainability requirements must be evaluated for consistency once established and then whenever any significant change is made.
5.2.3.C8: The program manager is accountable for the system's RAM performance throughout the program life-cycle. Included in this is ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, ensuring the program is properly staffed for RAM throughout the life-cycle, tracking and mitigating RAM risks, and verifying RAM performance throughout the life-cycle.

Sample Questions:

5.2.3.Q12: What are the maintainability measures (MDT, MTTR, ADT, 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, 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-MS 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 availability, reliability, and maintainability requirements must be evaluated for consistency once established and then whenever any significant change is made.
5.2.3.C12: The program manager is accountable for the system's RAM performance throughout the program life-cycle. Included in this is ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, ensuring 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 program manager should ensure that proper production processes and controls are in place.

Sample Questions:

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 due 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 modeling and simulation 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 (SEP, RAM-C, standalone 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 DT/DOT&E events? {5.2.3.C12}
5.2.3.Q29: How has the program ensured 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 maintainability experts are included in all major program decisions throughout the system's life-cycle? {5.2.3.C13}

<u>Post-MS C</u>

<u>Criteria:</u>

5.2.3.C14: The program manager is accountable for the system's RAM performance throughout the program life-cycle. Included in this is ensuring appropriate tradeoffs were made during design, all aspects of RAM are considered when making program decisions, ensuring the program is properly staffed for RAM throughout the life-cycle, tracking and mitigating RAM risks, and verifying RAM performance throughout the life-cycle.

<u>Sample Questions:</u>

5.2.3.Q34: What was the observed maintainability during DT/IOT&E events and how does this compare to 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}

<u>References:</u>

1. Defense Acquisition Guidebook
2. Designing and Assessing Supportability in DOD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint, October 24, 2003
3. Independent Logistics Assessment, Version 1.0, January 2006

4. DOD GUIDE FOR ACHIEVING RELIABILITY, AVAILABILITY, AND MAINTAINABILITY, August 3, 2005
5. DoD Directive 5000.1 Defense Acquisition System, May 12, 2003
6. DoD Directive 5000.2 Operation of the Defense Acquisition System, May 12, 2003
7. CJCSM 3170.01C OPERATION OF THE JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM, 1 May 2007
8. CJCSI 3170.01M JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM, 1 May 2007