Report of the Reliability Improvement Working Group (RIWG)

Volume II - Appendices

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Appendix 1 Formulate Programs with a RAM Growth Program

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Appendix 1.1 Reliability Improvement Policy

(see also http://www.acq.osd.mil/sse/dte/docs/USD-ATLMemo-RAM-Policy-21Jul08.pdf)

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

JUL 21 2008

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENT
DIRECTORS OF THE DEFENSE AGENCIES
DEPUTY UNDER SECRETARY OF DEFENSE (A&T)

SUBJECT: Reliability, Availability, and Maintainability Policy

In recent years, there has been an increasing trend within the Department of weapon systems not achieving the required reliability during developmental testing and subsequently being found unsuitable during Initial Operational Test and Evaluation. Also, higher than anticipated ownership costs point to insufficient reliability engineering activities and logistics planning during the program acquisition phase. This trend indicates that reliability, availability, and maintainability (RAM) were not adequately designed into systems.

The Defense Science Board Task Force on Developmental Test and Evaluation recommended that RAM, including a robust reliability program with an established reliability growth approach, be a mandatory contractual requirement and be addressed at every major program review. Furthermore, the DoD Reliability Improvement Working Group identified the need for the Components to develop an associated implementing reliability policy.

Therefore, the Secretaries of the Military Department and the Directors of the Defense Agencies are directed to establish a reliability improvement acquisition policy to address the problem of inadequate system RAM. Each policy shall implement RAM practices that:

- Ensure effective collaboration between the requirements and acquisition communities in the establishment of RAM requirements that balance funding and schedule while ensuring system suitability and effectiveness in the anticipated operating environment.
- Ensure development contracts and acquisition plans evaluate RAM during system design.
- Evaluate the maturation of RAM through each phase of the acquisition life cycle.
- Evaluate the appropriate use of contract incentives to achieve RAM objectives.

The Secretaries of the Military Department and the Directors of the Defense Agencies will report back to me within 30 days with their plan to implement these policies.

Further, effective immediately, it is Department policy for programs to be formulated to execute a viable RAM strategy that includes a reliability growth program as an integral part of design and development. Additionally, RAM shall be integrated within the Systems Engineering processes, documented in the program's Systems Engineering Plan and Life Cycle Sustainment Plan, and assessed during technical reviews, test and evaluation, and Program Support Reviews. This policy will be included in the DoD Instruction 5000.2.

The Deputy Under Secretary of Defense for Acquisition and Technology will:

a. Within 30 days, prepare a Manual for use by requirements managers and program managers to develop and document better their sustainment requirements.

b. Develop supporting guidance to be included in the Defense Acquisition Guidebook, which reflects the above Manual.

c. Report any additional recommendations resulting from the Reliability Improvement Working Group to me not later than July 31.

Establishing reliability improvement policy, with appropriate oversight, will support effective implementation of the mandatory Materiel Availability Key Performance Parameter, and Materiel Reliability and Ownership Cost Key System Attributes. The implementation of these policies will result in reliable and maintainable systems that are of high quality and readily available to satisfy user requirements in meeting mission capability and operational objectives.

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John J. Young, Jr.

cc:
Service Acquisition Executives
Component Acquisition Executives

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Appendix 1.2 Sample Reliability Language for Acquisition Contracts

1.2.1 Template for Reliability Contract Language

- COVER PAGE -

Sample Reliability Language for DoD Acquisition Contracts
(see also https://acc.dau.mil/CommunityBrowser.aspx?id=219127&lang=en-US)

"The single most important step necessary to correct high suitability failure rates is to ensure programs are formulated to execute a viable systems engineering strategy from the beginning, including a robust RAM program, which includes reliability growth, as an integral part of design and development."

(Report of the Defense Science Board Task Force on Developmental Test and Evaluation, May 2008)

Enclosures follow:

1. Section C Statement of Work Reliability Language and Tailoring Instructions

2. Section L Proposal Instructions Reliability Language

3. Section M Evaluation Factors for Award Reliability Language

4. Checklist for Evaluating Reliability Program Plans

Enclosure 1. Section C Statement of Work Reliability Language and Tailoring Instructions

Instructions for Use and Tailoring

- The sample language below is appropriate for both Technology Development and System Development and Demonstration contracts. The Reliability Program Plan should address the entire life cycle but the contractor's execution of the plan is of course limited to the contract period of performance.
- It is assumed that the quantitative reliability requirements, Operational Mode Summary/Mission Profile, Failure Definition & Scoring Criteria, and other requirements (e.g., schedule requirements) are specified elsewhere in Section C (e.g., in the System Specification or Purchase Description).
- The sample language should be tailored to each specific program. There are tailoring notes embedded in the sample language for the Program Manager's use. If there will be a down-select at the end of the contract based, in part, on demonstrated or projected reliability, language explaining this should also be included where appropriate.
- It should be noted that this sample language is an intensive reliability engineering and growth program that is fully integrated with Systems Engineering. Specific Reliability Activities described below cannot logically be deleted.

Sample Language

Reliability Program. The contractor shall implement and execute each of the Reliability Activities as described below to ensure achievement of the reliability requirements established in the System Specification [TAILOR].

1. Reliability Program Plan. The contractor shall develop and follow a Reliability Program Plan in order to achieve the following four objectives (1) understand the customer/user's requirements, (2) design for reliability, (3) produce reliable systems, and (4) monitor and assess field reliability. The Reliability Program Plan shall, at minimum, employ each of the Reliability Activities herein and shall address reliability funding, schedule, outputs, and staffing.

2. System Reliability Model. The contractor shall develop a reliability model for the system. At minimum, the system reliability model shall be used to (1) generate and update the reliability allocations from the system level down to lower indenture levels, (2) aggregate system-level reliability based on reliability estimates from lower indenture levels, (3) identify single points of failure, and (4) identify reliability-critical items and areas where additional design or testing activities are required in order to achieve the reliability requirements. The system reliability model shall be updated whenever new failure modes are identified, failure definitions are updated, operational & environmental load estimates are revised, or design and manufacturing changes occur throughout the life cycle. Detailed component stress and damage models shall be incorporated as appropriate.

3. Systems-Engineering Integration. The contractor shall implement a sound systems-engineering process to translate customer/user needs and requirements into suitable systems/products while balancing performance, risk, cost, and schedule. The contractor shall (1) incorporate the Reliability Activities described herein as an integral part of a disciplined and documented systems engineering process and plan, (2) submit the potential reliability improvements identified during the execution of the Reliability Activities to the appropriate engineering organizations, (3) monitor and evaluate the reliability impact of changes to the design or manufacture of the system, (4) manage and control reliability critical items, and (5) ensure adherence to design rules that impact reliability, including derating, electrical, mechanical, and other guidelines.

4. System-Level Operational & Environmental Life-Cycle Loads. The contractor shall estimate and periodically update the operational & environmental loads (e.g., mechanical shock, vibration, and temperature cycling) that the system is expected to encounter in actual usage throughout the life cycle. These loads shall be estimated for the entire life cycle which will typically include operation, storage, shipping, handling, and maintenance. The estimates shall be verified to be operationally realistic with measurements using the production-representative system [TAILOR] in time to be used for Reliability Verification. If the load information identified in the System Specification [TAILOR] is insufficiently detailed regarding the actual operational & environmental loads the system will encounter throughout the life cycle, the contractor shall seek access to customer assets (e.g., test courses or vehicles that the system will be integrated with) in order to obtain the needed specifics.

5. Life-Cycle Loads on Assemblies, Subassemblies, and Components. The contractor shall estimate the life-cycle loads that subordinate assemblies, subassemblies, components, commercial-off-the-shelf, non-developmental items, and government-furnished equipment will experience as a result of the product-level operational & environmental loads estimated above. These estimates and updates shall be provided to teams developing assemblies, subassemblies, and components for this system. These estimates shall also be provided to teams selecting and integrating items not specifically developed for this system, which may include commercial-off-the-shelf, non-developmental items, and government-furnished equipment, as well as assemblies, subassemblies, and components. These estimates of life-cycle loads shall be refined periodically as the system-level loads are updated and/or as the design evolves. The teams that receive initial estimates shall be provided with these updated estimates. Eventually the estimates shall be verified with measurements (e.g., from instrumented systems/products used under operationally-realistic conditions).

6. Identify and Characterize Failure Modes and Mechanisms. The identification of failure modes and mechanisms shall start immediately after contract award. The estimates of life-cycle loads on assemblies, subassemblies, and components obtained above shall be used as inputs to engineering- and physics-based models in order to identify potential failure mechanisms and the resulting failure modes. The teams developing assemblies, subassemblies, and components for this system shall identify and confirm through analysis, test, or accelerated test the failure modes and distributions that will result when life-cycle loads estimated above are imposed on these assemblies, subassemblies, and components. The teams selecting and integrating items not specifically developed for this system (which may include commercial-off-the-shelf, non-developmental items, and government-furnished equipment, as well as assemblies, subassemblies, and components) shall identify and confirm, through analysis, test, or accelerated test, the failure modes and distributions that will result when these life-cycle loads are imposed on these items. Failure modes that may be induced by user or maintainer error shall be identified and confirmed through analysis, test, or accelerated test. Failure modes and distributions that may be induced by manufacturing variation or errors shall be identified and confirmed through analysis, test, or accelerated test. These failure modes and distributions shall be updated as the design and the manufacturing processes evolve, if the Failure Definition and Scoring Criteria identified in the System Specification [TAILOR] is updated, and when the life-cycle operational & environmental loads are updated. These updates shall continue after the system is fielded.

All failures that occur in either test or the field shall be analyzed until the root cause failure mechanism has been identified. Identification of the failure mechanism provides the insight essential to the identification of corrective actions, including reliability improvements. Predicted failure modes/mechanisms shall be compared with those from test and the field.

7. Closed-Loop Failure-Mode Mitigation. The contractor shall have an integrated team, including suppliers of assemblies, subassemblies, components, commercial-off-the-shelf, non-developmental items, and government-furnished equipment, as applicable, analyze all failure modes arising from modeling, analysis, test, or the field throughout the life cycle in order to formulate corrective actions.

Failure modes shall be mitigated by one or more of the following approaches:

- eliminating the failure mode,
- reducing its occurrence probability or frequency,
- incorporation of redundancy, and/or
- mitigation of failure effects (e.g., fault recovery, degraded modes of operation, providing advance warning of failure).

The contractor shall aggressively mitigate failure modes to ensure the reliability requirements are successfully verified and do not degrade in production or in the field. Failure modes that are expected to occur during the system life cycle shall be included in the system reliability model.

The contractor shall employ a mechanism (e.g., a Failure Reporting, Analysis, and Corrective Action System or a Data Collection, Analysis, and Corrective Action System) for monitoring and communicating throughout the organization
(1) descriptions of test and field failures,
(2) analyses of failure mode and root-cause failure mechanism,
(3) the status of design and/or process corrective actions and risk-mitigation decisions,
(4) the effectiveness of corrective actions, and
(5) lessons learned.

The failure modes monitored by this mechanism shall map to the customer-supplied failure definitions and scoring criteria; this mechanism shall be accessible by the customer.

8. Reliability Assessment. The model developed in System Reliability Model shall be used, in conjunction with expert judgment, in order to assess if the design (including commercial-off-the-shelf, non-developmental items, and government-furnished equipment) is capable of meeting reliability requirements in the user environment. If the assessment is that the customer's requirements are infeasible, the contractor shall communicate this to the customer. The contractor shall allocate the reliability requirements down to lower indenture levels and flow them and needed inputs down to its subcontractors/suppliers.

The contractor shall assess the reliability of the system periodically throughout the life cycle using the System Reliability Model, the life-cycle operational & environmental load estimates generated herein, and the failure definition and scoring criteria. Reliability assessments shall be made based on data from analysis, modeling & simulation, test, and the field, and shall be tracked as a function of time and compared against reliability allocations and customer reliability requirements. For complex systems/products, or when the customer requires this [TAILOR], the assessment strategy shall include reliability values to be achieved at various points during development. The contractor shall monitor and evaluate the reliability impact of changes to the design or manufacture of the system. The implementation of corrective actions shall be verified and their effectiveness tracked. Formal reliability growth methodology shall be used where applicable (e.g., when failure modes are discovered and addressed with a test-analyze-and-fix process that is applied to complex assemblies) in order to plan, track, and project reliability improvement.

9. Reliability Verification. The contractor shall plan and conduct activities to ensure that the achievement of reliability requirements is verified during design. The strategy shall ensure reliability does not degrade during production or in the field. The contractor shall develop and periodically refine a Reliability Requirements Verification Strategy/Plan that is an integral part of the systems-engineering verification and is coordinated and integrated across all phases. The verification shall be based on analysis, modeling & simulation, testing, or a mixture, and shall be operationally realistic. The verified System-Level Operational & Environmental Life-Cycle Loads as well as the failure definition and scoring criteria shall be used. Additional customer requirements identified in the System Specification, if any (e.g., reliability qualification testing, testing in customer facilities, customer-controlled, customer-scored testing), shall be included [TAILOR]. The customer will review and approve the strategy/plan [TAILOR].

10. Failure Definitions. The contractor shall understand the failure definition and scoring criteria and shall develop the system to meet reliability requirements when these failure definitions are used and the system is operated and maintained by the user. The contractor shall identify and mitigate human errors that may occur when actual users operate and maintain the system.

11. Technical Reviews. The contractor shall conduct technical interchanges with the customer/user in order to compare the status and outcomes of Reliability Activities, especially the identification, analysis, classification, and mitigation of failure modes. The contractor shall conduct reliability reviews that promote an understanding of the user environment in which the system will operate and to assure progress toward achieving the reliability requirements. The conduct and scheduling of reliability technical reviews shall be integrated with the program's systems engineering reviews as set forth in the Integrated Master Plan/Integrated Master Schedule. Reliability reviews should begin early in the system development process and continue through production and deployment. Technical reviews shall include participation by reliability subject matter experts using the process provided in the program's Systems Engineering Plan for selecting peer reviewers independent of the program.

12. Methods and Tools. The contractor shall implement each of these Reliability Activities with appropriate reliability design and development methods and tools. Information on a variety of reliability methods and tools may be found in the DoD Guide for Achieving Reliability, Availability, and Maintainability, 3 Aug 2005. The contractor shall select appropriate methods and describe them in the Reliability Program Plan. The customer may elect to review, comment and negotiate regarding the methods selected by the contractor. The contractor shall identify and employ a set of design-reliability Best Practices. The contractor shall execute all of the Reliability Activities set forth herein using the approaches, methods, and tools described in the customer-approved Reliability Program Plan.

13. Outputs and Documentation. The contractor shall provide the customer with continuous access to the status and outputs of the Reliability Activities. The progressive achievement of the four Reliability Program Plan objectives shall be documented and periodically updated in the form of a Reliability Case. The contractor shall submit documentation for customer review and approval as specified by the Reliability Activities paragraphs.

Contract Data Requirements List items:

- Reliability Program Plan
- Reliability Requirements Verification Strategy/Plan
- Reliability Case

Enclosure 2. Section L Proposal Instructions Reliability Language

Instructions for Use

The rationale for requesting a draft Reliability Program Plan with the offeror's proposal is that the Statement of Work reliability language mandates an intensive reliability engineering and growth program that is fully integrated with Systems Engineering. It is expected that this will require additional resources compared to previous development contracts and the offeror needs to recognize and plan for this from the beginning if it is to occur. The government should evaluate the draft plan, negotiate if need be, and approve it before contract award.

Sample Language

The offeror shall develop and follow a Reliability Program Plan in order to achieve the following four objectives (1) understand the customer/user's requirements, (2) design for reliability, (3) produce reliable systems/products, and (4) monitor and assess user reliability. The Reliability Program Plan shall, at minimum, employ each of the twelve Reliability Activities described herein. The Reliability Program Plan is initially prepared in response to the Request for Proposals and is updated and coordinated with the customer when appropriate.

The proposed Reliability Program Plan shall:
- Provide visibility into the management and organizational structure of those responsible and accountable (both offeror and customer) for the conduct of Reliability Activities over the entire life cycle.
- Define all resources required to fully implement the reliability program.
- Include a coordinated schedule for conducting all Reliability Activities throughout the system life-cycle.
- Include detailed descriptions of all Reliability Activities, functions, documentation, processes, and strategies required to ensure system reliability maturation and management throughout the system life cycle.
- Document the procedures for verifying that planned activities are implemented and for both reviewing and comparing their status and outcomes.
- Manage potential reliability risks due, for example, to new technologies or testing approaches.
- Flow reliability allocations and appropriate inputs (e.g., operational & environmental loads) down to subcontractors and suppliers.
- Include contingency-planning criteria and decision-making for altering plans and intensifying reliability improvement efforts.

<u>System Reliability Model</u>:
Describe
(1) the methods and tools that will be used to build and refine the system reliability model,
(2) the extent to which detailed component stress and damage models will be incorporated in the system reliability model,

(3) how the system reliability model will be updated as the system design evolves, as failure modes are identified, as failure definitions are updated, and as operational & environmental loads are updated throughout the life cycle, and
(4) how the system reliability model will be used to identify reliability-critical items and to identify areas where additional design or testing activities are required in order to achieve the specified reliability requirements.

<u>Systems-Engineering Integration</u>:
Describe
(1) how it will be ensured that the Reliability Activities are an integral part of the systems-engineering process,
(2) how reliability-improvement actions will routinely be incorporated into the design and manufacture of the system,
(3) how the reliability impact of system design changes and supplier change notices will be monitored and evaluated,
(4) how reliability-critical items will be managed and controlled, and
(5) how it will be ensured that design rules that impact reliability, including derating, electrical, mechanical, and other guidelines, are adhered to.

<u>System-Level Operational & Environmental Life-Cycle Loads</u>:
Describe
(1) how and when the offeror will develop, refine, and verify that the estimates of system-level operational & environmental life-cycle loads are operationally realistic, and
(2) requirements, if any, for access to customer assets.

<u>Life-Cycle Loads on Subsystems, Assemblies, Subassemblies, and Components</u>:
Describe
(1) how and when the offeror will prepare, refine, and verify estimates of the life-cycle loads that subordinate assemblies, subassemblies, components, commercial-off-the-shelf, non-developmental, and customer-furnished items will experience as a result of system-level operational & environmental loads,
(2) how and when teams (a) developing assemblies, subassemblies, and components or (b) selecting and integrating items not specifically developed for this system, will receive these estimates and updates.

<u>Identify and Characterize Failure Modes and Mechanisms</u>:
Describe
(1) how and when failure mechanisms and modes that may result when the estimated life-cycle loads are imposed on the system will be identified for items specifically developed for this system as well as for items being selected and integrated into it,
(2) how and when failure modes that may be induced by manufacturing variation and errors will be identified,
(3) how and when user- and maintainer-induced failure modes will be identified, and
(4) how the offeror will ensure that test and field failures are analyzed to root cause.

<u>Closed-Loop Failure-Mode Mitigation</u>:
Describe
(1) strategies for monitoring, assessing, and communicating the status of test and field failures throughout the organization,
(2) strategies for identifying, developing, and approving design and/or process corrective actions to eliminate root failure causes throughout the system life cycle,

(3) how the implementation of corrective actions will be verified and their effectiveness tracked,
(4) how lessons learned will be documented, reviewed, and communicated, and
(5) how root-cause analysis of test and field failures will be used to improve the reliability of the system.

<u>Reliability Assessment</u>:

Perform a feasibility assessment as described in the Reliability Assessment section of the Statement of Work and provide it with the draft Reliability Program Plan submitted in response to this Request for Proposal.

Describe

(1) how and when reliability assessments will be performed (including, when applicable, customer-specified reliability values that must be achieved at various points during development),
(2) which assessment methods will be used, and
(3) how design and process changes will be documented, monitored, and evaluated for their impact on reliability.

<u>Reliability Verification</u>:

Describe

(1) the strategy for verifying the satisfaction of customer reliability requirements under operationally-realistic conditions and as an integral part of the systems-engineering verification,
(2) the activities to be performed and processes to be used that will ensure that inherent reliability levels are not degraded during subsequent phases of the system life cycle.

<u>Failure Definitions</u>:

Describe how the failure definitions and scoring criteria will be used during development to minimize the occurrence of failures in the field when actual users operate and maintain the system.

<u>Technical Reviews</u>:

Describe how and when technical interchanges and reviews will be conducted including detailed, independent peer reviews.

<u>Methods and Tools</u>:

Describe

(1) the methods and tools that will be used to implement the Reliability Activities, and
(2) the design-reliability Best Practices to be used and how adherence to them will be ensured.

<u>Outputs and Documentation</u>:

Describe how and when the status and outputs of the Reliability Activities will be documented and how continuous customer access will be provided.

Enclosure 3. Section M Evaluation Factors for Award Reliability Language

Instructions for Use

If credible quantitative reliability estimates are available that employ essentially the same Operational Mode Summary/Mission Profile and Failure Definition & Scoring Criteria, these estimates should be used for proposal evaluation. Otherwise, or in addition, the sample language below may be used.

Sample Language

One evaluation factor is the proposed Reliability Program Plan.

Note:
The Checklist for Evaluating Reliability Program Plans (Enclosure 4) may be used to assist with this process.

Enclosure 4. Checklist for Evaluating Reliability Program Plans

Reliability Program Plan

- Implements with appropriate methods, tools, and Best Practices, the Reliability Activities described herein in order to accomplish the four objectives?
- Includes procedures for verifying planned Reliability Activities are implemented?
- Manage risks due to new technologies?
- Includes decision-making criteria and plans for intensifying reliability-improvement efforts?
- Periodic updates coordinated with customer/user?

System Reliability Model

- Build & refine model throughout the life cycle?
- Routinely update model as failure definitions are updated, failure modes are identified, operational & environmental load estimates are updated, and as design or manufacturing changes are made?
- Detailed component stress & damage models included?
- Model used to (1) update allocations, (2) aggregate reliability, (3) identify single points of failure, (4) identify reliability-critical items and the need for additional design or testing activities?

Systems-Engineering Integration

- Reliability Activities integral to system engineering process throughout life cycle?
- Reliability-improvement actions routinely incorporated during design, production, and in the field?
- Reliability impact of design changes and supplier change notices monitored & evaluated throughout the life cycle?
- Manage and control reliability-critical items?
- Design rules that impact reliability adhered to?

System-Level Operational & Environmental Life-Cycle Loads

- Develop and periodically update load estimates throughout life cycle?
- Estimates verified on instrumented systems/products with operationally-realistic conditions applied in time for Reliability Verification?
- Use estimates in reliability modeling, assessment, verification?
- Coordinate estimates with Systems Engineering?

Life-Cycle Loads on Assemblies, Subassemblies, and Components

- Develop and periodically update these load estimates based on operational & environmental loads applied at the system-level?
- Verify load estimates on instrumented systems/products/assemblies with operationally-realistic conditions applied?
- Flow down estimates and updates to designers, integrators of commercial-off-the-shelf, non-developmental items, government-furnished equipment, and suppliers?
- Use estimates to identify failure modes & mechanisms, and in assessments and verification?

Identify and Characterize Failure Modes & Mechanisms

- Identify failure modes & mechanisms throughout the life cycle?
- Begin to identify failure modes & mechanisms as soon as development begins using realistic life-cycle operational & environmental loads in conjunction with engineering- and physics-based models?
- Teams developing assemblies, subassemblies, and components for system identify and confirm failure modes and distributions with analysis, test, or accelerated test?
- Teams selecting/integrating assemblies, subassemblies, and components for system (including commercial-off-the-shelf, non-developmental items, and government-furnished equipment) identify and confirm failure modes and distributions with analysis, test, or accelerated test?
- Identify and confirm failure modes induced by manufacturing variation and errors?
- Identify and confirm failure modes induced by user or maintainer errors?
- All test and field failures analyzed to root cause?

Closed-Loop Failure-Mode Mitigation

- Analyze and map to the customer-specified Failure Definitions and Scoring Criteria all failure modes in order to formulate corrective actions throughout the life cycle?
- Aggressively mitigate failure modes until reliability requirements are met?
- Employ a mechanism for monitoring and communicating the implementation and effectiveness of corrective actions that is accessible by the customer?
- Include failure modes that may occur during the life cycle in the system reliability model?

Reliability Assessment

- Assess reliability requirements feasibility using the System Reliability Model in conjunction with expert judgment?
- Reliability requirements allocated to lower indenture levels and flowed to subcontractors/suppliers?
- Periodically assess reliability of system throughout the life cycle using the reliability model, the life-cycle operational & environmental load estimates, and the customer-specified failure definition and scoring criteria?
- Reliability values to be achieved at various points in the program included?
- Reliability assessments from analysis, modeling & simulation, test, and the field tracked as a function of time and compared to allocations and customer reliability requirements?
- Monitor and evaluate the implementation of corrective actions as well as other changes to the design or manufacture of the systems/product that may impact reliability?
- All assessments include commercial-off-the-shelf, non-developmental items, and government-furnished equipment?

Reliability Verification

- Develop and periodically refine a Reliability Requirements Verification Strategy/Plan that is an integral part of the systems-engineering verification and is coordinated and integrated across all phases?

- Strategy ensures reliability requirements will be verified during design and will not degrade during production or in the field?
- Includes reliability values to be achieved at various points during development?
- Verification based on analysis, modeling & simulation, testing, or a mixture, and operationally realistic?
- Verified System-Level Operational & Environmental Life-Cycle Loads will be used?
- Customer-specific requirements, if any, included?

Failure Definitions
- Understand customer-specified failure definition and scoring criteria?
- Design to avoid failures due to user or maintainer errors?
- Reliability Program Plan integrates customer-specified failure definition and scoring criteria with (1) system reliability model, (2) identification of failure modes & mechanisms, (3) closed-loop failure-mitigation process, (4) reliability assessment, and (5) reliability verification throughout life cycle?

Technical Reviews
- Reliability Program Plan specifies how and when technical reviews will be conducted throughout the life cycle?
- Conduct periodic interchanges with customer/user that promote understanding of operational environment?
- Technical reviews scheduled and conducted to (1) assure progress towards achieving reliability requirements, (2) verify that planned Reliability Activities are implemented, and (3) compare status and outcomes of Reliability Activities?
- Independent peer review conducted by subject matter experts?
- Conduct & participate in reviews with customer/user that address identification, analysis, classification, and mitigation of failure modes?

Methods & Tools
- Reliability Activities implemented with methods & tools from Reliability Program Plan?
- Reliability Best Practices implemented and adhered to?
- Changes in methods, tools, or Best Practices included in Reliability Program Plan update and approved by customer?

Outputs and Documentation
- Planning for Reliability Program Plan updates?
- Continuous customer access to status and outputs from all Reliability Activities?
- Outputs appropriately scheduled and documented in Reliability Case?

1.2.2 Illustration of a Performance Incentive for Reliability

SAMPLE PERFORMANCE INCENTIVE - PERFORMANCE INCENTIVE FEE

In addition to the Incentive Fee payable under this contract, a performance incentive fee may be earned based on the demonstration of product reliability. Performance targets for system reliability are established at the specified knowledge points in paragraph _____________ of the Statement of Work. For each knowledge point, a fee may be earned for demonstration of the performance target in accordance with the table below:

Knowledge Point	Target Mean Time Between Failure	Fee Pool
A	_______	$______
B	_______	$______
C	_______	$______

Performance tests of system prototypes will be conducted as specified, and the results will be compared to the performance targets. If demonstrated performance meets or exceeds the performance target, the fee associated with the knowledge point is earned and will be paid. If demonstrated performance is less than the performance target, the available fee is lost, and it may not be rolled over to other incentive events.

GUIDANCE FOR USE OF SAMPLE PERFORMANCE INCENTIVE

There are many ways in which the contracting strategy can be used to influence the delivery of highly reliable products, provided that there is a clear requirement for system reliability in the contract work statement. One approach is to use penalties to measure the failure to achieve specified performance requirements. One such example is a warranty, which can be a requirement to replace an item that does not perform to a specified level. This can have the effect of influencing the design to reflect a higher reliability standard than what is specified. Other examples are to focus on reliability issues or concerns as past performance is evaluated during the contract, or to establish payment withholds for failure to achieve a specified performance level (such as down time for an information technology service).

An alternative approach is to recognize accomplishments rather than to measure failures. A performance incentive can be crafted based on the specific circumstances associated with a program that will reward the degree of attainment of performance targets. A good performance incentive is a specific objective characteristic that is simple and that can be measured by clear test criteria and performance standards. As such, it is necessary to define the specific performance expectations of this characteristic as it matures during the development process. For example, range can be a straightforward measure of a test asset given a clear description of the test conditions that will be observed. For reliability, it will probably be necessary to define a metric, such as Mean

Time Between Failures, that corresponds to the system requirement for reliability, and to define the test that will be used to measure performance of the test asset. These definitions are included in the contract work statement or in a special provision of the contract.

Regardless of the contract strategy selected, the contract and incentive language should, as a goal, be structured and enforced to (1) minimize the likelihood that the Government will pay an incentive fee for something it is already entitled to receive, (2) encourage the Contractor to invest in reliability design and growth early in the system development life cycle and (3) ensure that the Government does not bear an undue cost burden through the inability of the Contractor to meet the contractual system reliability requirements.

The attached illustration provides a sample performance incentive fee. It assumes that the contract is for development of a new system, and that a Cost Plus Incentive Fee was selected as the contract type for a development effort that will include the design, fabrication, and testing of system prototypes. Key events in the development process for this particular item would be identified as ‘knowledge points.’ It might include such events as first article test, specific developmental tests, system verification review, or other events that are included in the program’s integrated master plan. The contract work statement would define a performance target to correspond to each knowledge point, and it would define a prototype test to be conducted at the knowledge point to measure actual performance (in this example, reliability as determined by Mean Time Between Failures). The calculation of the fee is straightforward: the fee is earned if performance is demonstrated at or above the performance target, and fee is lost if the demonstrated performance is below the performance target.

It must be emphasized that this is only one illustration. Performance incentives, including the basis for objective measurement of performance, must be tailored to the individual acquisition.

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Appendix 1.3 Early Reliability, Availability, and Maintainability Planning

1.3.1 Program RAM Planning Template

Following is a Reliability, Availability, and Maintainability Planning Template that incorporates relevant considerations throughout the life-cycle.

Limitation and Recommendation:
Due to time allocated to the Reliability Improvement Working Group work group to complete work and submit a report, the focus of effort for this Reliability, Availability, and Maintainability Planning Template was only on Reliability.
It is recommended that follow-on activity be initiated to focus on the other key areas of Availability, Maintainability, and Sustainability - to insure their inclusion as appropriate in the this and any other products of the Reliability Improvement Working Group.
This recommendation is consistent with findings and recommendations of the Defense Science Board report.

This Template can be found at http://www.acq.osd.mil/sse/docs/RAM-Planning-Template.xls

Reviews for application of the template:

Current 5000.2			
Milestone	Phase	Review	Decision Point
A	Concept Refinement	Initial Technical Review	Pre- MS A
A	Concept Refinement	Alternative System Review	Pre- MS A
B	Technology Development	System Requirements Review	MS A
C	System Design	Integrated Baseline Review	MS B
C	System Design	System Functional Review	MS B
C	System Design	Preliminary Design Review	MS B
C	System Design	Critical Design Review	MS B
C	System Demonstration	Test Readiness Review	MS B
C	System Demonstration	Flight Readiness Review	MS B
C	System Demonstration	System Verification Review	MS B
C	System Demonstration	Functional Configuration Audit	MS B
C	System Demonstration	Production Readiness Review	MS B
Post-C	Production and Deployment	Operational Test Readiness Review	MS C
Post-C	Production and Deployment	Physical Configuration Audit	MS C
Post-C	Production and Deployment	Full Rate Production Decision Review	FRP DR
Post-C	Operation and Support	In-Service Review	FRP DR and Later

Adapted from Review Readiness Criteria developed for OUSD(AT&L)

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
Initial Technical Review	Reliability requirement analysis	Reliability	To demonstrate that the program reliability requirements are consistent with, and satisfy, customer needs and expectations	Refined reliability needs stated as broad measures of effectiveness with thresholds and objectives if possible	Reliability requirements stated in system level operational terms. Evaluation of the stated requirements includes verifying completeness.	
				Rationale for the preferred solution	Documented reliability assumptions and supporting rationale	
				Key reliability risk estimate	Documented risk assessment	
				Assessment of relative reliability risks associated with using Commercial Off The Shelf/Non-Developmental Items if anticipated in any of the candidate system investigated in the Analysis of Alternatives	Risk assessment includes evaluating potential reliability issues due to environmental or use profile differences	
				Begin notional system reliability requirements development	Reliability requirement estimates documented in Reliability, Availability, Maintainability - Cost Report supporting the Analysis of Alternatives	
	Maintainability requirement analysis	Maintainability	To demonstrate that the program maintainability requirements are consistent with, and satisfy, customer needs and expectations	Refined maintainability needs stated as broad measures of effectiveness with thresholds and objectives if possible	Maintainability requirements stated in system level operational terms. Evaluation of the stated requirements includes verifying completeness.	
				Rationale for the Analysis of Alternatives solutions	Documented rationale	
				Risk assessment for the Technology Development phase	Documented risk assessment	
				Assessment of relative maintainability risks associated with using Commercial Off The Shelf/Non-Developmental Items if anticipated in any of the candidate system investigated in the Analysis of Alternatives	Documented Commercial Off The Shelf/Non-Developmental Items risk assessment	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
				Draft system requirements document	Maintainability requirement estimates documented in the Reliability, Availability, Maintainability - Cost Report supporting the Analysis of Alternatives	
Alternative System Review	Reliability drivers and risks identification for preferred system design	Reliability	To demonstrate that reliability cost drivers and risks have been documented	Key program reliability life cycle cost drivers identified	Reliability cost drivers documented in the Reliability, Availability, Maintainability - Cost Report. Rough estimates available for cost to design in various levels of reliability and associated reductions in life-cycle costs and logistics footprint.	
				Reliability assumptions documented	Assumptions documented in Reliability, Availability, Maintainability - Cost Report--including optempo, expected environmental conditions, and Operational Mission Summary/Mission Profile completed. Reliability analysis part of Analysis of Alternatives.	
				Reliability experts involved in developing and reviewing the cost estimate	Reliability experts members of the program staff	
				Analysis of Alternatives completed (Alternative System Review entry criteria)	Documented Analysis of Alternatives with reliability analysis	
				Reliability risks documented and deemed manageable within cost estimates	Reliability requirements determined to be achievable within program schedule and budget.	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
	Maintain-ability driv-ers and risks identi-fication for preferred system design	Maintainability	To demon-strate that maintain-ability as-sumptions, cost drivers, and risks have been identified and docu-mented	Key program maintainability cost drivers iden-tified	Analysis of maintainability cost driv-ers documented in Reliability, Avail-ability, Maintainability - Cost Report. Rough estimates available for cost of various levels of maintainability and associated reductions in life-cycle costs and logistics footprint.	
				Maintainability assumptions documented	Assumptions, including personnel requirements, spare part require-ments/approach, determination of maintainability demonstration re-quirements, documented in the Reli-ability, Availability, Maintainability - Cost Report.	
				Maintainability experts involved in developing and reviewing the cost estimate	Maintainability experts members of the program staff	
				Analysis of Alternatives completed (Alternative System Review entry criteria)	Documented Analysis of Alternatives with maintainability analysis	
				Maintainability risks documented and deemed manageable within cost estimates	Maintainability requirements deter-mined to be achievable within pro-gram schedule and budget.	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
MS A Decision	Evaluation of concept readiness for transition to Technology Development Phase	Reliability	To ensure reliability requirements meet customer expectations, needs, and is affordable as a system	Analysis conducted to assure derived reliability requirements are reasonable	Reliability requirements stated at a confidence level and documentation of reliability analysis. Risks associated with ability to achieve requirements within current technology.	
				User availability requirements and related reliability values derived and documented	Range of satisfactory reliability values determined establishing a "design space." Effects of maintainability, support concept, life-cycle cost, and logistics support and maintainability.	
				Traceability matrix developed relating each reliability requirement to specified user need	Traceability matrix	
				Reliability testing identified and incorporated into preliminary program planning	Quantitative reliability values verifiable by analyses, tests, or comparison.	
		Maintainability	To ensure maintainability requirements meet customer expectations, needs, and is affordable as a system	Derived maintainability requirements analyzed for reasonableness, ability to achieve within current technology, and risk areas	Maintainability requirements stated at a confidence level and documentation of maintainability analysis.	
				User availability requirements and related maintainability values derived and documented	Maintainability requirements are quantified and verifiable by analyses, tests, or comparison. Built In Test detection requirements documented. Maintainability requirements allocated to subsystems/subcontractors.	
Integrated Baseline Review						

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
System Func-tional Review	System require-ments identifica-tion	Reliability	Functional baseline established to satisfy require-ments	User reliability requirements translated into contractual specifications	Contract reliability requirements documented (Inherent Availability, Mean Time Between Failure, Mean Time Between Removal, Mean Time Between Calendar Failure) at stated confidence	
				System specification completed including reli-ability requirements	System specifications documented	
				Initial reliability requirements allocation com-plete	Lower level reliability allocation documented	
				Reliability Scorecard assessment completed (scorecard can be found at https://acc.dau.mil/CommunityBrowser.aspx?id=210483&lang=en-US)	Scores indicate a strong reliability program.	
				Request For Proposal includes a robust reli-ability assessment and growth program as an integral part of design, development, and sys-tems engineering	Request For Proposal clause for reli-ability	
				Integrated process to identify and mitigate failure modes based on engineering and physics of failure based approaches	Engineering (Data Collection Analysis and Corrective Action System/Failure Reporting and Corrective Action System, sneak circuit, reliability en-hancement testing, etc.) and physics of failure based processes docu-mented and initiated	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
		Maintainability	Functional baseline established to satisfy require-ments	User maintainability requirements translated into contractual specifications	Contract maintainability requirements documented (Inherent Availability, Mean Time To Repair, Administrative Delay Time, Logistics Delay Time) at stated confidence	
				System specification completed including maintainability requirements	System specifications documented	
				Maintainability requirements allocated to lower levels	Lower level maintainability allocation documented	
				Built In Test detection and false alarm risk balanced	Documented analysis of Built In Test detection	
Prelimi-nary De-sign Re-view	System require-ments initial evaluation	Reliability	Assurance that design maturity is sufficient to begin de-tailed design	Reliability program plan completed (individual plan or part of ongoing System Engineering Plan updates)	Documented reliability program plan	
				Reliability addressed in ongoing System Engi-neering Plan updates	Reliability documented in Systems Engineering Plan	
				Assess progress identifying and mitigating failure modes based on engineering and physics of failure based approaches	Engineering (Data Collection Analysis and Corrective Action System/Failure Reporting and Corrective Action System, sneak circuit, reliability en-hancement testing, etc.) and physics of failure based process outputs for review	
				Reliability modeling and simulation initiated for system and lower levels as required	Reliability model and simulation plan documented	
				System and component level Developmental Testing testing planned and begun as proto-types become available	Developmental Testing test plan	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
				Robust effort initiated to identify and mitigate failure modes with accelerated testing of components followed by operationally-realistic testing of subsystems and systems	Reliability growth program documented	
				Reliability Scorecard assessment updated (scorecard can be found at https://acc.dau.mil/CommunityBrowser.aspx?id=210483&lang=en-US)	Scores indicate a strong reliability program.	
				Robust effort initiated to identify and mitigate failure modes do to manufacturing variation and workmanship errors	Documented production plan	
				Robust effort initiated to identify and mitigate failure modes chargeable to operators and maintainers (human errors)	Human factors, Human Systems Integration, etc. documented	
				Characterization of loads at various component system locations through modeling or instrumented prototypes	Component load models documented	
		Maintainability	Assure the maintainability program is sufficiently designed and implemented to begin detailed design	Maintainability of lower level assemblies stated at a confidence level	Maintainability requirement allocation completed with Mean Time To Repair assigned at the sub-system and assembly levels	
				Human Systems Integration included as part of Systems Engineering	Human Systems Integration in System Engineering Plan	
				Testability analysis addresses diagnostics and trade-offs among Built In Test, Automated Test Equipment, and other (automated or manual) test methods	Testability analysis documentation	
				Failure mode identification activities on track	Top level Failure Modes and Effects Analysis completed, Physics-of-Failure analyses documented, etc.	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
				Maintenance risk areas identified, tracked, and mitigated	Risk assessment includes evaluating potential maintenance issues or risks	
Critical Design Review	Evaluation of completed design	Reliability	Review of reliability program status including achieved results	Reliability documentation updated based on results to date	Updated documentation	
				System, component, assembly, and subassembly reliability testing status	Results of completed testing and additional testing identified	
				Assess progress identifying and mitigating failure modes based on engineering and physics based methods, analysis of manufacturing variation and workmanship errors, and analysis of failure modes chargeable to operators and maintainers	Progress review including analysis outputs (Failure Modes and Effects Analysis, Data Collection Analysis and Corrective Action System/Failure Reporting and Corrective Action System, Fault Tree Analysis, manufacturing studies, Human Systems Integration, etc.)	
				Assess whether reliability growth is on track to meet requirements based on operationally realistic subsystem and system testing	Reliability status updated	
				Reliability Scorecard assessment updated (scorecard can be found at https://acc.dau.mil/CommunityBrowser.aspx?id=210483&lang=en-US)	Scores indicate a strong reliability program.	
				Reliability modeling and analyses & Physics of Failure completed	Documented modeling and analysis	
				In-service environmental characterization refined and completed	Updated characterization of loads	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
		Maintainability	Review of maintain-ability program status including achieved results	Maintainability assigned at system level with sub-system and assembly level values updated as required to reflect lessons learned	Maintainability requirement development completed with Mean Time To Repair assigned at the system, sub-system, and assembly levels	
				Failure mode identification activities on track	Failure Modes Effects Analysis completed reflecting current configurations, Physics-of-Failure analyses updated to address current configurations, and Data Collection Analysis and Corrective Action System/Failure Reporting and Corrective Action System systems functioning	
Test Readiness Review/Flight Readiness Review	Design maturity sufficient to begin testing	Reliability	Evaluation of system readiness to enter Developmental Testing	Failure Definition and Scoring Criteria sufficiently completed to enable system Developmental Testing evaluation	Failure Definition and Scoring Criteria documented	
				Maintenance processes identified and documented with resources available to support system Developmental Testing	Maintenance processes for system Developmental Testing documented	
				Reliability assessment methods of system Developmental Testing identified	Documented assessment methods	
				System testing includes integrated reliability testing	Reliability testing part of Test and Evaluation Master Plan	
				Reliability models updated and available to update supportability analysis	Updated reliability models	
				Test requirements traced to user measures	Traceability matrix	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
				Assess whether reliability growth is on track to meet requirements based on operationally realistic subsystem and system testing	Reliability status updated and included in availability analysis	
				Remaining reliability risks identified, documented, and mitigation plan developed, assigned, and resourced	Reliability risk mitigation plan	
		Maintainability	Determination of maintenance measures to assist in availability calculations	System maintainability testing as part of the integrated test plan	Maintainability testing part of Test and Evaluation Master Plan	
				Reliability related maintenance measures documented	Statistical documentations of demonstrated maintainability and Built In Test coverage and false alarm rate	
System Verification Review/Functional Configuration Audit	Production representative system complies with performance specifications	Reliability	Evaluation of system Developmental Testing results	Test results analyzed using statistical measures with results extrapolated to operational environment if required	Test report	
		Maintainability	Evaluation of demonstrated maintainability	Maintenance Developmental Testing results evaluated against requirements and models	Developmental Testing test report	
				Maintainability risks documented and deemed manageable within cost estimates	Risk assessment includes maintainability issues	
Production Readiness Review	System and manufacturing process maturity sufficient to begin initial production	Reliability	Assurance that production process will not induce reliability failures	Production reliability risks reviewed, identified, and mitigated	Key manufacturing factors affecting component reliability identified	
				Manufacturing process optimization strategies implemented	Description of optimization efforts	
				Pilot manufacturing lines set up and tested including validation that adequate yields and reliability are producible	Documentation of Low Rate Initial Production or prototype production process and capabilities	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
				Data Collection Analysis and Corrective Action System/Failure Reporting and Corrective Action System and Test Analyze And Fix resourced through production	Support plans and resources documented	
Operational Test Readiness Review	System maturity sufficient to begin Initial Operational Test and Evaluation	Reliability	Evaluation of system readiness to enter Operational Testing	Failure Definition and Scoring Criteria sufficiently completed to enable system Operational Testing evaluation	Failure Definition and Scoring Criteria documented	
				Maintenance processes identified and documented with resources available to support system Operational Testing	Maintenance processes for system Operational Testing documented	
				Reliability assessment methods of system Operational Testing identified	Documented assessment methods	
				System testing includes integrated reliability testing	Reliability testing part of Test and Evaluation Master Plan	
				Reliability models updated and available to update supportability analysis	Updated reliability models	
				Test requirements traced to user measures	Traceability matrix	
				Remaining reliability risks identified, documented, and mitigation plan developed, assigned, and resourced	Reliability risk mitigation plan	
			Evaluation of achieved and demonstrated maintenance capabilities	Maintenance demonstration results evaluated against requirements and models	Maintenance demonstration report and analysis	
				Maintainability risks documented and deemed manageable within cost estimates	Risk assessment includes maintainability issues	

Review	Activity	Reliability or Maintainability	Purpose	Sub-Activity	Evidence	Evaluation
				Operational Testing maintenance/logistics processes identified, documented, resourced, and staff trained	Documented support approach for Operational Testing	
Physical Configuration Audit						
Full Rate Production	System Initial Operational Test and Evaluation performance and manufacturing processes maturity sufficient to begin full-rate production	Reliability	Sufficient reliability demonstrated to enter full rate production	Reliability Initial Operational Test and Evaluation performance reviewed versus requirements	Operational Testing report, reliability case, risk management	
				Reliability risks identified, mitigation plans developed, assigned, and resourced	Reliability risk mitigation plan	
		Maintainability	System is maintainable within program affordability requirements	Maintenance Operational Testing results evaluated against requirements and models	Operational Testing test report	
				Maintainability risks documented and deemed manageable within cost estimates	Risk assessment includes maintainability issues	
In-Service Review	Status check of measured performance in actual use	Reliability	Review of in-service reliability	Ongoing in-service reliability monitoring including trend analysis	Documented reliability monitoring results	
				Obsolescence plan completed and implemented	Obsolescence plan	
		Maintainability	Review of in-service maintainability	Ongoing in-service maintenance monitoring including trend analysis	Documented maintenance monitoring results	

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1.3.2 Reliability Section in Defense Acquisition Program Support Assessment Methodology

This methodology can be found at http://www.acq.osd.mil/sse/docs/DAPS-Subsection-5_2-Suitability-RIWG-Draft-08-15-08.pdf

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}

<u>Pre-MS C</u>

<u>Criteria:</u>

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

Sample Questions:

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}

Post-MS 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.

Sample Questions:

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
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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:

Criteria:

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.

Sample Questions:

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}

Pre-MS 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 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.

<u>Sample Questions:</u>

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}

<u>Pre-MS C</u>

<u>Criteria:</u>

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.

<u>Sample Questions:</u>

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}

Post-MS C

Criteria:

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.

Sample Questions:

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}

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

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Appendix 1.4 Standard Evaluation Criteria

The criteria can be found at:

https://acc.dau.mil/CommunityBrowser.aspx?id=210483&lang=en-US

Reliability Program Detailed Scorecard

Reliability Program Elements	Scoring		
Reliability Requirements and Planning	R	Y	G
Routinely builds and updates Reliability Case/Reliability Program Plan during product development			
The Reliability Case/Reliability Program Plan documents that the developer has a clear understanding of the reliability requirements, the plan to achieve the requirements is reasonable and achievable, and progress towards meeting the requirements is regularly updated. The Reliability Case provides the Customer assurance that the contractor is aggressively pursuing design practices and testing activities consistent with industry high performers. The developer has a reliability program plan that is based upon realistic timelines, testing, and product design activities that will produce a product that meets the reliability requirements. Realistic delays associated with incorporating corrective actions are identified and incorporated into the plan.	Green		
The Reliability Case/Reliability Program Plan does not clearly demonstrate that the developer has an understanding of the reliability requirements, the plan to achieve the requirements does not exist or is questionable in terms of implementation, and progress towards meeting the requirements is documented sporadically or not at all. The Reliability Case does not provide assurance that the contractor is pursuing the latest/highest quality design practices or testing activities. The reliability plan is questionable in terms of realistic timelines, testing and product design activities to produce a product that meets reliability requirements. Delays associated with incorporating corrective actions may not be realistic if identified at all, or were not incorporated into the plan.	Yellow		
Developer has a very poor or no Reliability Case/Reliability Program Plan.	Red		
Well-established and documented reliability and quality lessons learned			
Successful achievement of reliability and quality objectives is documented for previous programs.	Green		
Reliability and quality objectives were not well-established or documented for previous programs.	Yellow		
Poor reliability and lessons learned from previous programs and documented poorly or not at all.	Red		
Design team has a history of producing reliable hardware and software			
Design team has produced hardware and/or software for numerous programs and in most cases previous programs have proven to be reliable.	Green		
Design team has produced hardware and/or software for a limited number of previous programs and in some cases programs have proven to be reliable.	Yellow		
Design team has produced hardware and/or software for very few or no previous programs such that history of producing reliable hardware does not exist.	Red		
History of applying innovative approaches to reliability and high-level and continuous focus on reliability improvement			
The developer has a history of applying innovative approaches and placing a lot of emphasis on achieving high reliability and finding ways to achieve reliability improvement.	Green		
The developer has displayed a moderate level of emphasis on finding ways to improve reliability on previous programs.	Yellow		
The developer has little to no experience in developing approaches and/or shows minimal interest/emphasis on finding ways to achieve reliability improvement.	Red		
Reliability activities of the stated reliability program are clearly identified, include timelines/dates and are integral to design and testing activities and consistent with the program's schedule			
All of the Reliability/Availability/Maintainability (RAM) activity is incorporated into the program Integrated Master Schedule (IMS).	Green		
Some of the RAM activity is incorporated into the program IMS.	Yellow		
RAM activity is not incorporated into the program IMS.	Red		
Reliability Program identifies progressive assurance (routine evidence) delivery dates for specific products and/or analyses to assure program is on track to achieving requirements.			

The Reliability Program outlines a detailed schedule with delivery dates for specified products and/or analyses to provide the customer with information to determine if the program is on track to achieving reliability requirements.	Green		
A general schedule is outlined for deliverables which may or may not be specifically identified to provide the customer with information needed to determine if the program is on track to meet reliability requirements.	Yellow		
There is no schedule to track achievements towards meeting reliability requirements.	Red		
Incorporates parts, materials, and processes management in overall systems engineering approach			
The developer diligently incorporates all parts, materials, and process management in the overall Systems Engineering approach to assure proper application of parts, materials, and processes corresponding to the product life cycle stresses and reliability requirements.	Green		
The developer does not subject all parts, materials and process management to the overall systems engineering approach thus not assuring proper application of all parts, materials and processes correspond to the product life cycle stresses and reliability requirements.	Yellow		
The developer incorporates few or no parts, materials and process management in the overall systems engineering approach.	Red		
Identify available resources (materials, human resources, equipment, etc.)			
Developer clearly identifies available materials, equipment, analyses, human resources, analytical tools, etc. and how they will be utilized throughout the lifecycle to produce a highly reliable product.	Green		
Developer identifies some of the available resources but has not thoroughly thought out what resources will be available and how they will be used throughout the lifecycle to produce a highly reliable product.	Yellow		
Developer has identified few or no resources and processes necessary to develop a highly reliable product.	Red		
Identified all limited-life components; replacement policy has been formulated			
The developer has identified all the life-limited components. A well thought out and detailed cost effective replacement policy has been formulated for these components to maintain an adequate level of reliability throughout the product's lifecycle.	Green		
Developer has identified a limited number of life-limited components. A general replacement policy has been formulated without specific details necessary to maintain an adequate level of reliability throughout the product's lifecycle.	Yellow		
Few to no life-limited components have been identified. Replacement policy has not been developed to maintain an adequate level of reliability throughout the product's lifecycle.	Red		
Use reliability engineering and management tools like Failure Modes and Effects Criticality Analysis (FMECA) and Reliability Growth			
A Detailed/thorough FMECA is developed, and Reliability Growth tools are planned and used continuously throughout the lifecycle of the program to track the progress of the program.	Green		
A general FMECA not thoroughly thought out is developed and limited use of Reliability Growth tools are used during program development.	Yellow		
A FMECA is not developed and Reliability Growth tools are not used during the program lifecycle.	Red		
Training and Development	R	Y	G
Sufficiently-sized reliability engineering staff directly tied to design team			
The reliability engineering staff is an appropriate size, according to the size of the program and associated workload, and is in open communication with the design team.	Green		
There is a reliability engineering staff, but workload is excessive and they may not be tied to the design team.	Yellow		
The reliability engineering staff is not sufficient and is not tied to the design team.	Red		
Develop training plan for both individual contributors and management, including a schedule, budget, and identification of training personnel			
A well thought out and detailed training plan has been developed for all contributors and management which clearly identifies the schedule, budget and identification of training personnel.	Green		
A general plan has been developed but does not specify all necessary details regarding schedule, budget, and identification of training personnel.	Yellow		
A very limited or no training plan has been developed.	Red		
Monitor new developing technologies, modeling and analysis techniques, trends, etc. that impact reliability and adjust training accordingly			

Training staff is very diligent and does an excellent job of keeping abreast of newly developing technologies, modeling and analysis techniques and any processes that impact reliability and reliability improvement. Appropriate technologies, modeling/analysis techniques and processes are worked into training programs.		Green	
Training staff keeps abreast of some newly developed technologies, modeling and analysis techniques and processes that impact reliability and reliability improvement and is able to incorporate some of these into the training program.		Yellow	
Training staff does not (or does a very poor job of) keeping abreast of newly developed technologies, modeling and analysis techniques and processes that impact reliability and reliability improvement and does a very poor job of incorporating new ideas and processes into the training program.		Red	
Do not rely on handbook practices (e.g. MIL-HDBK-217) and do not view reliability as just Mean Time Between Failure (MTBF)			
The developer is focused on designing and building a product that has a significant failure-free operating period and views reliability as more than just Mean Time Between Failure (MTBF). The developer addresses probabilistic analysis as part of the product design. The developer does not rely on handbook predictions as an indicator of design status and maturity. Staff understand how to allocate, model, analyze, and assess a variety of reliability requirements.		Green	
The developer relies heavily on handbook predictions as an indicator of design status and maturity and views Mean Time Between Failure as the primary measure of reliability. Staff has a limited understanding of how to allocate, model, analyze and assess a variety of reliability requirements.		Yellow	
The developer relies solely on handbook predictions as an indicator of design status and maturity and views Mean Time Between Failure as the only measure of reliability. Staff has little to no understanding of how to allocate, model, analyze and assess a variety of reliability requirements.		Red	
Reliability Analysis	R	Y	G
Comprehensive Thermal and Vibration analyses and/or Finite Element Analyses (FEA) are conducted to address potential failure mechanisms and failure sites			
Design is modeled for thermal and vibration characteristics. Boundary conditions are determined from higher-level models or measured data. Special items and operating conditions will be modeled. Vibration response will be measured in multiple locations in all appropriate axes. FEA will be performed on structure. All thermal and vibration objectives should be met.		Green	
Design may be modeled. Boundary conditions are determined from higher-level models or measured data. Vibration response will not be measured in multiple locations or in all appropriate axes. Limited FEA may be carried out. Some thermal or vibration objectives will not be met.		Yellow	
No thermal or vibration analyses or FEA are planned.		Red	
Critical loads and stresses are characterized; life cycle environment and operation duty cycle stresses are characterized			
Clearly define estimates of life-cycle user and environmental loads, update periodically, verify with measurements on pre-production systems/products. The developer must characterize the critical loads and stresses. Validate with additional testing and data collection.		Green	
Estimate life-cycle user environmental loads from "like-systems" in similar operational environments. Measurements not verified on actual system through testing and data collection.		Yellow	
Life-cycle user environmental loads and duty cycle stresses are not defined.		Red	
Reliability challenges are known; likely failure mechanisms and failure sites are known			
Failure modes and distributions are clearly identified and confirmed through analysis, test, or accelerated test. They are updated as the design evolves and when inputs are updated.		Green	
Failure modes and distributions are roughly identified through limited research/analysis or comparison to like systems. Attempts are made to update as designs evolve.		Yellow	
Likely failure mechanisms and failure sites are unknown.		Red	
Conduct failure modes, effects, and criticality analysis (FMECA), Fault Tree Analysis (FTA); crosswalk to low level testing and a failure mechanism analysis to ensure programmatic coverage			

The developer uses reliability engineering and management tools such as Failure Modes and Effects Criticality Analysis (FMECA) and Reliability Growth. These tools and analyses are directly linked to the product design team and the developer uses the results to influence the product design and to focus the product design team efforts. The FMEA analysis is performed on the equipment/system from the functional level to the system level. All potential item and interface failure modes are identified and their effects determined on the immediate function, on the equipment/system and on the operation. Corrective design options or other actions to eliminate design or manufacturing risks, safety concerns and built-in test limitations are well documented. The FMEA process and results are evaluated at each technical review.		Green	
The developer uses less formal processes such as comparison to like systems or handbook predictions to estimate to identify failure modes and their effects on the system. Product design team may not be fully engaged or included in this process. Corrective design options or actions to eliminate design or manufacturing risks, safety concerns and built-in test limitations are not well documented.		Yellow	
FMECA and Fault Tree Analysis or less formal processes are not conducted to identify failure modes.		Red	
Routine technical assessments of each reliability parameter and technical interchanges throughout development in order to understand and mature failure and maintenance definitions and scoring criteria			
The developer clearly understands the rationale for the customer's reliability and maintainability requirements and conducts routine technical interchanges throughout the product development in order to understand and mature the customer's failure and maintenance definitions and scoring criteria based on the developer's latest detailed design configuration of the system.		Green	
The developer does not display a clear understanding of the rationale for a customer's reliability and maintainability requirements and conducts infrequent technical interchanges or conducts interchanges only when requested by the customer when problems arise. Developer is slow to react/update customer's failure and maintenance definitions and scoring criteria based on latest design configuration.		Yellow	
Developer clearly does not understand or care about customer's reliability and maintainability requirements, or does not conduct routine technical interchanges and develops maintenance definitions and scoring criteria that are not acceptable to the customer or are inappropriate to the current design.		Red	
Engineering-based reliability assessment to show high probability of passing test			
Developer routinely conducts engineering-based reliability assessments to evaluate the design in terms of reliability. Design changes are incorporated based on analysis prior to testing to increase the probability of meeting reliability requirements, "passing the test," and reducing the amount of "test - fix - test," thereby saving test resources.		Green	
Developer does conduct a limited amount of engineering based reliability assessments, somewhat improving the ability to meet reliability requirements but not increasing the probability of "passing the reliability test" as much as would be possible by more frequent analysis.		Yellow	
Developer conducts little to no engineering based reliability assessments thereby decreasing the probability of passing the test and increasing test resources required.		Red	
Reliability Testing	R	Y	G
Conduct low level testing early to identify and mitigate failure modes. Conduct highly accelerated life testing (HALT) and highly accelerated stress screening.			
The developer conducts early design testing that is specifically designed to precipitate failures so that the design can be improved early in the product design cycle. The developer routinely conducts low-level testing starting very early in the product development process. The developer also conducts significant integration testing. The developer routinely presents the results, along with the results of the failure mechanism modeling, to the customer to demonstrate and provide progressive assurance that the product development is on a track that meets the specified reliability requirements. The developer conducts Highly Accelerated Life Testing (HALT) and Highly Accelerated Stress Screening (HASS). These tests are conducted with specific failure mechanisms in mind. Corrective actions are identified and implemented in a timely manner.		Green	
The developer conducts some testing in an attempt to impact design. Customer may or may not be aware of the testing results. HALT test and HASS screening not always conducted. Corrective actions not always implemented in a timely manner.		Yellow	
No low level testing is conducted to identify and mitigate failure modes.		Red	
Consider embedded instrumentation by incorporating diagnostics, prognostics, testing, and training			

The developer has considered embedded instrumentation per CJCSI 3170.01F by incorporating diagnostics, prognostics, testing, and training into the product design early in the product development process and has assessed a number of options to include time-history based prognostics, precursor-based prognostics, and stress-history based prognostics.		Green	
The developer has considered some level of embedded instrumentation. A limited level of diagnostics, prognostics, testing and training or at least one of the 4 categories of data to be collected by embedded instrumentation has been considered. Prognostics options considered but not thoroughly assessed.		Yellow	
No embedded instrumentation or options for prognostics has been considered, or was considered too late in the development process for a cost effective re-design.		Red	
Update reliability assessments, critical items, and failure models/mechanisms based on results			
Reliability assessment, critical items and failure modes are updated routinely and in a timely manner based on results of detailed reliability analyses and test results. Updates are coordinated with the customer for their approval and developer uses updates to impact design changes.		Green	
Reliability assessments, critical items and failure modes not updated routinely or in a timely manner. Updates not always coordinated with the customer and timeliness may affect ability to impact design changes in order to stay on schedule.		Yellow	
Reliability assessments, critical items and failure modes are not updated or are updated too late in the program to allow design fixes.		Red	
Test data analysis to update component stress and damage failure models and model parameters			
Conducts modal vibration survey tests, thermal profile survey test and component analysis test early in the life cycle of development to determine chassis and circuit card assembly (CCA) natural frequencies, temperature profile within the chassis and material properties, failure mechanisms and/or internal structure for advanced damage analysis. Data collected from test will be used to validate and/or update model parameters to refine analyses conducted using damage failure models.		Green	
Limited testing conducted to update some but not all parameters used in damage failure models.		Yellow	
No testing conducted to update component stress and model parameters.		Red	
Supply Chain Management	R	Y	G
List of preferred/qualified/approved parts and suppliers and second source plans and contingency plans to deal with future part obsolescence			
The developer has clearly established management procedures and design controls including allocation of requirements to ensure that products obtained from subcontractors and vendors will meet reliability and maintainability requirements. Status shall be presented at all technical reviews. The developer has analyzed and fully understands the developer's supply chain. The developer understands in detail the reliability risks and design/manufacturing practices of the component and subassembly suppliers. The developer has also analyzed and has detailed contingency plans to deal with obsolescence of parts.		Green	
General/unspecific procedures have been developed for obtaining products from subcontractors and vendors. The developer has a basic understanding of supply chain and a general understanding of practices of the component and subassembly suppliers. Limited/general plans for dealing with obsolescence of parts.		Yellow	
Developer has little to no knowledge of supply chains history of providing reliable parts and has put little or no thought into how to deal with parts obsolescence.		Red	
Acceptance or rejection of in-coming lots based on supplier's historical quality data and current reliability data			
Developer has a process in place to obtain detailed knowledge of suppliers history of product quality. Developer makes a concerted effort to obtain current reliability data of recent vendor products. Detailed procedures and criteria are in place to accept or reject vendor lots based on their historical quality data and current reliability data.		Green	
Developer has general knowledge of suppliers history of product quality and does not always keep up to date on current reliability of recent vendor products. Acceptance/rejection of vendor lots is done on an ad-hoc basis--there are general procedures in place but no detailed procedures or criteria on which to base the decision.		Yellow	
Developer has little to no knowledge of suppliers history of product quality and current reliability data.		Red	
Specify incoming inspection for vendor quality			

Developer has detailed and specific procedures which lay out the process and the acceptance criteria for inspection and acceptance or rejection of vendor parts and materials. Inspection parameters, procedures and acceptance criteria are well documented.		Green	
Developer has ad-hoc procedures for inspecting and accepting or rejecting vendor supplies. Process is not well defined, and criteria for accepting/rejecting are not specific. Process and criteria not laid out in a formal document.		Yellow	
Developer has not established a process for inspection of vendor quality.		Red	
Plan and establish mature and well-documented manufacturing procedures			
Developer has written very detailed and specific manufacturing procedures for each product. Procedures enhance design parameters identified during testing and analysis to enhance the reliability of the product. All manufacturing procedures are well documented.		Green	
Developer has written generalized/non-specific manufacturing processes for each product. Procedures may not be specific enough to enhance design parameters identified during testing and analysis to enhance reliability of the product. Manufacturing procedures are not well documented.		Yellow	
Developer has not established manufacturing procedures.		Red	
Execute established manufacturing quality assurance and qualification testing procedures			
Developer executes all industry standard well established manufacturing quality assurance and qualification testing procedures for designs throughout the life-cycle development.		Green	
Developer executes some but not all industry standard well established manufacturing quality assurance and qualification testing procedures for designs throughout the life-cycle development.		Yellow	
Developer does not execute established manufacturing quality assurance and qualification testing procedures.		Red	
Failure tracking and reporting	R	Y	G
Reviews are conducted for disposition and adequacy of corrective actions			
Developer hosts routine reviews to clearly define all corrective actions taken throughout the development process and to get customer approval for corrective actions taken. All problem areas and corrective actions taken are clearly documented.		Green	
Developer hosts ad-hoc reviews to discuss corrective actions. Problems and corrective actions not clearly defined and not all are covered during review. Documentation is not complete.		Yellow	
Very few if any reviews are held to discuss corrective actions. Problems are corrective actions are poorly defined and not well documented, if documented at all.		Red	
Traceability and failure analysis of failed components, appropriately documented			
All failures occurring during testing, including acceptance, burn-in, performance evaluation and qualification, are collected and analyzed. These data shall be used for design improvements and pattern failure identification. Each failure shall be analyzed to determine the specific cause and effect. Problem areas shall be investigated using tools like finite element analysis to identify the underlying cause of the failure. All results are clearly documented and problem areas/solutions identified at each technical review.		Green	
Not all failures occurring during testing were collected and analyzed. Not every failure/analysis is documented and no concerted effort to review problem areas/solutions at technical reviews.		Yellow	
Little to no traceability and failure analysis of failed components. Very poor if any documentation.		Red	
Utilize failure reporting, analysis and corrective action system (FRACAS)			
The developer has a closed-loop Failure Reporting Analysis And Corrective Action System (FRACAS). The FRACAS process is well structured and directly tied into the product design team. The FRACAS process collects all of the information necessary to track and correct deficiencies. The FRACAS process is under the purview of a failure review board that has the authority and commitment to assign resources to resolve problems.		Green	
The developer has a process to track and correct deficiencies, however, it is not well structured and does not always collect all of the information necessary. Individuals may be reviewing the failures and looking at solutions, but it is an ad-hoc process with no structured review board to assign resources to resolve problems.		Yellow	
Developer has not defined a process to track and correct deficiencies.		Red	
Verification and validation	R	Y	G

Update potential failure modes/mechanisms documentation	
Developer does an excellent job of conducting testing and analysis throughout the life-cycle of the program and thoroughly documents potential failure modes/mechanisms. Documentation is updated in a timely manner throughout the life-cycle development.	Green
Developer attempts to keep potential failure modes/mechanisms updated, but does not thoroughly document the updates in a timely manner.	Yellow
Developer does not document or does a very poor job of documenting updated potential failure modes/mechanisms.	Red
Modify reliability analysis methodologies and failure models	
Developer diligently modifies reliability analysis methodologies and failure models as changes in operating conditions and design changes occur. All changes that impact reliability are appropriately modeled.	Green
Developer is slow to modify reliability analysis methodologies and failure modes as changes in operating conditions and design changes occur. Not all changes that impact reliability are modeled.	Yellow
Developer does a very poor job of modifying reliability analysis methodologies and failure modes throughout the life-cycle of the system.	Red
Modify testing and procedures based on product field failures	
Developer does an excellent job of tracking failures in the field, modifying testing and procedures to be able to fully identify the cause of the failures in order to take corrective actions and implement fixes.	Green
Developer does not do a thorough job of tracking product field failures and therefore is not always able to modify testing and procedures adequately enough to identify the cause of the failures and take corrective actions for all of the failures.	Yellow
Developer does a very poor job of tracking product field failures (if at all), and is not able to modify any testing and procedures to identify cause of the failures.	Red
Conduct technical design reviews	
The developer conducts routine technical assessments of each reliability parameter based on the current known design configuration and knowledge throughout the product development cycle with a major emphasis on early assessments through formal technical reviews (technical reviews are typically design reviews such as System Requirements Review, System Functional Review, Preliminary Design Review, Critical Design Review, and Test Readiness Reviews as a minimum).	Green
The developer conducts ad-hoc reviews, not necessarily keeping up with the latest technical design. Formal technical reviews are not conducted on a routine basis.	Yellow
Developer does a poor job of conducting technical assessments of reliability parameters.	Red
Reliability Improvements	R Y G
Make improvements without direction from the customer	
Developer routinely takes the initiative to conduct engineering-based analysis and analyze test results to identify design improvements needed to improve reliability of the product. Developer makes the improvements without direction from the customer. Results/improvements made are well documented and presented at technical reviews.	Green
Developer takes the initiative to make some design improvements, but is more inclined to make improvements as directed by the customer.	Yellow
Developer makes no improvements unless directed by the customer.	Red
Document lessons learned	
Lessons learned are identified and communicated to all stakeholders of the multifunctional team, and to the organization as a whole, to ensure that systemic problems (and their solutions) are adequately addressed to preclude repeating of past problems and failures.	Green
The lessons learned are poorly identified or communicated to some members of the team and not necessarily the entire organization.	Yellow
The lessons learned are not identified and communicated to the team or the organization. Past problems and failures are not documented, which will lead to additional failures in the future.	Red
Track effectiveness of corrective actions	
Developer does an excellent job of configuration control. All corrective actions and their effectiveness are well documented in specific detail.	Green
Developer notes corrective actions, however specific details and effectiveness are not well documented.	Yellow

Developer does not track, or does a very poor job of tracking corrective actions and documenting their effectiveness.	Red		
Maintain database of field incidents			
Developer is aware of all incidents that occur in the field and keeps a very detailed database of each of the incidents.	Green		
Developer is not aware of most incidents that occur in the field but does not keep detailed records.	Yellow		
Developer does not maintain a database of field incidents.	Red		

References

IEEE Standards Board, "IEEE Draft Standard for Organizational Reliability Capability," IEEE Std P1624™ / Draft 2, 2008.
Tiku, S., and Pecht, M., "Reliability Capability Evaluation for Electronics Manufacturers," Dissertation to the Faculty of the Graduate School of the University of Maryland, College Park, 2005.
Alion Science and Technology Corporation, "Alion System Reliability Center Reliability Maturity Assessment Procedure."
Raytheon Reliability Scorecard (items referenced and reviewed)
GEIA Standard 4 April 2008.
RIAC System Reliability Toolkit
Memorandum signed by Claude Bolton. "Reliability of U.S. Army Materiel Systems" 6 Dec 2007.

Appendix 1.5 Reliability Champions

OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, DC 20301

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Continuing to Improve Reliability across Administration Transition JUN 25 2008

The attached Defense Science Board (DSB) report recommends that acquisition programs include a robust reliability growth effort as an integral part of their systems engineering during development. The DSB found that the lack of having such reliability growth efforts is widespread and is a failure that we must begin correcting now. Clearly, inadequate system reliability will deny our warfighters the use of systems, and also run-up sustainment costs.

In February we invited Service Acquisition Executives to participate in a "Reliability Improvement Working Group" to implement recommendations contained in an interim version of the attached report. The group's progress to date is encouraging. As that group's actions transition to your staffs, continued progress and a successful transition across administrations in January 2009, will depend upon continuity of focus. Therefore, we propose you each consider establishing a permanent headquarters staff position - a position which includes "reliability" in the title - to continue to improve reliability across the administration transition.

Thank you for your support; improving system reliability is fundamental to both enhancing warfighting effectiveness and containing our sustainment costs.

Dr. Charles E. McQueary
Director, Operational Test & Evaluation

James I. Finley
Deputy Under Secretary of Defense
for Acquisition and Technology

Attachment:
As stated

cc:
Deputy Secretary of Defense
Under Secretary of Defense for Acquisition, Technology & Logistics

DISTRIBUTION:
SECRETARY OF THE ARMY
SECRETARY OF THE NAVY
SECRETARY OF THE AIR FORCE

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Appendix 2 Train and Educate RAM and T&E Workforce

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION
TECHNOLOGY
AND LOGISTICS

JUL 29 2008

MEMORANDUM FOR PRESIDENT, DEFENSE ACQUISITION UNIVERISTY (DAU)

SUBJECT: Addition of Reliability, Availability and Maintainability (RAM) Courses to Selected DAWIA Certification Career Paths

The 2007 Defense Science Board Task Force on Developmental Test and Evaluation recommended the curriculum at the Defense Acquisition University (DAU) be modified to stress the importance of a robust reliability design and test effort as part of the systems engineering process. This modification will facilitate proper emphasis on RAM in defense acquisition programs and at major program reviews.

In support of this recommendation, the DoD Reliability Improvement Working Group (RIWG) identified a critical need for improved RAM knowledge within the DAWIA workforce, especially in the Program Management, Contracting, Life Cycle Logistics, Systems Engineering, and Test & Evaluation acquisition career fields. The RIWG recommends adding courses covering RAM topics to selected career fields at Levels I, II and III as well as to the recently mandated Requirements Management Certification track in accordance with the attached recommendations.

Concurrently, the RIWG is reviewing existing DAU RAM learning assets and will provide recommendations to enhance these learning assets by separate correspondence not later than 29 July 2008. The RIWG also recommends that DAU consider establishment of a Learning Center of Excellence to support extended RAM education and training via such mechanisms such as Rapid Deployment Training, Targeted Training and Community of Practice /Special Interest Area products.

Request the Director, Learning Capabilities Integration Center establish this subject as an agenda item for the August 4, 2008 Overarching-Functional Integrated Product Team (O-FIPT). An RIWG representative will be available to discuss this key area. I ask the O-FIPT to consider these recommendations and provide a strategy to address them within 30 days for incorporation in the RIWG Final Report.

Kristen J. Baldwin
Acting Director
Systems and Software Engineering

Attachment:
DAWIA Career Field Recommended Changes

cc: Contracting FIPT Executive Secretary
Information Technology FIPT Executive Secretary
Life Cycle Logistics FIPT Executive Secretary
Program Management FIPT Executive Secretary
PQM FIPT Executive Secretary
SPRDE FIPT Executive Secretary
T&E FIPT Executive Secretary

DAWIA Career Field Recommended Changes

CAREER TRACK	LEVEL I	LEVEL II	LEVEL III	RECOMMENDATION
Contracting	**CLE 301**			**Add as Core**
IT		CLE 301		
Life Cycle Logistics	CLE 301	LOG 203		
Production, Q&M		CLE 301, LOG 203		**Change to Core from "As Assigned"**
Program Management	**CLE 301**	**LOG 203**		**Add as Core**
SPRDE PE	**CLE 301**	LOG 203		**Add as Core**
SPRDE S&T	CLE 301	**LOG 203**		**Add as Core**
SPRDE SE	CLE 301	LOG 203		**Change to Core from "As Assigned"**
T&E	**CLE 301**	**LOG 203**		**Add as Core**
COURSE SPECIFICS				
LOG 203 Reliability & Maintainability				**Strengthen Course (classroom, cross-career)**
CLE 301 Reliability & Maintainability				**Strengthen Course (classroom, cross-career)**
Requirements Management Certification (RMC)	CLM 041	**RQM 110**	**TBD**	**Add RAM Concepts to Level II / Level III**
LOG 211 Supportability Analysis				**Proposed New Course** 36 hours classroom instruction – builds on and expands LOG 201 and LOG 203's focus on Supportability Analysis, Maintenance Planning, RAM, and Life Cycle Cost – includes rigorous mathematical analysis.

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Appendix 3 Implement Mandated Integrated Testing

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Appendix 3.1 Implement Integrated Test Processes into T&E Strategies

3.1.1 Definition of Integrated Test

See: http://www.acq.osd.mil/sse/dte/docs/SecDefMemo-Definition-of-Integrated-Testing-25Apr08.pdf

OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, DC 20301

MEMORANDUM FOR COMPONENT ACQUISITION EXECUTIVES — APR 25 2008

SUBJECT: Definition of Integrated Testing

Rigorous test and evaluation is key to the ability of the Department's acquisition process to provide the Soldiers, Sailors, Airmen, and Marines the systems on which they depend. As we strive to shorten acquisition timelines and meet performance, cost and schedule thresholds, it is essential to achieve efficiency by integrating all testing (contractor and government).

DoDI 5000.2 and the USD(AT&L) and DOT&E December 22, 2007 memorandum mandate the use of integrated testing. We are providing the following definition, effective immediately.

Integrated testing is the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation and reporting by all stakeholders particularly the developmental (both contractor and government) and operational test and evaluation communities.

The Reliability Improvement Working Group, established by our February 15, 2008 memo, is charged with implementing the mandate to integrate developmental and operational testing and will provide guidance to include this definition in the next update to the Defense Acquisition Guidebook.

Dr. Charles E. McQueary
Director, Operational Test and Evaluation

James I. Finley
Deputy Undersecretary of Defense
for Acquisition and Technology

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Appendix 3.2 Language for Chapter 9 of the Defense Acquisition Guidebook

See https://akss.dau.mil/DAG/TOC_GuideBook.asp?sNode=R9-0&Exp=Y

Content for Defense Acquisition Guidebook

9.0.X. Contents

Throughout this chapter, the terms developmental and operational should be interpreted as broad statements of a type of testing or evaluation, and not as the testing controlled by a particular organization. For example, developmental is a type of testing, that can be directed and conducted by both government and contractor test organizations. Likewise, operational is a type of testing that could be directed by Component operational test organizations.

9.X.X.. Integrated Testing

Integrated Testing is defined as the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation, and reporting by all stakeholders, particularly the developmental (both contractor and government) and operational test and evaluation communities. Integrated testing is a process, not an event or separate test phase, nor is it a new type of test. Integrated testing is intended to result in resource efficiencies (time, money, people, and assets) and an enhanced data set for separate evaluations. For example, the data from an integrated test could be used by the contractor for design improvements, by the developmental evaluators for risk assessments, and the operational evaluators for operational assessments. However, integrated testing does not replace or eliminate the need for Initial Operational Test and Evaluation required by Title 10 §2399.

9.X.X Integrated Test Planning and Execution

The goal of integrated testing is to conduct a seamless test program that produces credible qualitative and quantitative data useful to developmental and operational evaluators, and to address developmental and operational issues. Integrated testing allows for the collaborative planning of test points, where a single test point or mission can provide data to satisfy both developmental and operational objectives. The integrated test process must not compromise the test objectives of the participating test organizations. The goal is to plan and execute test activities that satisfy multiple objectives, thereby reducing or eliminating the number of repetitive test events. Integrated testing is not just concurrent or combined DT and OT, where both DT and OT test points are interleaved on the same mission or schedule. Integrated testing focuses the entire test program (CT, DT, LFT, and OT) on designing, developing, and producing a comprehensive plan that coordinates all test activities to support evaluation results for decision makers at required decision reviews.

Integrated testing must begin and be embedded in the strategy for T&E, although most of the effort takes place during the detailed planning and execution phases of a test program. The foundation of the integrated test strategy should be based upon an Evaluation Framework as discussed in Section 9.X.X. It is critical that all stakeholders understand what evaluations are required to assess risks, assess maturity of the system and to assess the operational effectiveness, operational suitability and survivability/lethality. The “end state” of what will be evaluated must be defined up front so all stakeholders are working toward the same goal. Once this is accomplished, an integrated test program can be developed that collects the data to make the evaluations.

One method is to perform a mission analysis by breaking down the COIs into tasks and subtasks. The COIs are derived from the capability requirements documents and the CONOPS and are the critical first steps in developing the test program. Breaking the COIs into tasks and subtasks will ensure system designers, developmental testers and operational testers are all in agreement concerning the missions, tasks, and defined capabilities. There is no single implementation of integrated testing that will be optimum for all programs, but planning and conducting the test program in a collaborative manner will result in a more effective and efficient test effort.

Once the COIs and tasks are understood, the CTPs, MOEs, and MOSs can be developed and presented in the Evaluation Framework which ensures direct traceability and linkage of system characteristics, specifications, and user requirements, to a mission or missions. This structured approach ensures that all test activities are necessary, unnecessary duplication is eliminated, and that no areas are missing in the overall RDT&E effort.

For integrated testing to be successful, it is important that the pedigree of the data be understood and maintained. The pedigree of the data refers to accurately documenting the configuration of the test asset and the actual test conditions under which each element of test data was obtained. The Program Manager-established T&E WIPT plays an important role in maintaining the integrated test process for a program. The T&E WIPT establishes agreements between the test program stakeholders, regarding roles and responsibilities in not only implementing the integrated test process, but also in developing and maintaining a data repository, where all stakeholders will have access to test data for separate evaluations.

Appendix 3.3 Early T&E Involvement in RFP Development

See: http://www.acq.osd.mil/sse/dte/guidance.html

Incorporating Test and Evaluation into Department of Defense Acquisition Contracts

Final Draft V4
August 13, 2008

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

Systems and Software Engineering
Developmental Test and Evaluation

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The DT&E office will develop and coordinate changes to the Guide as required, based on policy changes and customer feedback. To provide feedback, please send comments by e-mail to ATL-DT&E@osd.mil.

Change Number	Date of Change	Change	Date Posted	Name

Record of Changes

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1.0 INTRODUCTION

1.1. Purpose

This guide is designed to help the Department of Defense (DoD) and industry test and evaluation (T&E) professionals identify T&E items to consider for inclusion when drafting a statement of objectives (SOO), statement of work (SOW), and request for proposals (RFP), and during solicitation and contract execution. The guide presumes the reader has an understanding of T&E and the DoD systems acquisition processes as described in Department of Defense Instruction 5000.02 (DODI5000.02), and the Defense Acquisition Guidebook (DAG), and particularly, Chapter 9, Integrated Test and Evaluation. This guide follows the format and some content in the published guidebook on contracting for systems engineering (SE). Where the SE guidebook is primarily for the system engineers this guidebook focus on the T&E topics, issues, and items relative to the same contractual documents as referred to in the SE guidebook.

The guide is structured to address generic T&E items common across DoD Components. Components may have specific T&E direction and guidance each deems necessary for DoD 5000-based acquisition programs. Most contracts begin at MS B but a contract may be required prior to MS B for a prototype or some other product. The SOO, SOW and RFP development is essentially the same as described in this document. A good reference for discussion and description of Component T&E organizations is the Defense Acquisition University's T&E Management Guidebook (**reference a**) especially chapters 3 and 4.

The T&E guidance is based on programs that implement an acquisition strategy in which the development and testing has a single prime contractor. This is one of many DoD contracting types. Some project/system acquisitions will have different contracts. For example, Department of the Navy warship and combat system ACAT programs may contract the engineering and production work for accomplishment by other government and industry organizations, for risk mitigation of the prime contract work. Regardless of the contract type, the important thing is to consider T&E requirements in the context of the contract, regardless of the specific type. The PM can tailor the T&E guidance to fit his particular situation or approach.

The information and guidance are based on the sequenced development process of a SOO, SOW, and the RFP leading to a contract. The underlying T&E considerations also apply to a rapid acquisition and fielding process, although the rapid process requires a much more focused test and evaluation strategy (a strategy, including M&S, which links the key decisions in the system lifecycle to knowledge from developmental and operational evaluations, and outlines the test methodologies to obtain the data for evaluation. Hereafter referred to as "T&E strategy") and approach (an event-driven plan including a process for the identification, implementation, testing, and evaluation of corrective actions prior to the next test including incremental testing, development, and fielding) based on performance of key system capabilities and safety.

Program managers (PMs) and the lead testers and evaluators for the Government and the contractor should consistently focus, and keep the program manger (PM) focused, on the

T&E requirements for their respective teams. T&E excellence requires active leadership, sound planning, and realistic integrated developmental and operational testing (DT/OT).

The test and evaluation (T&E) community consists of a broad range of personnel who perform a wide variety of T&E functions in support of the acquisition, T&E, and contract-writing processes. Whenever this Guide refers to T&E personnel, ensure that the appropriate type(s) of T&E personnel are cited who must have the appropriate T&E skills to provide the required support. For example, when addressing the translation of critical technical parameters (CTP) into contract specifications, this Guide recommends that persons skilled in research, development, test and evaluation (RDT&E) are assigned to write and/or review those parts of the contractual documents. When addressing contractor support needed for OT&E, OT&E personnel from the operational test organization(s) should be enlisted to write and/or review those parts of the contractual documents.

The primary theme to remember is that if a T&E item or requirement is not in the SOW, it probably will not be in the RFP, and if it is not in the RFP, it probably will not be in the contract. If it is not in the contract – ***do not expect to get it!***

1.2. Guide Organization.

This guide contains the following four sections. The sections are organized to assist the user to focus on specific segments of the contract development process:

- **Section 1. Introduction.** This section covers the guide's purpose, organization, definitions, and an overview of the Defense Federal Acquisition Regulation Supplement (DFARS) (**reference b**).
- **Section 2. Pre-Solicitation.** This section discusses the importance of including the T&E contracting approach, including the T&E strategy and approach in the Acquisition Plan, Test and Evaluation Master Plan (TEMP), Incentives, Award Fee Plan, Statement of Objectives (SOO), and ultimately in the Statement of Work (SOW).
- **Section 3. Solicitation.** This section summarizes the source selection focus for those T&E items in the Technical, Management, Cost, Proposal Risk, and Past Performance elements of the source selection. The section highlights proposal documents that evolve into the negotiated contract.
- **Section 4. Contract Execution.** This section addresses the transition to Execution, Award Fee, and Defense Contract Management Agency (DCMA) support. This section discusses the key actions immediately following contract award.

1.3. Definitions

Following are definitions for the principal terms used in this guide.

1.3.1. Statement of Objectives (SOO). The SOO is the portion of a contract that establishes a broad description of the Government's required performance objectives.

1.3.2. Statement of Work (SOW). The SOW is that portion of a contract that establishes and defines the work to be performed by the contractor, and it may incorporate specifications, data item descriptions (DIDs), or other cited documents. The SOW should be consistent with all "promises or claims," made in the proposal. A very good reference is the Defense Acquisition University's (DAU) on-line continuous learning module (CLM) 031, "Improved Statement of Work", which you can browse or take for credit (**reference c**).

1.3.3. Request for Proposals (RFP). The RFP is a solicitation used in negotiated acquisition to communicate Government requirements to prospective contractors and to solicit proposals.

1.3.4. Contract. A contract means a mutually binding legal relationship obligating the seller to furnish the supplies or services (including construction) and the buyer to pay for them. It includes all types of commitments that obligate the Government to an expenditure of appropriated funds and that, except as otherwise authorized, are in writing. In addition to bilateral instruments, contracts include (but are not limited to) awards and notices of awards; job orders or task letters issued under basic ordering agreements; letter contracts; orders, such as purchase orders, under which the contract becomes effective by written acceptance or performance; and bilateral contract modifications. Contracts do not include grants and cooperative agreements. (FAR 2.101)

1.3.5. Proprietary Right. Proprietary Right is a broad term used to describe data exclusively owned by the contractor. These data could be intellectual property, financial data, etc. A contractor may use the term in a proposal to protect the contractor's sensitive information from disclosure, but the term is not a category of rights applicable to technical data to include T&E data under all contracts.

1.3.6. Contract Data Requirements List (CDRL). The CDRL (DD Form 1423) lists the contract data requirements authorized for a specific acquisition and becomes part of the contract. Additionally, the CDRL may list packaging, packing, and marking requirements, delivery requirements, and work directed through special contract requirements.

1.3.7. Data Item Description (DID). A DID is a description of a data item that is to be put on the contract. Each data item will have its own DID. There are three types of DIDs: standard, tailored, and one-time.

- **Standard DID:** A standard DID is one that is used "as-is." A standard DID is used if it exactly describes the information requirement that needs to be put on contract.
- **Tailored DID:** A tailored DID is one in which not all of the requirements quoted in a standard DID need to be put on contract. The standard DID is "tailored down"; the scope of the DID is reduced by taking out some of the words, paragraphs or sections. A DID can only be tailored by removing existing requirements from a

standard DID, new requirements cannot be added to a standard DID. Many times DIDs are tailored to accept a contractor's data format.

- **One-Time DID:** A one-time DID is used when a data requirement cannot be met by using a standard or tailored DID. These are DIDs that are written to acquire specific information on a specific contract.

1.3.8. Integrated Master Plan (IMP). The IMP contains event-based technical activities with entry and exit criteria and reflects the technical approach to the program.

1.3.9. Integrated Master Schedule (IMS). The IMS is an integrated, networked schedule containing all the detailed discrete work packages and planning packages necessary to support events, accomplishments, and criteria of the IMP. (A good source for more details on both the IMP and IMS is the "Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide (**reference d**).

1.3.10. Test and Evaluation Master Plan (TEMP). The TEMP documents the overall structure and objectives of the Test and Evaluation (T&E) program. It provides a framework within which to generate detailed T&E plans and documents schedule and resource implications associated with the T&E program. The TEMP identifies the necessary Developmental Test and Evaluation (DT&E), Operational Test and Evaluation (OT&E), and Live Fire Test and Evaluation (LFT&E) activities. It relates program schedule, test management strategy and structure, and required resources to: Critical Operational Issues (COIs), Critical Technical Parameters (CTPs), objectives and thresholds documented in the Capability Development Document (CDD), evaluation criteria, and milestone decision points. The Government TEMP should be shared with industry, as appropriate. The TEMP does not relieve the contractor of any contractual obligations. It serves as an indicator of Government expectations, and should compliment, not contradict, specifications and contractual language. Sharing the TEMP pays dividends and should be a common practice as appropriate to contractual T&E responsibilities (e.g., a single prime contractor responsible for all T&E).

1.3.11. Work Breakdown Structure (WBS). The WBS is a fundamental project

management technique for defining and organizing the total scope of a project, which delineates and segregates the technical elements to report costs to support technical management decisions and progress. A well-designed WBS describes planned outcomes instead of planned actions. The WBS needs to be consistent with the T&E program and how the T&E program will be conducted or it may be difficult to evaluate.

1.3.12. System Performance Specification (SPS). The System Performance Specification (or equivalent) contents will be incorporated into the contract. It describes the operational characteristics desired for an item without dictating how the item should be designed or built. JCIDS documents (i.e., CDD, CONOPS) are the basis in developing the system specification. These documents are key to developing sound contractual documents. A complete understanding of the system, verifying system performance, and validating T&E results will ultimately be based on meeting JCIDS requirements.

1.3.13. Title 10 United States Coded (U.S.C.). Title 10, Section 2399 - Operational test and evaluation of defense acquisition programs, paragraph (d**) -** Impartiality of Contractor Testing Personnel states that **-** In the case of a major defense acquisition program no person employed by the contractor for the system being tested may be involved in the conduct of the operational test and evaluation. The limitation in the preceding sentence does not apply to the extent that the Secretary of Defense plans for persons employed by that contractor to be involved in the operation, maintenance, and support of the system being tested when the system is deployed in combat.

1.4. Defense Federal Acquisition Regulation Supplement (DFARS)

1.4.1. Using DFARS. Guide users are not expected to have the same knowledge as contracting officers (KOs) but should understand the purpose of DFARS and where to look for specific guidance and information. DFARS and a Service's or Agency's contracting supplement provides specific clauses that must be included in the contract, and they may identify items for delivery. What is expected to be delivered is the main T&E focus, especially contractual language on proprietary/intellectual rights and data access and sharing.

1.4.2. DFARS Requirements. The DFARS remains the source for regulation and implementation of laws as well as DoD-wide contracting policies, authorities, and delegations. In other words, DFARS will answer the questions, *"What is the policy?"* and *"What are the rules?"* The DFARS Procedures, Guidance, and Information (PGI) web site connects the acquisition community to the available background, procedures, and guidance and answers the questions *"How can I execute the policy?"* and *"Why does this policy exist?"* Another source for understanding DFARS is DAU's CLM CLC 113 - Procedures, Guidance, and Information, which you can browse or take for credit.

1.4.3. Federal Acquisition Regulations (FARS) (**reference e**) **Part 16.** FAR Part 16 FARS, Service supplements and individual Service award fee guides provide additional information on types of contracts and incentives that may be used. (FAR 16.405-2; DFARS Part 216.405-2; AFARS Part 5116.4052(b); AFFARS Part 5316.405-2; Air Force Award Fee Guide; Army Award Fee Guide.

1.5. Acquisition Process

This guide focuses on contract development leading to contract award. Traditionally, program designation and contract award is at MS B. However, regardless of the acquisition phase, some contracts may be awarded prior to MS B, and the T&E contractual considerations described in this guide still apply. The five major phases of the Government acquisition process are defined in DoDD 5000.1, The Defense Acquisition System and DoDI 5000.02, Operation of the Defense Acquisition System. Figure 1-1 below depicts the current Defense Acquisition Management Framework.

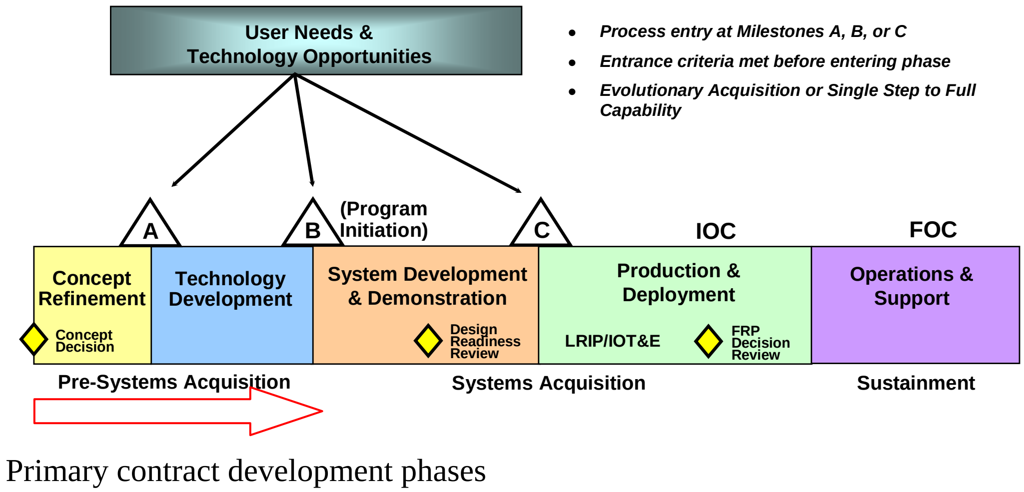

Figure 1-1. The Defense Acquisition Management Framework

Figure 1-2 below is a simplified illustration of the above acquisition process depicting the associated contracting steps. It begins when the warfighter identifies the need ([Joint Capabilities Integration and Development System (JCIDS) 3170.01E]) to the acquisition activity, which then translates that need into a requirement and purchase request. The KO solicits offers from industry and awards a contract. In the final step, the contractor closes the loop by delivering supplies and services that satisfy the Government need. During acquisition planning, primary responsibility rests with the acquisition activity.

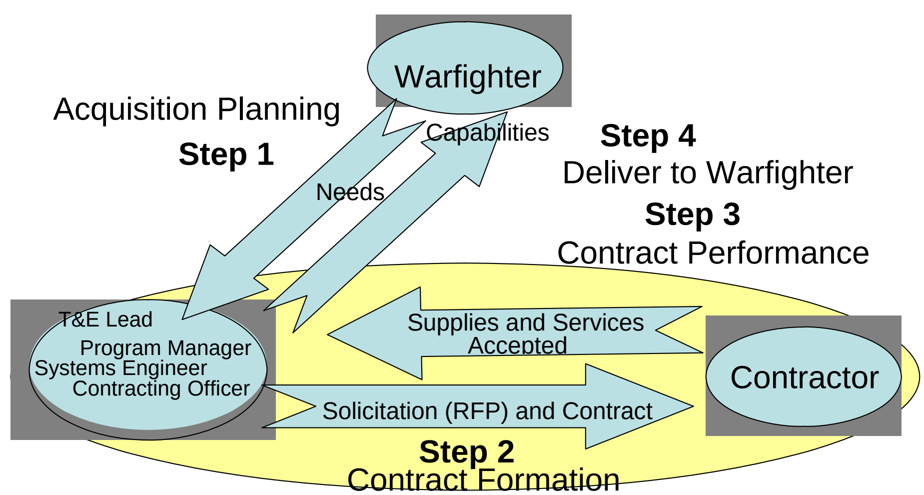

Figure 1-2. Simplified Government Acquisition Process

Acquisition planning is the process of identifying and describing contract requirements and determining the best method for meeting those requirements (e.g., business, program Acquisition Strategy), including solicitations and contracting. Acquisition planning focuses on the business and technical management approaches designed to achieve the program's objectives within specified resource constraints. The Acquisition Strategy (AS), usually drafted in the Technology Development (TD) phase of acquisition, is required and approved by the MS B Decision Authority (MDA) and provides the integrated strategy for all aspects of the acquisition program throughout the program life cycle. Earlier developmental activities are guided by the Technology Development Strategy (TDS). The TEMP provides the strategy on the content, management, and focus of the T&E aspects of the acquisition program. The Acquisition Plan provides more specific plans for conducting the acquisition and is approved in accordance with agency procedures (FAR Part 7). A Source Selection Plan specifies the source selection organization, evaluation criteria, and procedures, and is approved by the KO or other Source Selection Authority (SSA). All of these documents guide RFP development. Other companion program artifacts include, for example, the Capabilities Documents (Initial Capability Document [ICD], Capability Development Document [CDD], and the Capability Production Document [CPD]); Risk Management Plan (RMP), Technology Readiness Assessment (TRA); Information Support Plan (ISP); Systems Engineering Plan (SEP); Product Support Strategy (PSS); DoD Directive 3200.11 Major Range and Test Facility Base; 2003 National Defense Authorization Act (NDAA) and Support and Maintenance Requirements. A good source for policy and guidance is DAU's Acquisition Community Connection (ACC) Practice Center web site (**reference f**).

The program team must have strong technical, contracting, and T&E leadership as the program moves through its steps in contract formulation and execution. It is imperative to have the KO involved in the program acquisition planning process as early as possible.

1.6. Contracting Process

The program manager (PM), chief or lead systems engineer (SE), KO, and lead tester and evaluator must work together to translate the program's Acquisition Strategy or Acquisition Plan and associated technical approach as defined in the Government SEP into a cohesive, executable contract, as appropriate. Table 1-1 identifies some typical contract-related activities from requirements identification through contract close-out and capturing lessons learned and the role of the lead for T&E who provides the T&E input, review, and coordination.

Table 1-1 Contracting Activities and T&E Role

Typical Contract-Related Activities	T&E Role ("Lead for T&E" refers to the individual who leads the T&E review, coordination, etc., effort for the PM)
1. Identify overall procurement requirements and associated budget.	PM provides any program-related requirements. Lead for T&E provides program T&E requirements. Describe the Government's T&E needs and any constraints on the procurement.

Typical Contract-Related Activities	T&E Role ("Lead for T&E" refers to the individual who leads the T&E review, coordination, etc., effort for the PM)
2. Identify T&E actions required to successfully complete T&E and performance milestones.	Lead for T&E defines the T&E strategy and approach and required T&E efforts. These will be consistent with the program's Acquisition Strategy or Acquisition Plan, SEP and within the DoDI 5000.02 requirements. This effort should include identification of test and training ranges of the Major Range and Test Facilities (MRTFB), test equipment and facilities of the MRTFB, capabilities designated by industry, academia, unique instrumentation, threat simulators, targets, and Modeling and Simulation (M&S). Certain test events such as IOT&E, and IV&V may have to be performed by independent third SMEs.
3. Collaboration on acquisition and T&E strategies.	The PM, users, and appropriate T&E personnel collaboratively develop the acquisition and T&E strategies so that users' capability-based operational requirements (i.e., CDD, CONOPS) are correctly translated into accurate contractual terms and actions that give the highest probability of successful outcome for the government."
4. Identify the reliability, availability, and maintainability (RAM) requirements and the need for a Reliability Program Plan (RPP).	PM, SE, and Lead for T&E identify the RAM and RPP requirements for a robust RAM program, which includes reliability growth, as an integral part of product/system design, development, and T&E consistent with technical maturity and the system engineering plan.
5. Document any trade studies, Limited Demonstration Tests (LDTs), or market research results and identify potential industry sources.	PM and Lead for T&E identify programmatic and T&E information needed and assists in evaluating the search results for each area. See FAR Part 10 for sources of market research and procedures. Small Business must be considered.
6. Document the role of M&S.	PM, with the Lead for T&E, identify the role M&S will contribute to the acquisition process, especially the T&E process. This effort should be consistent with the engineering plan for M&S. Address the need for a Modeling and Simulation Support Plan (MSPP) if required per Component direction.

Typical Contract-Related Activities	T&E Role ("Lead for T&E" refers to the individual who leads the T&E review, coordination, etc., effort for the PM)
7. Prepare a Purchase Request.	PM and Lead for T&E ensure the specific programmatic and T&E needs are defined clearly. Consider the needs for testing COTS as well as any possible contractual implications, regarding testing, associated with FAR Part 12 Commercial Contracts. A Purchase Request should include product descriptions; priorities, allocations, and allotments; architecture; Commercial-off-the Shelf (COTS),Government-Furnished Information (GFI), or Government property or equipment; information assurance and security considerations; and required delivery schedules.
8. Identify acquisition streamlining approach and requirements.	The program team works together to ensure FAR and DFARS requirements are met while tailoring the acquisition strategy and approach. The PM is owner of the program acquisition strategy and planning. The Lead for T&E develops and reviews (and PM approves) the T&E strategy and approach with the PM and lead engineer. Acquisition streamlining approach and requirements include: budgeting and funding, contractor versus Government performance, management information requirements, environmental and safety considerations, offeror expected skill sets, and milestones. These are addressed in the Acquisition Strategy or Acquisition Plan.
9. Determine Contractor OT&E Support.	PM and Lead for T&E will identify what, if any, contractor support is required for OT&E. There are five permissible types of contractor OT&E support. 1) Maintenance and support actions of the same type that the system contractor would be expected to perform as part of interim contractor support or contractor logistics support when the system is deployed in combat. 2) Conducting and reporting analyses of test failures to assist in isolating causes of failure (but excluding participation in data scoring and assessment conferences. 3) Providing and operating system-unique

Typical Contract-Related Activities	T&E Role ("Lead for T&E" refers to the individual who leads the T&E review, coordination, etc., effort for the PM)
	test equipment, test beds, and test facilities which may include software, software support packages, instrumentation and instrumentation support. 4) Providing logistics support and training as required in the event that such services have not yet been developed and are not available from the military department or Defense Agency having responsibility for conducting or supporting the operational test and evaluation. 5) Providing data generated prior to the conduct of the operational test, if deemed appropriate and validated by the independent operational test agency in order to ensure that critical issues are sufficiently and adequately addressed.
10. Plan the requirements for the contract Statement of Objectives (SOO) / Statement of Work (SOW) / specification, and T&E reviews in support of the technical reviews, test readiness reviews (TRRs) acceptance requirements, and schedule.	Lead for T&E is responsible for the development of the T&E contents of the SOO/SOW, and supporting the technical and test readiness reviews.
11. Plan and conduct Industry Days as appropriate.	PM and Lead for T&E support the KO in planning the meeting agenda to ensure T&E needs are discussed.
12. Establish contract cost, schedule, and performance reporting requirements. Determine an incentive strategy and appropriate mechanism (e.g., Incentive/Award Fee Plan and criteria).	Lead for T&E provides T&E resource estimates, and support development of the Work Breakdown Structure (WBS) based on preliminary system specifications; determines T&E event-driven criteria for key technical and readiness reviews; and determines what T&E artifacts are baselined. The PM, Lead for T&E, and lead engineer advise the KO in developing the metrics/criteria for an incentive mechanism.

Typical Contract-Related Activities	T&E Role ("Lead for T&E" refers to the individual who leads the T&E review, coordination, etc., effort for the PM)
11. Identify T&E data requirements.	Lead for T&E identifies all T&E Contractor Data Requirements List (CDRL) intellectual property requirements, if any, and T&E performance expectations.
12. Establish warranty requirements, if applicable.	Lead for T&E works with the KO on determining cost-effective warranty requirements, such as: addressing and correcting defects (hardware, software, documentation) as part of the warranty. Under the warranty, the contractor will correct to the government's satisfaction each defect which the government specifies needs to be corrected prior to fielding.
13. Prepare a Source Selection Plan (SSP) and RFP (for competitive negotiated contracts).	Lead for T&E provides input to the SSP per the SOO/SOW, Section L (Instructions, conditions, and notices to offerors or respondents) and Section M (Evaluation factors for award) of the RFP.
14. Conduct source selection and award the contract to the successful offeror.	Lead for T&E participates on source selection teams.
15. Implement requirements for contract administration office memorandum of agreement (MOA) and/or letter of delegation.	Lead for T&E provides input regarding the T&E support efforts for inclusion in the MOA and/or letter of delegation. The MOA should define product/system performance requirements and or attributes.
16. Monitor and control (M&C) contract execution for compliance with all requirements.	PM, Lead for T&E, and program team perform programmatic and T&E M&C functions as defined in the contract. They assist the Earned Value Management (EVM) implementation by monitoring the criteria for completion of T&E events, activities, and delivered products. They also assess T&E performance criteria in the Incentive/Award Plan.
17. Contract Close-out.	Contract close-out is mainly an accounting/administration activity, but KO provides status to PM. Lead for T&E may have input regarding any T&E-related articles, such as M&S tools and final performance reports.

Typical Contract-Related Activities	T&E Role ("Lead for T&E" refers to the individual who leads the T&E review, coordination, etc., effort for the PM)
18. T&E Lessons Learned.	Lead for T&E, and contractor partner, should be capturing, and adjusting as necessary, lessons learned as the T&E effort progresses through the acquisition process. The lessons learned should be provided to the PM as part of the T&E close-out process and final PM report, as appropriate, to the program sponsor, or as directed.

2.0 Pre-Solicitation

The contents of this section will help you focus on and consider the most important contractual T&E items as you formulate the T&E strategy and approach. The discussion is applicable to whether you are preparing for a weapons system, C4ISR, or AIS acquisition program. A solid T&E strategy and approach foundation will facilitate the transition to the solicitation phase.

2.1. Planning

During the program life cycle it is critical that the PM, SE, and T&E personnel recognize an early and consistent incorporation of T&E considerations and requirements begin at the onset of program planning during the Concept Refinement (CR) and Technology Development (TD) phases. The program acquisition strategy must be grounded in a technical approach with achievable, testable, and measurable performance requirements and reliability metrics embodied in viable system solutions that are within cost and schedule constraints.

The PM and his/her team, and the program, must be prepared to enter the System Development and Demonstration (SDD) phase with cost, schedule, and expected system performance requirements balanced and synchronized. Five important PM and team T&E considerations when beginning pre-solicitation activities are:

- Selecting a domain-experienced contractor with proven past T&E performance for a product or system similar to the one being developed must be a priority.

- Ensuring program planning documentation, even in draft, such as the Acquisition Strategy or Plan, Analysis of Alternatives (AoA), SEP, SSP, Risk Management Plan (RMP) and the RFP are available, coordinated, and consistent. The SEP, SSP, RMP, and the resulting RFP integrate the T&E policy directives and best practices from both Government and industry.

- Ensuring the integrated T&E strategy and approach addresses the total life cycle of the program and includes an event-based T&E approach and not schedule driven, but logically sequenced test events consistent with product or system development) and demonstrated performance review philosophy and reliability metrics.

- Ensuring the specific test ranges/facilities and test support equipment are identified for each type of testing. Any shortfalls between the scope and content of planned testing with existing and programmed test range/facility capability must be identified with associated risk analysis**.** Ensure any applicable open air range requirements for OT&E are also addressed in addition to individual DT&E requirements.

- Incorporating T&E requirements in budgets and cost estimates in the program's T&E approach and achievable performance requirements, and integrated into the program's Integrated Master Plan (IMP), Integrated Master Schedule (IMS)/Integrated Master Test and Evaluation Schedule, and Earned Value Management (EVM) System. Program T&E cost and schedule realism must be supported by aggressive leadership, sound program planning, and timely application of resources along with execution of mature technical, T&E, reliability, and management processes.

- Consideration for Joint Interoperability Test Command (JITC) interoperability and net ready key performance parameter certification must be made. Additionally, planning considerations for sufficient and early Information Assurance (IA) planning through the DoD Interim Guidance for DoD Information Assurance and Certification Accreditation Process (DIACAP) process must be factored into the test strategy to ensure operationally representative test environments and connectivity can be obtained.

2.1.1. Requirements

The T&E lead individual is responsible for establishing sound testable and measurable system performance requirements. The approved performance requirements are the backbone of the T&E strategy, approach, execution, and reporting. Performance requirements, derived from operational requirements, must be established that correlate with program costs and schedule. If these three elements are not balanced at the start of SDD phase, or program award, the program has a high probability of incurring cost increases and suffering schedule delays or worse, a deficient system. The system performance requirements should be performance based, and potential system solutions must be based upon mature technology and be within program cost and schedule constraints. These performance requirements are documented in the Acquisition Program Baseline (APB), and should be in the SOO, and based on the operational requirements stated in the ICD, or the follow-on CDD and associated JCIDS documentation. The preliminary system specification may include some of the JCIDS documents (or extracts from them) such as operational and system architectural views and Concept of Operations (CONOPS). The program office may also provide portions of the JCIDS documentation as reference material to aid the offerors' understanding of the operational requirements. The preliminary specification in the RFP is a precursor to the System Performance Specification that represents the program's functional baseline to be placed on contract. The functional baseline in the SPP is the first critical technical baseline established at the start of SDD.

Key for the T&E team is understanding all the stated and implied requirements and how to best meet those requirements through integrated T&E, use of M&S, establishment of a test team composed of all the stakeholders, and ensuring the T&E strategy and approach address system-of-systems (SoS) and joint T&E to the extent necessary to adequately demonstrate performance in the expected operational environment with realistic T&E events and schedule. The T&E lead along with test team members should develop a Requirements Testability Matrix (RTM) depicting how each requirement will be tested.

The DoD worked closely with both industry and the Government Electronics and Information Technology Association (GEIA) on the development of a new standard, GEIA-STD-0009, *Reliability Program Standard for Systems Design, Development, and Manufacturing*. The DoD was motivated to initiate and support this undertaking because many systems have not been achieving the required level of reliability during

developmental testing and have been subsequently found unsuitable during Initial OT&E. In May, 2008, the Defense Science Board DT&E Task Force (**reference g**) examined this issue and concluded that a new reliability program standard, which includes reliability growth as an integral part of design and development, and can be readily cited in DoD contracts, is urgently needed.
GEIA-STD-0009 consists of the essential reliability processes that must be performed in order to design, build, and field reliable systems. GEIA-STD-0009 is, at its core, a reliability engineering and growth process that is fully integrated with systems engineering. In order to facilitate its use in DoD acquisition contracts, enabling sample reliability contractual language is posted on DAU's ACC website (**reference h**). GEIA-STD-0009 should be explicitly cited in the system specification.

2.1.2. Test and Evaluation Strategy and the Acquisition Strategy/Plan

The PM and Lead for T&E must recognize and emphasize the importance of a sound T&E strategy and approach to the program. The recognition begins with the statement of required capability, resulting in an approved system definition that provides a product meeting the user's needs. There is no "one size fits all" approach for programs, but disciplined adherence to proven T&E processes and practices will lead to a sound T&E strategy and approach. When developing the T&E strategy and approach consider that the single most important step necessary to correct suitability failures is to ensure programs are formulated to execute a viable systems engineering and T&E strategy from the beginning, including a robust RAM program, which includes reliability growth and development.

The Government TEMP is the foundation T&E document supporting the acquisition strategy and PM's program schedule and contains key items which must be considered when developing the SOW and RFP. The Government's T&E strategy and approach should describe what is to be accomplished. The offeror's integrated T&E approach provided in the proposal will expand on how the offeror intends to execute the integrated T&E program applying their domain experience and corporate best practices. The Government TEMP should be prepared as early as possible to properly influence the acquisition process by providing a carefully planned T&E strategy and approach to meet the programmatic and operational needs. This strategy and approach becomes very important if the acquisition strategy and engineering strategy employs incremental development and fielding. TEMP development should begin in parallel with the analysis of operational requirements so the T&E strategy and approach are consistent with the required capability. The Government should share the draft TEMP, along with the draft preliminary system specification with industry representatives to obtain their perspective on the T&E strategy and approach. In addition to the TEMP, the program requires supporting documents such as the SEP, AS, RPP, and ICD/CDD. These program documents capture information important to developing the T&E strategy and approach.

2.2. Working With Industry

During the pre-solicitation phase of a program it is important that the T&E process be applied to set the stage for future expectations. The Government is in the leadership role in this stage and early industry inputs can provide critically important insights into the technical and performance challenges, program technical approach, and key business motivations. Lessons learned from past programs suggest the pre-solicitation process can be very productive when a highly collaborative environment is created involving the user, acquisition community, and industry personnel. The program should ensure early and frequent industry involvement while developing the T&E strategy and approach and formulation and the development of the system performance requirements. Industry will provide important insight into both the T&E and business aspects of the program. The Government should include its T&E strategy and approach in the draft RFP to foster this synergism and interaction. Notwithstanding the desire to work with industry and getting input on T&E solutions from potential contractors, Government personnel must always keep in mind that individual contractors will have potential biases that will intrude into their recommendations.

2.3. Formula-type Incentives and Award Fees

2.3.1. General. There are two broad types of incentive contracts, those that rely on the Application of predetermined, formula-type incentives and award-fee contracts, where the award amount is determined by the Government's judgmental evaluation of the contractor's performance.

Incentive contracts are designed to obtain specific acquisition objectives by establishing reasonable and attainable targets that are clearly communicated to the contractor, including appropriate incentive arrangements designed to motivate contractor efforts that might not otherwise be emphasized and discourage contractor inefficiency and waste. Most incentive contracts include only cost incentives, which take the form of a profit or fee adjustment formula and are intended to motivate the contractor to effectively manage costs. No incentive contract may provide for other incentives without also providing a cost incentive or constraint.

In developing appropriate incentives, the Government must take care to provide incentives for the desired behavior only, and not for actions that are counterproductive or for requirements that the contractor would otherwise be required to perform. Incentive increases or decreases are applied to performance targets rather than minimum performance requirements. Incentives are directly linked to expectation setting, understanding, and interactive management. Incentives and motivations must support the overall program needs and not sub-optimize a specific aspect of the program.

2.3.2. Formula-type Incentives. Formula-type incentives are based on either a single criterion or multiple criteria which can be objectively measured. DoD is moving more towards incentives based on objective criteria – according to the Defense Procurement and Acquisition Policy (DPAP memorandum "Proper use of Award Fee Contracts and Award Fee Provisions," dated APR 24 2007, **reference i**) "***It is the policy of Department that objective criteria will be utilized, whenever possible, to measure contract performance.***" For example, a cost incentive would be that the additional cost for every dollar over the target cost of the contract would be split between the Government and the contractor based on a fee adjustment formula (i.e., share ratio). Including incentives for T&E excellence, in addition to the cost incentive, can be an important aspect of the program acquisition strategy and should be an explicit consideration for any development or test program contract. The incentive strategy must be balanced with the program cost, schedule, and performance requirements reflected in the program documentation. Incentives reinforce the Government's emphasis on T&E leadership, planning, and execution with the contractors. Incentives beyond the required cost incentive may be monetary, non-monetary, positive, or negative, but regardless of their structure, the goal is to motivate delivery of high-quality performance in achieving program goals.

Incentives for motivating excellence in the T&E portion of a program may be based on schedule or on performance, but no incentive contract may provide for other incentives without also providing a cost incentive or constraint (FAR 16.402). Some of the T&E criteria are inherently mixed with other criteria, especially technical criteria, for example, risk management, timely data delivery, and access. Incentives should be tied to specific test events, such as demonstrating a specific capability, or TPMs, in the system integration laboratory or testing a critical capability with a full-scale test article. The incentives applicable to T&E have tended to be subjective award fee measures, which will be discussed in the following section. When structuring incentives for the entire program, the RFP team must keep in mind that it is the policy of the Federal government to not incentivize minimum performance requirements, and to avoid the potential dangers of incentive dilution, incentive contradiction and unintended adverse consequences. For example, small increases in incentivized performance may have undesirable impacts on other program elements that are important, but not incentivized. Or, a contractor's desire to earn schedule incentives could detract from sound engineering decisions.

The incentives should consider non-test items that will end up driving the length or productivity of the test program. For example, if a radar system is not ready for test at the same time as the rest of the weapon system, then the test program could be delayed or lose efficiency because the program has to repeat test events when the radar is installed. In that case, an incentive placed on delivery of critical subsystems to the test program would have a greater effect on test program efficiency than any incentive applied directly to the test program itself. However, this may also be accomplished through a modification in delivery schedules of the critical subsystems. In general, focus incentives on demonstrating that key programmatic and technical risks are resolved as soon as possible, and avoid any incentives that may drive the contractor to delay testing inappropriately.

Incentives can also be tied to the contractor using preexisting Government test ranges/facilities to include instrumentation. As a national asset, the MRTFB is sized, operated, and maintained to provide T&E information to DoD Component T&E users in support of DoD research, development, T&E and acquisition process. If the contractor develops an internal test capability for a system which already exists within the MRTFB, a cost penalty will be incurred.

2.3.3. Award Fees. The application of award fee incentives is generally associated with cost-reimbursement contracts, but may be used in either fixed-price or cost-reimbursement type contracts. An award fee provision may be used when the Government wishes to motivate a contractor and other incentives cannot be used because contractor performance cannot be measured objectively (FAR 16.404 and 16.405-2). The award fee approach is suitable for use when the work to be performed is such that it is neither feasible nor effective to devise predetermined objective incentive targets applicable to cost, technical performance or schedule.

Although award fee incentives can produce positive effects, the effort required for doing periodic evaluations in accordance with the award fee plan (e.g., continuous monitoring, midterm analyses, final analyses, and reports for each period) must also be considered, particularly for smaller program teams. Consider the investment in resources versus incentive gain trade-off before deciding to use an award-fee approach. Award fee criteria need specific data and examples of performance when making an award fee determination. As subjective measures are used, it is important that the contractor clearly understand expectations and be promptly advised of any problems or issues that may affect the award determination.

The contractor earns the incentives through a subjective evaluation process described in an Award Fee Plan. For example, if the program requires the contractor to develop a test bed, the award fee incentive could be related to the test bed development, test, and acceptance according to the schedule, cost, and test bed performance requirements. This incentive approach allows the Government to motivate exceptional contractor performance considering the conditions under which it was achieved, normally in such areas as quality, timeliness, technical progress, technical ingenuity, and cost-effective management. Early completion of technical reviews should not be award fee criteria since it may be counterproductive to the conduct of thorough event-based reviews. Attachment B lists sample T&E award fee criteria. Following are 14 items to consider when developing T&E award fee criteria.

Table 2-1. T&E Award Fee Considerations

1. Contractor has executed the T&E strategy and approach in accordance with the TEMP/Test Plan (TP), and keeps the management plans/tools integrated.
2. Contractor has implemented and demonstrated a disciplined T&E management process to capture test entrance, exit, and success criteria with clearly defined metrics.
3. Contractor has presented a well-thought-out trade study and/or limited development testing (LDT) plans for the program and provides evidence of systematically evaluating all aspects of the system. The trade studies utilize common sets of critical trade parameters that are focused on the critical performance, schedule, and cost requirements of the program. Trade studies are documented and archived to establish an audit trail for the principal technical decisions on the program. The contractor conducts LDTs to test and evaluate specific critical aspects of system performance.
4. Test and evaluation data ownership, control, access, sharing and delivery support the T&E strategy and approach.
5. Contractor continually demonstrates timely and efficient preparation of T&E plans and reports as the system is progressively described to its lowest level of

detail.

6. Contractor uses models and simulations to minimize the number of tests.
7. Contractor has implemented a process to track test failures, analyze and establish corrective actions, and provide feedback into plans and procedures to improve T&E efficiency.
8. Contractor has established and implemented an event-based T&E process through the use of Technical Performance Measurements (TPMs) to include reviewing events with entry criteria, exit criteria, and success criteria.
9. Contractor demonstrates effective risk management, actively involving the Government to assess major risk areas, and establishes specific risk mitigation plans that are integrated into program plans.
10. Contractor flows down T&E processes and plans to the subcontractors and actively involves the subcontractor team in T&E baseline management, configuration management, requirements management and risk management activities.
11. Contractor has a disciplined action item tracking system that documents system and sub-system, if applicable, performance problems/issues that require program management attention.
12. Contractor has an exceptional record in meeting milestones and due dates and effectively uses T&E metrics to manage the T&E program.
13. The contractor has demonstrated knowledge of department level policy and guidance includes Joint Capabilities and Integration and Development System and Testing in a Joint Environment Roadmap.
14. Encourage prospective offerors to provide opportunities for integrating contractor testing, developmental testing, and operational testing to develop cost effective test programs with shorter schedules.

2.3.4. Information on Incentives. FAR Part 16, the DFARS, Service FAR supplements and individual Service incentive and award fee guides (e.g., Air Force Award Fee Guide, Air Force Guide Award Term / Incentive Options, Army Award Fee Guide) provide additional information, address ways to structure incentive and award fee plans, and provide examples. Additionally, there are applicable references and guides. There is OUSD(AT&L) memorandum, subject: Award Fee Contracts (**reference l**). The DAU "Award and Incentive Fees" Community of Practice (**reference m**), and a Guide – "Incentive Strategies for Defense Acquisitions"(**reference o**) which provides details on different incentive approaches.

2.4. Market Research

FAR Part 10 requires the Government's acquisition strategy to include the results of market research. FAR Part 10 implements Title 41 U.S.C. 253a(a)(1), 41 U.S.C. 264b, and 10 U.S.C. 2377 requirements. Market research is one method to establish the availability of products and the suitability of commercial products (e.g., COTS products) to meet the potential Government system performance needs. It supports the acquisition planning and decision process by supplying technical and business information about commercial and DoD technology, products, and industrial capabilities.

Market research is used to obtain current information on companies' maturity model level rating and how they have applied their rated processes within specific domains of their company. The specific rating is not the sole determiner of process maturity. The corporate commitment to continuous process improvement with documented plans and maturity milestones is an important element. Frequently during the pre-solicitation and RFP preparation phase of a program, the Government team seeks business, T&E, and acquisition planning information via request for information (RFI). The Government usually sends these requests via the Government-wide point of entry (GPE) which can be found at the Federal Business Opportunities (FEDBIZOPs) web site (https://www.fbo.gov/index?cck=1&au=&ck=). The RFIs solicit data from interested industry sources and might be limited since it is an unfunded request for data and information. The RFI can be used to supplement market research and to secure specific types of T&E data, including the extent of their domain T&E experience and details on their T&E "best practices." RFIs can provide valuable insight on how potential offerors have integrated their technical, T&E, and management processes to effectively manage prior programs. Each year the Major Range and Test Facility Base (MRTFB) activities are required to submit a notice, via FEDBIZOPs, which describes the nature of the anticipated commercial work and invites private sector responses of capability to perform these T&E services.

2.5. Industry Days

Before release of a formal RFP, the Government may hold "Industry Days" to inform industry about the technical requirements, acquisition strategy, and T&E strategy, and to solicit industry inputs for the pending program. Industry Days facilitate a program's communications between Government and industry. During this time communications are the least encumbered by the formality and limitations associated with the formal RFP/source selection process. T&E personnel need to avail themselves of the opportunity for free and open communications. They should emphasize the importance of the significant aspects of T&E requirements (such as, M&S, hardware-software and system component integration T&E, test beds, prototypes, incremental T&E and fielding, interoperability architectures, and specific ranges) to resolve T&E complexities and mitigate actual or anticipated program risks. The Government should initiate discussions of the following seven T&E topics during Industry Days discussions.

- T&E strategy and approach. Continually emphasize the importance of the overall technical approach and associated T&E strategy and approach. The Government prepared TEMP should be made available to industry.
- User of M&S. Discuss M&S testing (especially the verification, validation, and accreditation (VV&A) process and proprietary rights) and any trade studies, LDTs, and analyses that have been conducted during the requirements generation process. While solution alternatives are studied during this phase of the program, the emphasis should remain on the resulting performance

requirements, not on the specifics of the alternatives. Government trade studies, LDTs, and analyses should be made available to industry as appropriate.

- Potential T&E solutions. While it is necessary to investigate potential T&E solutions that are responsive to the requirements, the Government team should avoid becoming fixated with the solutions. The user sometimes becomes enamored with what he likes, the acquisition team focuses on the one that works, and industry has one it wants to sell. The team should focus on establishing the cost-effective T&E processes and events that can be operationally evaluated and deliver the necessary operational capability.
- Supporting Management Processes. T&E members need to emphasize that potential offerors must have T&E management processes to be implemented during program execution. The Government team should have a clear understanding of system/sub-system requirements, encourage the offerors to discuss their T&E approach, and encourage the potential offerors to document their approach.
- T&E approach. T&E members need to address the T&E approach and how it was established. This is an excellent opportunity to reinforce the importance of the T&E processes and schedule for the program and for the Government to describe its T&E approach to the program
- Corporate Proprietary Information. Recognize that prospective offerors exercise extreme caution during open sessions for fear of compromising a competitive advantage or revealing a perceived weakness. During one-on-one sessions the discussions are more open and free, but be careful to provide all offers with equivalent information about the government's needs without divulging potential solutions considered by other offers.
- Areas of Mutual Interest. Identify areas of interest and encourage prospective offerors to provide data, insights, and suggestions that facilitate the transition into SDD with sound performance requirements and a well structured T&E approach. The agenda and topics should not be solely left to the discretion of the offerors.

For additional information on exchanges with industry before receipt of proposals see the other eight techniques discussed in FAR 15.201(b).

2.6. Division of Responsibilities / Authority

An additional Government team consideration for working with industry is the division of responsibilities between the Government and the contractor, and also the level of authority granted to each to execute the test program. The contract should be clear on what the contractor is expected to deliver in terms of articles, performance, or services. However, T&E programs usually involve a shared responsibility in the planning, execution, and reporting of T&E. If this shared responsibility and authority are not clearly addressed during contract formulation and award, then any misunderstandings will cause problems during program execution. The problems will range from minor discussions over who can approve test plans, to major disconnects, such as missing equipment, which can bring the program to a halt.

The strategy for planning and executing the test program needs to be agreed to prior to release of the solicitation. One strategy consideration concerns overall control of the test program – will the contractor run everything with the Government testers in a support role at the contractors facility, or will it be shared, or will the Government testers at Government ranges/facilities be in control with the contractors in a supporting role? Remember, for operational testing, the contractor can only be involved to the extent that they will be involved once the system is fielded. Responsibilities related to the planning of detailed tests and the control of execution of test events needs to be considered also. In addition, responsibilities for conducting test-related safety analyses and mitigating test risks must be thought through during SOW and RFP generation. Some of the answers will be driven by the choice of test ranges and facilities to be used, (e.g., contractor or Government) but it still must be explicitly considered.

Another factor in addressing the level of responsibility of the contractor versus the Government is the overall level of system performance responsibility assigned to the contractor through the contract. Will the contractor have Total System Performance Responsibility (TSPR), in which case the contractor would be expected to handle all of the integration issues for the total system and deliver end system performance? Or will the contractor be responsible for only one element of the total system, and the Government or another contractor will become the system integrator, and accept the risks associated with delivering end system performance? Choosing one or the other, or some other approach, will have an impact on how the Government works with the contractor, and the appropriate division of responsibilities and authority between the Government and the contractor.

2.7. Draft Request for Proposals

The RFP is a solicitation used in negotiated acquisition to communicate Government requirements to the prospective offerors and to solicit proposals. The FAR 15.204 specifies that the format and content of RFP and contracts are prepared in accordance with specific guidelines called the Uniform Contract Format (see Figure 2-1).

Part I – Schedule
A-Solicitation/contract form
B-Supplies or services and process/costs
C-Description/specifications/statement of work
D-Packaging and marking
E-Inspection and acceptance
F-Deliveries or performance
G-Contract administration data
H-Special contract requirements

Part II – Contract Clauses
I-Contract clauses

Part III – List of Documents, Exhibits, and Other Attachments
J-List of attachments

Part IV – Representations and Instructions
K-Representations, certifications, and other statements of offerors or respondents
L-Instructions, conditions, and notices to offerors or respondents
M-Evaluation factors for award

Figure 2-1 Uniform Contract Format

The RFP typically includes two kinds of documentation – Program and RFP documents. Figure 2-2 depicts the flow from program documentation to populate typical RFP Sections to a typical proposal.

Program Documents— Acquisition Strategy, program Integrated Master Plan (IMP) or top level program roadmap, Incentive plan or Award Fee Plan, Government SEP, TEMP, preliminary system performance specification are the program's important documents which are typically attached or referenced in the RFP and may be included in an "Offerors Library." These documents describe the Government's management, technical and T&E approach to the system acquisition along with the required system performance requirements and other important program planning elements.

RFP Documents—A typical RFP includes a model contract with any special contract requirements, Contract Line Item Numbers (CLINs), Statement of Objectives (SOO) or Statement of Work (SOW), Contract Data Requirements List (CDRL), Preliminary WBS, Evaluation Criteria (Section M) and Instructions to Offerors (Section L). The RFP (in concert with the Program Documents) defines the program to be proposed.

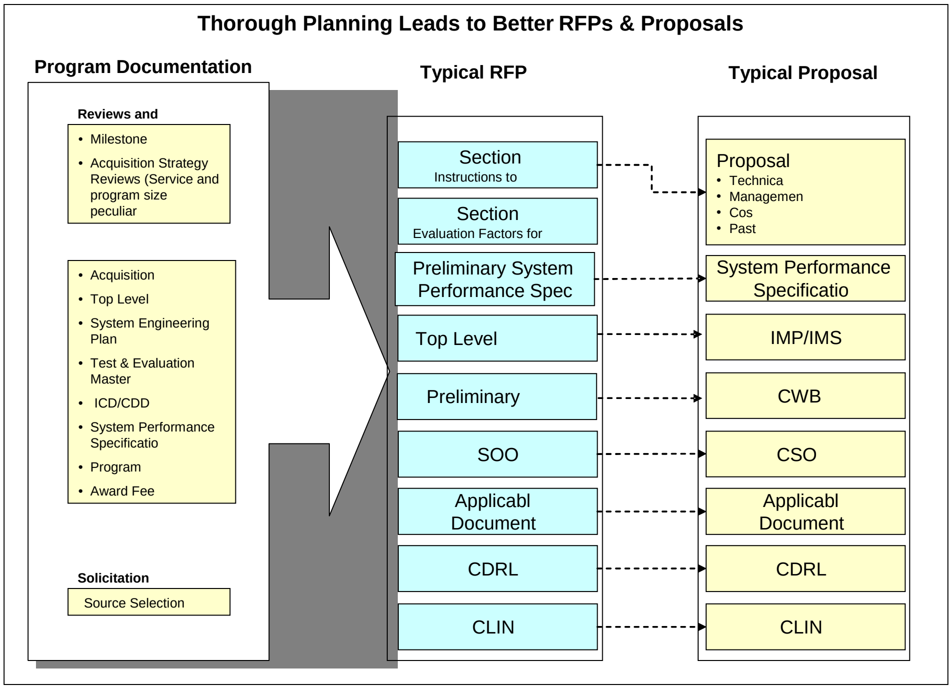

Figure 2-2 Relationship of Program Planning to a Typical RFP and Proposal

Early preparation of the Government TEMP is an important step to foster synergy among RFP sections. An integrated approach, developed specifically for each program, will result in a high degree of synergism and integration of all RFP and proposal elements. For instance, the SOW, IMP, IMS, SEP, TEMP, model contract, and the critical processes are all interrelated. The following subsections discuss the core RFP documents that contain substantive T&E material and the applicable companion proposal documents. Sections C, L, and M are the primary parts of the RFP influenced by the T&E approach to the program.

The RFP captures and amplifies the acquisition, technical, T&E, and support program strategy. There is a natural flow of information from the program strategy, to RFP, to proposal, and the resulting contract. Each program must develop the RFP according to the program strategy. Some items are required for source selection purposes only, such as the proposal volumes and/or past performance information. Some items will become parts of the contract, such as the IMP, SOW, and system specification.

2.7.1. Statement of Objectives (SOO)

The SOO is that portion of a contract that may establish a broad description of the Government's required performance objectives. The SOO delineates the program objectives and the overall program approach. The SOO, along with the preliminary system performance specification (covering the technical performance requirements), provides offerors guidance for proposing a program to meet the user's needs. The SOO is an RFP document that does not become part of the ensuing contract.

Section C contains the detailed description of the products to be delivered or the work to be performed under the contract and the preliminary system performance specification. The preliminary system performance specification was addressed in Section 2.1.1 and its conversion to the contract specification is addressed in Section 2.3.2. Other contract requirements documents may be included such as sample IMP event descriptions, CDRL, Contract Security Classification Specification (DD 254), pricing matrices. The following list contains text for inclusion in a SOO that emphasizes the main T&E themes of the guide. Specific program requirements and the program strategy are used to modify this example.

Table 2-2 T&E Content for the Statement of Objectives

Statement of Objectives

The T&E approach will capitalize on industry domain experience "best practices," and will implement DoD T&E policies. The program shall:

1. Document the T&E approach in an integrated Government TEMP that covers the life of the program.
2. Utilize contractor T&E "best practices" and processes to reduce cost. Includes agile and mature technical and management program processes based on company processes that undergo continuous improvement throughout the program's life cycle. Policies and processes shall flow down to the lowest level of the contractor (subcontractors, teammates, or vendors) team.
3. Implement event-based program milestones (e.g., Critical Design Review [CDR]) and integrated schedules (e.g., Integrated Master T&E Schedule). Implement event-based T&E events and reviews involving both Government and industry SMEs.
4. Use contractor configuration management processes to control the configuration of the T&E data. Provide real time access to the T&E baseline data for program participants.
5. Enhance opportunities for incorporation of improved capabilities and advanced technology using the modular open systems approach. Encourage use of commercial products/processes/standards.
6. Include Government participation on integrated product teams (IPTs)* to gain insight into program progress.
7. Document the requirement for Reliability Program Plan (RPP)
8. Implement a comprehensive risk management process that is focused on the program's critical path to systematically identify and eliminate/mitigate cost, schedule, technical, and performance risks.
9. Institute a requirements management process coupled with a T&E baseline management strategy that supports the TD and SDD phases, as applicable, and an orderly transition to the production, deployment, operation and support acquisition phases.

* T&E SMEs may participate in different teaming arrangements, including T&E IPTs, T&E Working IPTs (WIPTs), and program-specific teams such as contractor/combined

test teams (CTTs), a combined T&E Task Force (CTF), or integrated test teams (ITTs). The title by itself is not the important item. The key to a team structure is the charter, which lists the roles, responsibilities, products, and stakeholder membership.

2.7.2. Statement of Work (SOW)

The SOW is that portion of a contract that establishes and defines all non-specification requirements for a contractor's efforts, either directly or with the use of specific cited documents. The offeror may provide a SOW to be included in the negotiated contract. The Government may provide a SOW as part of the RFP instead of a SOO, in which case the offerors will tailor the SOW in their proposals depending on their specific solutions to the requirement. The SOW should:

- Describe the T&E events and activities to be accomplished that reflect the T&E approach to the program as described in the TEMP.
- Reflect use of T&E processes across the program, which are critical for program success. Processes such as, reliability growth planning, assessing technology maturity, management of performance deviations and waivers, performance baseline control, risk management, configuration, and T&E data management, including government access and sharing of contractor data, tests, and results.
- Plan for and support T&E events and event-based reviews as defined in the TEMP and or the program plan.
- Address the T&E baseline management process, associated T&E data, and Government approved stakeholder access to all T&E, to include M&S, data.
- Provide for TEMP updates and continuous process improvement consistent with corporate improvements, technical changes, and program needs.
- Include a cross reference matrix tracking the Government SOO requirements to the proposed SOW. The SOW should be structured for the proposed system solution and not restricted by the structure of the Government's SOO.
- Include the necessary contract language to ensure a RPP is delivered.
- Address the following items, as necessary, relative to the T&E strategy and approach: Contractor Test Plan, Detailed Test Plans and Reports, T&E Support for Government conducted tests, Test Instrumentation, Test Readiness Reviews, Failure Review Boards, Deficiency Reporting (DR), and T&E WIPT support.

The contractor SOW addresses the requirements stated in the SOO or RFP SOW, other sections of the RFP, and derived requirements based on the offeror's approach. The SOW should include those T&E tasks and activities that the contractor is required to execute during the contract. The T&E approach relies heavily on contractor's processes and practices and the SOW should address the application of these processes and practices during DT&E and OT&E and sustainment as applicable to the program. It is generally not the intent to put the specifics of the contractor's individual processes and practices on contract, but the SOW should recognize the application of key T&E processes and practices on the program. The SOW should address the Government's requirement –not a contractor's solution. When a contractor proposes a detailed SOW, it must still be stated in terms to describe the Government's requirements. Following is a sample SOW.

Table 2-3 T&E Contents for the Statement of Work

Sample Instruction for Proposing T&E Activities in a Statement of Work
The offeror shall provide a SOW to be included in the negotiated contract. The SOW shall: 1. Describe the T&E work/tasks/activities to be accomplished on the program that reflect the T&E approach to the program as described in the TES/TEMP. 2. Identify the role of M&S to be used in support of the T&E process and the documented Validation, Verification and Accreditation (VV&A) of any M&S to be used. 3. Reflect use of T&E processes across the program that are critical for program success (e.g., requirements management, performance baseline control, risk management, configuration and data management, and interface management). 4. Provide for event-based reviews as defined in the Integrated Master T&E schedule and or the program master schedule. 5. Address the T&E baseline management process, associated data, and stakeholder access to all T&E data, especially the handling and accountability of expected performance deviations or waivers. 6. Provide for TES/TEMP updates and continuous process improvement consistent with corporate improvements and program needs. 7. Include a cross reference matrix showing the tracking of Government SOO or SOW requirements to the proposed SOW. The SOW should be structured for the proposed system solution and not restricted by the structure of the Government's SOO or SOW. 8. Provide the proposed RPP format and content. 9. Describe the deficient reporting strategy in terms of methodology, processes, and database(s) used to support the contract and throughout the system life cycle. The proposed contractor DR database must be compatible with (i.e., feed into) the Government's DR database

2.8. T&E Focus Areas

The following are nine specific T&E interest areas. The PM team needs to address each area in the planning stage, prior to issuing a solicitation for a contract.

2.8.1. Reliability.

The offeror is expected to develop and provide an RPP in order to achieve the following four objectives: 1) understand the Government's requirements, 2) design product/system for reliability, 3) produce reliable products/systems, and 4) monitor and assess user reliability.

The RPP should:

- Provide visibility into the management and organizational structure of those responsible and accountable (both offeror and customer) for the conduct of Reliability Activities over the entire life cycle.
- Define all resources required to fully implement the reliability program.
- Include a coordinated schedule for conducting all Reliability Activities throughout the system life-cycle.
- Include detailed descriptions of all Reliability Activities, functions, documentation, processes, and strategies required to ensure system reliability maturation and management throughout the system life cycle.
- Document the procedures for verifying that planned activities are implemented and for both reviewing and comparing their status and outcomes.
- Manage potential reliability risks due, for example, to new technologies or testing approaches.
- Flow reliability allocations and appropriate inputs (e.g., operational & environmental loads) down to subcontractors and suppliers.
- Include contingency-planning criteria and decision-making for altering plans and intensifying reliability improvement efforts.

The RPP is expected, at a minimum, to address the following twelve reliability activities. Specific descriptions of each of the activities may be found at attachment C and https://acc.dau.mil/CommunityBrowser.aspx?id=219127&lang=en-US.

- System Reliability Model
- Systems-Engineering Integration
- System-Level Operational & Environmental Life-Cycle Loads
- Life-Cycle Loads on Subsystems, Assemblies, Subassemblies, and Components
- Identify and Characterize Failure Modes and Mechanisms
- Closed-Loop Failure-Mode Mitigation
- Reliability Assessment
- Reliability Verification
- Failure Definitions
- Technical Reviews
- Methods and Tools
- Outputs and Documentation

2.8.2. Shared Test Data Access

There is never enough time to test everything during the development of a system. Most systems will utilize technology and subsystems developed for other programs or in prior efforts. To take advantage of this prior data, and data generated during contractor development, the issue of data access needs to be addressed. Resolving the issue may touch on data rights issues, which can be a source of contention. The data access issue does not automatically mean buying all the data packages from the contractor. It just means ensuring the Government will have access to the needed data at a future point in time. Perhaps the best that can be negotiated in the contract is just the fee or rate to be paid for whatever data are needed in the future. The goal is that by negotiating the data access issue early, during the competitive portion of the contracting process, that it will minimize the cost for the data requested later during the execution of the contract. Note that data access could be considered from both perspectives – the contractor may want access to data the Government has or is aware of concerning technologies that the contractor needs. Typically, if contractor test data is to be used as part of the independent system evaluation the Government will require that the test be witnessed by the tester, evaluator, or the PM. Data access also means contractor's have the correct authorization to use the data, for example, IT 1 or 2 or 3 access permissions., and any security clearance requirements.

2.8.3. Integrated Testing

Integrated testing is defined as: "the collaborative planning and collaborative execution of test phases and events to provide data in support of independent analysis, evaluation and reporting by all stakeholders particularly the developmental (both contractor and Government) and operational test and evaluation communities." (**reference j**). The PM and Lead for T&E need to consider the availability of in-house and or Component T&E resources and then contractor use, relationship, and responsibilities for DT&E, OT&E, and LFT&E. The PM and Lead for T&E need to consider such questions as:

- Who will be in charge of the testing – Government or contractor?
- Will Government personnel "work" for the contractor (i.e. Government Furnished Personnel)?
- Who is accountable for test conduct and reporting?
- What is the Government's T&E oversight role and process?
- Will the Government witness the testing at the contractor's facility?
- Will the government receive all pertinent raw test data?"

The contractor T&E role and responsibilities must be clearly, accurately, and completely identified. FAR Subpart 9.5—Organizational and Consultant Conflicts of Interest (http://www.acquisition.gov/far/current/html/Subpart%209_5.html#wp1078823) provides the responsibilities, general rules, and procedures for identifying, evaluating, and resolving organizational conflicts of interest. DOT&E has specific statutory and regulatory guidance on contractor involvement on OT&E and LFT&E. Components have specific guidance relative to contractor involvement in their respective acquisition programs.

2.8.4. Modeling and Simulation (M&S)

One of the important PM team M&S strategy decisions that must be made early in a program is the allocation of M&S responsibility between the Government and its contractor(s), with attendant funding and accountability implications. This allocation typically varies by phase, with Government M&S activities prominent in the early phases (e.g., Concept Refinement, Technology Development), but the prime contractor assuming a preeminent role after source selection and throughout the System Development and Demonstration phase. Government M&S activity typically increases again during Operational Test & Evaluation (OT&E). The Government must decide to what degree it wishes to have an independent M&S-based capability rather than just insight into the contractor's M&S activities. The Government must also decide whether it will provide, or facilitate providing, the contractor with Government-owned M&S tools and data, and if so, what its limits of liability will be regarding the functional adequacy, trustworthiness, and evolution of such Government-furnished equipment or information (GFE/GFI). VV&A responsibilities must also be allocated. Close coordination is necessary between the program office's M&S lead and its Contracting Officer. Contracting strategies, solicitation, and contract clauses must be consistent with the decided division of responsibilities. Particular attention should be paid to the GFE/GFI aspects discussed above. RFP language and contract clauses should address M&S representation requirements; data rights; the contractor's own M&S planning and documentation thereof, including the examination of reuse opportunities; expectations regarding the sources of M&S tools and data; the ownership and maintenance of Government-funded M&S resources; VV&A; standards that must be complied with; Government user support; access control; and metrics and documentation requirements, all across the system's full life-cycle. The use or development of proprietary M&S tools, or those protected by copyright or patent, with Government funds should be allowed only on a specifically reviewed, by-exception basis. A key planning consideration is addressing the need for including updates to M&S in the RFP based on use of actual test data. Effective use of M&S throughout T&E process requires an iterative model-test-model process where possible.

Indicators of contractor M&S expertise should be considered in defining source selection criteria. Contractor attributes that have a direct relationship to successful M&S use may include:

- A documented systems engineering process showing its organizations, activities, the specific M&S tools used by each, and the information flows among them;

- An existing information-sharing infrastructure (e.g., integrated data environment) providing enterprise team members, on a nearly continuous, from-the-desktop basis, the capability to discover, access, understand, and download a comprehensive set of authoritative, accurate, and coherent product development information. The data items provided by this system should be accompanied with metadata providing the pedigree and sufficient applicability and context information to guide their valid use;

- Successful experience using a wide variety of models and simulations, both for design (prescriptive modeling environments such as systems engineering tools, Computer Aided Design (CAD), and software design tools) and assessment (descriptive M&S), from the engineering to mission levels;

- Successful participation in distributed simulation federations using an open standard architecture (e.g., the IEEE 1516 High Level Architecture);

- A record of reuse of M&S tools and information produced by other organizations (Government, industry and COTS);

- A documented VV&A process, with records indicating a history of compliance; and

- A staff with documented M&S expertise.

2.8.5. System of Systems (SoS)

Expected product/system interoperability should be clearly identified in the SOO and CONOPs and will drive the T&E strategy, needed resources, and schedule. For example, does the product/system being developed stand alone, or is it part of a SoS? What is the relationship between this system and the other systems? Are the boundaries/interfaces between systems well defined?

2.8.6. Government Furnished Equipment (GFE)

The identification of and control for GFE for T&E must be identified early because they will affect contract funding and scheduling. In areas like support equipment, not identifying GFE can be a showstopper if an assumption is made about equipment availability that is not true. Similarly, the Government does not want to pay for development of contractor-unique support equipment if the design can use existing support equipment.

2.8.7. Ranges & Resources

The identification of test ranges, facilities and other needed resources (such as personnel, equipment, Operational Test Agency (OTA)) for DT&E, OT&E, and LFT&E cannot wait until the final stages of TEMP approval. The test ranges, range resources, equipment, and personnel should be identified to the extent possible in the T&E strategy development process. Especially, those DoD assets the Government require the contractor to use, or require the contractor to specifically identify and justify use of its own test resources. There has to be a comparison of Government to contractor test facilities to ensure there is no duplication and that the most appropriate facility to conduct the test and evaluation is identified. If government test facilities are required, ensure that a appropriate language in their contract with the DOD contract sponsor that provides the use of test support from the

MRTFB facility at the Government-established rate in accordance with DODD 7000.14-R, volume 11A, chapter 12. Otherwise, defense contractors will be charged as commercial customers.

2.8.8. Safety

The type of product/system will drive the personal and system safety issues. Since the T&E program will involve real people using real systems, the strategy regarding ensuring the safe conduct of the test program must be captured. Especially, who has the final safety decision – Government (such as the program office or range safety officer) or contractor. Safety topics include who has accountability in case of an accident and who has weapon release authority.

2.8.9. Test Assets

A significant costing topic is the number of test assets required for conducting the necessary test cycles during DT, OT, Live-Fire, and contractor testing. The number of test assets required for conducting DT, IOT&E and LFT&E is typically recommended by the T&E WIPT with DOT&E concurrence and documented in the OSD approved TEMP. These determinations should include identification of spares. Consideration of this topic must be in conjunction with M&S expectations, any statutory and or regulatory requirements, and required sample size necessary to support the stated performance confidence levels.

2.8.10. Software

Software is a rapidly evolving technology that has emerged to compose major components and critical sub-systems of most DOD materiel solutions. Software allows creation of products that fundamentally differ from hardware components. The following six bullets identify differences between hardware and software.

- Software has no physical characteristics limiting size or prescribing natural, structural units with boundaries and proximal interfaces.

- Software structural units are statements, objects and programs for which the interfaces are intangible and range widely in diversity, complexity and dynamic behavior.

- Software functionality is virtually boundless, unconstrained by material properties and associated manufacturing technologies.

- Software units are captured abstractions of functions allocated to design, easily changeable and therefore challenging to manage and maintain.

- Unlike hardware that typically degrades gracefully before failing, software typically fails abruptly and with greater consequence to delivery of expected system performance.

- Software almost always delivers function through code execution in a non-deterministic domain space and therefore cannot be exhaustively tested and will always contain faults. Software testing mitigates the risk of performance failures by exposing code faults and is therefore fundamentally a risk reduction activity.

System designs that incorporate software components require consideration of these unique differences and their implications for software T&E processes in solicitations, proposals and evaluation of domain experience and past performance. Evidence of experienced software T&E organizations should include documentation and successful demonstration of:

- Allotment of sufficient financial, schedule, material and domain expertise across the WBS and IMP/IMS to properly incorporate software T&E with software design and production, system integration, and system sustainment.

- An initial software T&E strategy that addresses mitigation of high risk technologies in preliminary system designs and areas of highest complexity in the system software architecture. This strategy should identify and describe:

    - Software evaluation metrics for Management, Requirements and Quality, including Reliability,
    - Types and methods of software testing to support comprehensive evaluation,
    - A linkage of software T&E into program risk management and risk reduction activities,
    - Data management/analysis methods and tools,
    - Models and simulations supporting software T&E including accreditation status,
    - Software development /test and software-hardware integration labs and facilities.
- A defined software T&E process consistent with and complementing the software and system development, maintenance and system engineering processes, committed to continuous process improvement and aligned to support project phases and reviews, including an organizational and information flow hierarchy.

- Software test planning and test design initiated in the early stages of functional baseline definition and iteratively refined with T&E execution throughout allocated baseline development, product baseline component construction and integration, system qualification and in-service maintenance.

- Software T&E embedded with and complementary to software code production as essential activities in actual software component construction, not planned and executed as follow-on actions after software unit completion.

- Formal planning when considering reuse of COTS or GOTS software, databases, test procedures and associated test data that includes a defined process for component assessment and selection, and test and evaluation of component integration and functionality with newly constructed system elements.

3.0 Solicitation

The contents of this section will help you focus on and consider the most important contractual T&E items as you transition from the pre-solicitation phase to the actual drafting of the RFP. In contracting, the term "solicitation" means to go out to prospective bidders and request their response to a proposal. The solicitation builds upon the SOO and the SOW. All the previous identification, development, and refinement of T&E requirements now have to clearly, completely, and accurately captured in the appropriate sections of the RFP.

3.1. Section C of the RFP (SOO/SOW)

Section C of the RFP contains the detailed description of the products to be delivered or the work to be performed under the contract. This typically includes the Government's SOO (or SOW) and preliminary system performance specification. The preliminary system performance specification was addressed previously. Other requirements documents may be included such as sample IMP event descriptions, CDRL, Contract Security Classification Specification (DD 254), and pricing matrices. A major discussion item is the inclusion of the implementation and execution of reliability activities fully integrating systems engineering, DT and OT. Attachment C provides a checklist to guide your discussions and decisions relative to RAM planning, accountability, and reporting for your program.

3.1.1. Statement of Work (SOW)

The following five elements need to be considered during the proposal development.

- SOWs are often too detailed and inadvertently include inappropriate items for a contract. (For example: technical day-to-day procedures and/or instructions are captured in such detail, that as they mature during the program they cannot be implemented without a contract change.) The goal is to secure a commitment to implementing the process, not controlling the very detailed procedures. The TEMP should capture how the T&E processes operate for the program. Therefore the SOW should refer to the TEMP as a commitment to implementing the processes defined for the program.
- SOW tasks should be reflected in the IMP/IMS, especially the technical baseline management, technical design, verification, and validation tasks and their associated system-level event-based technical reviews.
- The SOW should not identify individuals or specific IPTs that accomplish the tasks and should avoid including dates for start or completion of tasks. These dates, and sometimes the IPTs that will accomplish the tasks, are identified in the IMS.

- Conducting event-based technical and test reviews should be appropriate and consistent with the program technical and support strategy included in the offeror's RFP.
- All the important T&E management processes and tasks should be included, such as: decision analysis, T&E planning, assessment, test plans and reports, and data requirements, risk, and configuration management. A checklist of the T&E supporting processes, tasks and products expected as part of the SOW can be a useful aid during the SOW evaluation to ensure completeness.

3.1.2. Test and Evaluation Master Plan (TEMP). The TEMP is used to evaluate the completeness of program planning and application of T&E best practices. The following is a list of five considerations when evaluating the offeror's proposed integration of their T&E solution and program technical approach with the management approach which should be included in a Source Selection Evaluation Guide or other appropriate document.

- The proposed T&E solution incorporates those best practices and the processes that are mature, stable, and will be applied to the program. Any tailoring or modifications to the standard processes (as reflected in corporate procedures) are appropriate to the program and should not increase cost, schedule, or technical risk. The offeror has made a corporate commitment and implemented plans for continuous process improvement.
- Major T&E reviews in support of the program's technical reviews (such as the System Requirements Review (SRR), System Functional Review (SFR), Program Design Review (PDR), and Critical Design Review (CDR) are clearly identified.
- A single T&E authority for the program has been identified. The T&E team's roles and responsibilities within the offeror's proposed organization have been clearly defined and assigned. A fragmented responsibility among IPTs, especially engineering and T&E, is a risk.
- The skill, experience level, and corporate commitment of key proposed T&E personnel have been ascertained. Plans for transition and personnel assignments are in place for a smooth ramp-up of work tasks without risk of delays. There are sufficient manpower resources identified and available to support the program.
- Key T&E processes critical to program success have been integrated with the program management, and engineering processes reflect the T&E approach in the TEMP. Examples include configuration management, requirements management, technical and performance baseline control, risk management, technology reuse/insertion/obsolescence planning, and modeling and simulation planning.

3.2. Section L of the RFP (Instructions to Offerors)

Many of the documents in the RFP evolve into the negotiated contract via the proposal and source selection process (Figure 3-1).

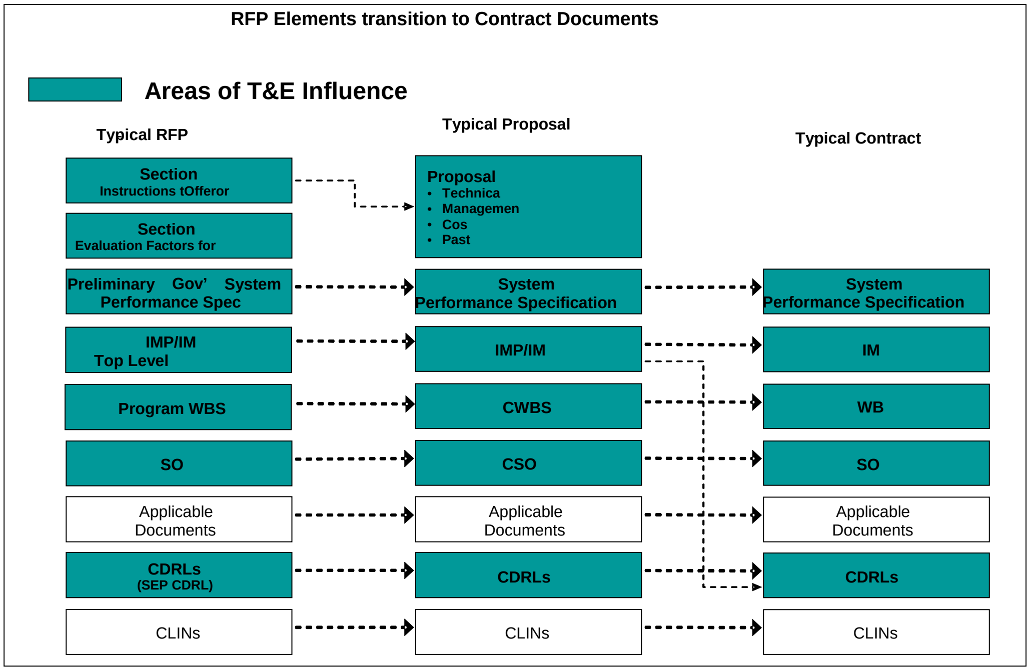

Figure 3-1 Relationship of Proposal Documents to Contract Documents

During the proposal evaluation it is important that any changes or deficiencies in these documents be corrected. The Source Selection Plan delineates how the Government and the contractors will communicate during the evaluation process, e.g., procedures for submittal of questions or requests for clarifications and submittal of a Final Proposal Revision. For all documents that are to be contractual the technical authority must ensure that they are complete and sufficient. Usually the IMP, WBS, System Specification, SOW, and CDRL are identified as contractual documents. Contract Data Item Descriptions (DIDs) and CDRLs may be tailored to the acquisition program in order to obtain contractor-produced plans or studies that satisfy specific program needs.

3.2.1. Section L Instructions. Section L of the RFP instructs the offerors how to structure their proposal and what should be included in each section of the submittal. It should be written after Section M, and tracked to the evaluation factors. The Government should avoid asking for unnecessary data in the proposal to satisfy technical curiosity. Otherwise both the contractor's proposal team and the Government reviewers will spend time proposing and reviewing unnecessary information. All data submitted in the proposal must correlate with the evaluation criteria in Section M, or be necessary to award the contract (e.g., model contract, SOW, CDRL, system performance specification). The offerors will treat all data as critical. If the offerors' time and resources are wasted on unnecessary data, the quality of the proposal may suffer, potentially affecting the choice of the right contractor with the right approach. Extraneous proposal data can also cause the Government evaluation team to spend valuable time on areas not germane to the evaluation criteria.

3.2.2. Integrated Master Plan/Integrated Master Schedule (IMP/IMS). The RFP should contain an event-based, top-level schedule depicting the major program elements and key milestones, such as contract award, DT&E, OT&E, reviews, production or long lead decisions, and system delivery.

3.2.3. IMP and IMS. The IMP and IMS should clearly demonstrate that the program is structured to be executable within schedule and cost constraints, and with acceptable risk. They should provide a functionally integrated picture of the proposed program. There must be a direct correlation between the event-driven activities in the IMP and IMS and the planned technical approach. Thus, both the IMP and IMS are key elements to proposal preparation and source selection. There must be a high correlation between the cost basis of estimates and information within the IMS. Following is a sample RFP Section L for the IMP/IMS.

Table 3-1 T&E Content for RFP Section L –IMP/IMS

Section L-IMP/IMS
The offeror shall submit an IMP/IMS {IMP/IMS Guide} that is structured as an event-based planning document. Engineering reviews such as the SRR, SFR, PDR, and CDR are typical. T&E supports each review, as required, with appropriate performance data. The IMP includes the accomplishments and criteria for the efforts involved with the design, development, test, production and sustainment including planned block upgrades, technology insertion, and entry and exit criteria. The offeror's T&E processes and corporate best practices (as described for the program) shall be the source of the test events, definitions, major T&E products, and criteria for the IMP events. The program's critical path is identified in the IMS. The result of a schedule risk assessment is presented which reflects acceptable schedule risk. For programs that require an IMP which includes a Process Narrative Section {IMP-IMS Guide Section 4.2.5}. The offeror shall include within the IMP process narratives brief synopses of the offeror's processes considered essential for program success. The narratives shall reference the offeror's corporate T&E processes and best practices and indicate how they are applied to the program.

3.3. Management Volume

The management volume is used to highlight special areas that are discriminators for the source selection. It should not be used to systematically address all technical and management processes to be used on the program. It should, however, provide a clear description of how the offeror plans to organize internally, interface with the Government program office and other external organizations, and manage subcontractors. This volume should include the approach to managing all program information, including T&E, information, how it is assembled and integrated, and how it is shared among stakeholders.

The proposal instructions should avoid a reliance on a “cookbook” list of specific T&E management processes to be discussed and evaluated. The important issue is that the offeror’s T&E processes and best practices are mature, integrated, and will be applied to the program. The focus should be on the key T&E processes that are important for program success. Examples of discriminating processes for a program might include: risk management, configuration management, T&E Key Performance Parameters (KPPs), Critical Operational Issues and Criteria (COIC), and Critical Technical Parameters (CTPS) metrics and system reliability growth, software maturation, program and performance review process, modeling and simulation, requirements and baseline management, and obsolescence/technology insertion planning. Following is a sample Section L for the Management Volume.

Table 3-2 T&E Contents for Section L –Management Volume

Section L-Management Volume
The offeror shall submit a Management Volume that describes the key management and technical processes and how they are integrated with the other management, financial, and functional processes. This volume shall include discussion of processes, program organization and special tools that are important to technical management. For example: program organization, roles and responsibilities of Integrated Product Teams (IPTs) and the T&E Team. T&E requirements management tracking tools, electronic and/or virtual program approach, special capabilities/facilities, data management/archiving/real-time access and data submittal, configuration management and supporting tools, modeling and simulation processes, and risk management processes. The role of reviews in baseline management, and system validation and verification processes including failure/fix reporting and tracking.

3.4. Contract Data Requirements List (CDRL) and Data Item Description (DID). Contract Data Requirements Lists (CDRLs) and Data Item Descriptions (DIDs) may be tailored to the acquisition program in order to obtain contractor-produced documents that satisfy specific program needs.

- CDRL. In this section, identify any T&E related data products that the potential contractor must produce. This may include plans, metrics, reports, artifacts, raw test data, or other T&E documentation. The CDRL will delineate the specific M&S items, data products, and timelines to provide these to the designated OTA.
- DID. In this section include those DIDs applicable, if any, to the T&E effort. A DID is a completed document that defines the data required of a contractor. The document specifically defines the data content, format, and intended use.

- Each T&E team will have to determine the need for DIDs supporting their effort. To determine if a T&E DID already exists, you can go to the Acquisition Streamlining and Standardization Information System (ASSIST) website (**reference k**). ASSIST is the source of DoD specifications and standards. Examples of T&E DIDs are:
  - **DI-NDTI-80566A** – Test Plan. The Test Plan underlines the plans and performance objectives at every level of testing on systems or equipment. It provides the procuring activity with the test concept, objectives and requirements to be satisfied, test methods, elements, responsible activities associated with the testing, measures required and recording procedures to be used
  - **DI-NDTI-80809B -** Test/Inspection Report. This data item description (DID) contains the format and content preparation instructions for the data product generated by the specific and discrete task requirement as delineated in the contract.
  - **DI-NDTI-81585A -** Reliability Test Plan. This plan describes the overall reliability test planning and its total integrated test requirements. It delineates required reliability tests, their purpose and schedule. This document will be used by the procuring activity for review, approval, and subsequent surveillance and evaluation of the contractor's reliability test program.

3.5. Section M of the RFP (Evaluation Factors)

A successful offeror's proposal must respond to the requirements of the RFP. It must be responsive to the Section L, Instructions to Offeror. Section M, Evaluation Factors for Award, is the standard against which the proposal will be evaluated and forms the basis for selection. To a large extent the quality of the proposal is directly related to the clarity of the Government's delineation of the technical requirements in the RFP. During the proposal evaluation the Government team will establish the degree to which the contractor has implemented RFP requirements and proposed a sound technical program with high expectations for success. The following is a summary of eight T&E focus and evaluation areas during the proposal evaluation. This list is not meant to be all inclusive. Components should have specific proposal evaluation criteria.

Table 3-3 T&E Focus and Evaluation Areas

- **T&E "Best Practices"**
  - The TEMP addresses the T&E approach across the program life cycle.
  - The offeror has proposed event-based tests and reviews with entry, exit criteria, and measure of success criteria.
  - The reviews include participation by both Government and industry T&E Subject Matter Experts (SME).
- **Offeror's Capability**
  - The offeror's domain experience (both process and product) is applicable to the program.
  - Domain expertise coupled with application of offeror's "best practices" using experienced personnel.
  - Proven Past Performance (domain and process areas). The offeror demonstrates positive past performance that supports a high probability of T&E success on the program.
  - Provides an acceptable deficiency reporting process and database compatible with the Government's DR data requirements and database
- **T&E Planning**
  - Adherence and application of corporate "best T&E practices" is inherent in the T&E approach.
  - The TEMP is a foundation document that is integrated into the IMP/IMS.
  - The T&E processes are integrated within the management and technical framework.
  - OT&E and JITC requirements are addressed (such as. Critical Operational Criteria, Information Assurance, SoS interfaces both within the SoS and outside systems, Critical Mission Function (CMF)).
- **T&E Baseline**

  Processes and resources (people, test ranges/facilities, instrumentation, and domain infrastructure) are integrated to systematically mature the T&E performance baseline.
  - Requirements management and traceability processes support the evolving T&E performance baseline.
- **Metrics**
  - Product metrics are linked with T&E performance baseline maturity.
- **Incentives**
  - Incentives support maturing the T&E baseline and are linked to final product performance at delivery.
- **Cost and Schedule Realism**
  - Program budgets and cost estimates are realistic. There is a balance between cost, schedule, and performance.
  - Cost estimates and schedule support the T&E strategy and approach in the TEMP.
  - The program's critical path is actively managed.
- **T&E Data Access**
  - Ownership, control, timely access, and delivery of T&E data, to include raw test data, to support the evolving technical baseline are clearly established. T&E data are consistent with the program's technical and acquisition strategy.

3.6. Sections M and L of the RFP

In order to accommodate variations among the DoD components source selection processes, RFP format nuances, and differences among programs, the discussion of Sections M and L is segmented into four general factors.

- Management
- Cost Factor
- Past Performance Factor and
- Cost Factor or Pricing Data

Each of these areas includes a brief discussion of the topic and example language (in shaded boxes) that can be applied to program RFPs.

Section M of the RFP states the evaluation factors and significant sub factors, and there relative importance, that are the basis for selecting the source. Section M should be written before Section L and should be carefully structured to address only those elements determined to be keys to success. Taking into account early industry input, focus the Section M criteria on the source selection discriminators required to select the best value proposal with acceptable program risk. Do not include proposal evaluation criteria that do not add value to the source selection. Weigh each and every lesson learned from previous programs and RFPs (especially similar programs) when establishing RFP requirements.

Sections M and L should be specific to each program, giving consideration to the scope and the nature of the technical program, maturity of the relevant technology, critical subcontract or teaming efforts, software content and Commercial-off-the-Shelf (COTS)/Non-Development Item (NDI). The task for the Government team is to provide the one-for-one match between the Section M criteria that will be used to evaluate the technical information and the proposal instructions in Section L. Normally there are three primary considerations:

1. Offerors' plans for implementing and managing the T&E process,
2. Offerors' technical approaches (both program and specific product offering) including supporting data (trades and analyses), and
3. Offerors' past performance.

The most effective criteria are measurable and relevant to the program, traceable, and under the offeror's control. Following are nine questions the Government team should answer when developing specific program related criteria for Sections M and L:

- How can the evaluation team develop confidence that the offerors' proposed T&E solutions, including unprecedented high risk solutions (e.g., lack of proven technical maturity), will meet performance requirements and can be implemented within technology, cost and schedule baselines?
- How will the evaluation team establish an understanding of the offerors' T&E approach?
- How can the evaluation team understand whether the specific plans for implementing and managing the T&E processes were based on company best practices, domain experience and company maturity ratings?
- How will the evaluation team understand whether the T&E solution is adequately supported by trade studies, LDTs, analyses, modeling & simulations and demonstrations? How will the evaluation team determine if the supporting trade studies, LDTs, trade criteria and analyses are the results of the T&E process during proposal preparation? Is there objective evidence the offeror used the processes proposed for the program?
- How will the evaluation team determine that relevant and demonstrated past performance from other programs is applicable to the T&E processes to the proposed approach (e.g., successful performance on similar complex systems)?
- How will the evaluation team assess the maturity and application of the offeror's proposed processes in the proposal risk assessment?
- How will the evaluation team determine that the T&E costs and resources (especially, number of operators, sample size, tests, ranges, and usage schedule and sequence), proposed for the system/sub-systems are reasonable and realistic for the planned T&E approach?
- How will the evaluation team establish that the proposed offeror's T&E schedule and critical path analysis are realistic and represents the planned T&E approach consistent with the overall program schedule?
- How can the evaluation team understand the trustworthiness of any M&S proposed for use in the T&E process?

It is common practice to include a matrix in the RFP which correlates Section L to Section M so that it is perfectly clear what portions of the proposal will be used to evaluate each Section M evaluation criteria element. This also serves as a quick check to make sure that each element of the proposal tracks to source selection criteria. The following paragraphs include sample Sections M and L text for each subject that need to be integrated with the rest of the Sections M and L in the program's RFP.

3.6.1. Technical Factor

T&E team members should be involved in the review and assessment of the technical portions of the source selection. This review generally involves:

1. the offeror's proposed technical solution,
2. the technical data supporting the offeror's proposed technical solution and how it meets the specification requirements, and
3. the System Performance Specification (or equivalent)

The core of the technical evaluation centers on the offeror's system performance specification, the technical solution of the approach, and any supporting trade studies, LDTs, analyses, modeling, and demonstrations that have been requested in Section L.

Most RFPs request two general types of technical data: the description of the proposed solution, and trade studies and analyses. The proposed solution and resulting performance is program specific and represent the bulk of the technical data submitted. This section includes drawings, flow diagrams, technical descriptions, and pictures of the offeror's proposed solution. This information is important because it is, in essence, the result (end product) of the engineering processes to include DT&E processes implemented by the bidder during the proposal phase.

The trade studies and analyses (including modeling and simulations) provide substantiating data showing not only the performance but also the extent and scope of alternative solutions considered before arriving at the proposed solution and specification. A well-structured family of trade studies, analyses, and M&S that support the system configuration and its performance is objective evidence that the bidder has implemented his engineering processes described in other sections of the proposal. The Government should ask for a summary of the trade studies, LDTs, and analyses that discuss the scope of the alternative solutions and performance capability considered before arriving at the proposed solution and specification. Many times "why" something was discarded is as important as "what" was selected. The trade study, LDTs, and analysis data clarify the inner workings of the offeror's processes. The data demonstrate the application of the offeror's requirements analysis process and is evidence that:

- the offeror has engineering and T&E processes,
- have applied them in arriving at a solution, and
- when coupled with other documents in the proposal, are committed to continue the processes during execution of the contract.

Following are sample Sections M and L for the Supporting T&E Data which need to be integrated with the program unique part of Sections M and L.

Table 3-4 T&E Contents for Section M – Supporting T&E Data

Section M-Supporting T&E Data
This supporting T&E data factor (sub factor) is met when the offeror's proposal demonstrates the following: 1. The offeror conducted a series of trade studies, LDTs, modeling and simulations, and analyses that systematically evaluated the full range of alternatives. The results

support the technical and program requirements and validate the proposed configuration and its performance.

2. Trade study and LDT processes were uniformly and consistently applied and followed the offeror's documented corporate processes as applied to the program in the TEMP.
3. Trade study and LDT criteria addressed the critical cost, technology, risk, and performance requirements/constraints for the program.
4. Recognition that a Reliability Program Plan (RPP) is required to understand Government requirements and the need to design and test for product/system reliability.

Table 3-5 T&E Contents for Section L – Supporting T&E Data

Section L – Supporting T&E Data

The offeror shall provide a summary of the T&E trade studies any LDTs, M&S results, ensure product/system reliability and analyses that were accomplished to arrive at the proposed solution. The offeror shall discuss:

1. The trade studies, LDTs, analyses, models and simulations processes.
2. A summary of the trade studies and LDTs analyses results that support the proposed solution and program T&E approach.
3. A description of the trade study and LDT criteria, how they relate to the key performance requirements/constraints for the program, and the planned processes addressed in the TEMP. The data shall address the range of alternatives considered and the important results that support the T&E strategy and approach decisions.
4. The process for developing and implementing a Reliability Program Plan (RPP).

3.6.2. System Performance Specification

A preliminary system performance specification is normally included in the RFP that defines the Government's performance requirements for the system. The offeror normally responds with a system performance specification in the proposal. This specification includes the Government requirements plus any derived requirements necessary to describe the system-level performance. It may include allocation of requirements and should include corresponding verification requirements. The system performance specification should not include SOW language, tasks, guidance, and data requirements but should reference necessary industry and approved military Specifications and Standards. Offerors responding to the RFP have a tendency to "parrot" back the Government's preliminary system performance specification in the proposal. They are hesitant to revise the content and format, and are especially hesitant to respond with revised requirements for fear of being judged non-responsive. The Government should make clear in the solicitation that the offerors need to do so. If the Government is receptive to considering revised performance requirements (trade space) that are cost effective, then this has to be clearly delineated in the RFP along with an indication of how the "value" to the Government will be established and evaluated. The system specification will be included in the contract.

In past practice, one particular element of the System Specification has received limited emphasis—Section 4.0 Verification and Test. The offeror must supply more than a simple table indicating the method of verification (analysis, inspection, simulation, test or demonstration). Section 4.0 of the specification, along with the System Test Plan, IMP/IMS and TES/TEMP, should provide the insight to understand the method and extent of system verification. An incremental buildup approach to testing including the T&E success criteria for each increment starting at sub-systems of the system hierarchy, should support minimizing the system test events and activities. Section 4.0 of the System Specification should reflect this T&E philosophy. Following are sample Sections M and L for the System Performance Specification. These samples should be modified for the program and integrated with the rest of the RFP's Section M."

Table 3-6 T&E Contents for RFP Section M – System Performance Specification

Section M- System Performance Specification

The offeror's system performance specification will be evaluated in conjunction with the technical solution based upon the following:

1. Specification includes the key requirements and functionality identified in the RFP's preliminary system performance specification stated in performance terms.
2. Requirements are quantifiable, testable and measurable and are supported by mature technology.
3. Objective values (goals) are clearly identified and distinguished from firm requirements.
4. Operational environment is described and defined in which the system, System of Systems (SoS), and/or Family of Systems (FoS) operates.
5. Environmental and safety design requirements and/or constraints are specified.
6. Functional, electronic, physical, hardware, and software interfaces for the system are included.
7. There is appropriate use of Government and industry specifications, standards, and guides. When Government documents are referenced, only those that have been approved should be referenced.
8. Test, verification, and reliability approaches for all system requirements included in the specification are complete and appropriate.
9. The specification does not include unnecessary requirements/language. (Examples include: SOW tasks, data requirements, product or solution descriptions.)
10. The requirements are achievable within the planned program schedule and cost.

Table 3-7 T&E Contents for Section L – System Performance Specification

Section L- System Performance Specification

The offeror shall propose a System Performance Specification that meets the Government minimum requirements. The specification should be performance based and address the allocation of Government performance requirements plus any derived requirements necessary to describe the performance of the integrated system solution. It should not be a mere "parroting back" of the Government's preliminary system performance specification, but keyed and tailored to the individual solution of the offeror. Key elements to be addressed in the System Performance Specification are as follows:

1. Accurate and complete understanding of the key performance requirements (e.g., KPPs) in the Government's preliminary system performance specification included in the RFP.
2. Derived requirements necessary to document the system performance that will govern the design, development and test program. (e.g., critical technical parameters (CTPs)).
3. Identified and documented system level interfaces that define the operational, physical, hardware, software and functional interfaces that define the program external interfaces and constraints (e.g., approved operational, functional, and or system architectures).
4. Test and Verification section to the specification that delineates the approach to verifying performance, success criteria, and key characteristics to include reliability metrics.
5. A cross-reference matrix showing the tracking of Government performance requirements to the offeror's proposed system performance specification. The specification should be structured for the proposed system solution and not restricted by the structure of the Government's preliminary system performance specification*.

* In general, the offerors follow the structure and organization of the Government preliminary system peformance specification when preparing the proposal's System Performance Specification. This may lead to an awkward specification structure if the offeror's breakout of the product differs from the Government's top level breakout. It should be clear in Section L that the format of the Government preliminary system performance specification is to be followed or that the offeror has the latitude to restructure the specification to conform to its proposed technical approach.

As discussed in Section 2, the source selection technical evaluation is primarily focused on the offeror's proposed system performance specification, product offering technical solution description, and supporting data.

The following 11 area need to be considered during the technical proposal evaluation and must be consistent with evaluation criteria contained in Section M.

- All the critical or key requirements must be included within the specification.
- Goals are appropriately identified and differentiated from firm requirements. Goals do not have much standing as contract performance requirements.

- Specification requirements are stated in performance language.
- SOW tasks or data deliveries are not in the specification.
- The System Performance Specification Verification and Test Section (Section 4) should be more detailed than a table reflecting only a method of verification. There should be a one-to-one correlation with the Performance Requirements (Section 3) and it must reflect the engineering and test approach documented in other sections of the proposal.
- System hardware and software interface requirements should be identified and documented. They become constraints on the system that are critically important.
- Watch for "parroting" of the Government requirements without regard to substantiating evidence in the other sections of the proposal. A claim of performance without substantiating data is a technical risk.
- The product offering is complete, meets performance requirements, and is supported by hardware and software demonstrated in a relevant operational environment.
- The product reflects special design considerations such as, Modular Open Systems Approach (MOSA), safety, security, etc.
- Analyses, modeling and simulation, and trade studies support design decisions and technical approach to the program as defined in the offeror's T&E approach.
- The processes should systematically address the technical challenge. The effort should be comprehensive (e.g., include all relevant solutions, technologies, and/or alternatives) and address the areas of technical, cost, schedule, and risk.

3.6.3. Management Factor

Test and evaluation management, design, integration, and verification/validation processes are normally evaluated using a combination of the offeror's SOW, TEMP, IMP/IMS and management volume, as directed to be submitted with the proposal. The purpose of the evaluation is to establish:

- the offeror's domain current and past performance and experience,
- the stability and maturity of the offeror's T&E processes and best practices, and,
- that valid and complete approaches to test and evaluate the proposed system/sub-system are consistently integrated throughout the program.

An integrated example Section M is provided since there is significant overlap of all these elements. Individual Section L examples are included within each subsection. Following is a sample Section M for the Technical and Management Integration.

Table 3-8 T&E Contents for Section M – Technical and Management Integration

Section M-Technical and Management Integration

This factor (sub-factor) is met when the offeror's proposal demonstrates the following:

1. The program tasks are complete and include a comprehensive description of the engineering and test tasks. Technical and test planning is complete, supports implementation of the program's technical strategy and supports accomplishment of the requirements and objectives as contained in the proposed contract. Management of technical and performance baselines and requirements using a tool set applicable to the program.
2. Test and evaluation processes are mature, stable, and represent the program's application of corporate best practices and lessons learned.
3. Approach, tasks, processes, and procedures are flowed down to the subcontractors, vendors and other teammates. A trained workforce (familiar with the processes, practices, procedures, and tools) is available or in place to ensure accomplishment of the work.
4. Test and evaluation processes, products, and events are included in the IMP/IMS and reflect the program technical approach. The IMP narratives include the T&E processes and sub-processes, e.g., requirements management and tracking, performance baseline control, interface management, configuration management, test data management, validation and verification process, failure reporting and corrective action system, risk management.
5. The IMS clearly indicates the program's critical path and has acceptable schedule risk.
6. The test and evaluation meetings, test events, status reviews and design reviews are identified, participation established and timing/frequency necessary to monitor and control T&E progress and support the technical progress.
7. There is a single T&E authority responsible for program T&E direction with lines of responsibility and authority clearly established. Key personnel are assigned and personnel resources identified. The role of the Government (program office, supporting Government organizations, and user) along with the key subcontractors has been identified.
8. Computer-based or software tools that are used for T&E management are real time (near real time) and accessible to all program participants. Processes, procedures, and tools for test data archiving and data deliveries are secure and accessible to appropriate program participants. The tasks, activities, and methods to facilitate Government's timely access to the necessary program T&E.
9. System-level T&E reviews and meetings are adequate to monitor and control T&E progress in support of the technical progress. IMP events include T&E milestones consistent with the technical and support strategy for the program. There is a sound approach to event-based reviews.
10. Test and evaluation product metrics address the key product performance requirements. The "leading and lagging" metrics provide past progress, current status to aid day-to-day management of the program for timely decision, and future projections. Root cause analysis processes are in place to continually improve the T&E processes and sub processes. Tracking and reporting T&E progress and performance metrics at major program reviews to ensure consistent application and continuing maturity of essential program processes (technical, configuration and data management, quality, subcontractor management, manufacturing, risk management, test and verification.)
11. Program working groups are established that effectively involve program participants to improve coordination with supporting organizations and streamline T&E and other decision-making.
12. Program's TEMP represents a sound integrated T&E approach. These are based on corporate procedures and address the critical T&E areas within the program. The plans are flowed down to the teammates, subcontractors and vendors involved in the program. The plans are consistent with the SOW, SEP, IMP/IMS, and other program management plans and processes to support critical path analysis, EVM, risk management.
13. The basic principles and T&E approach stated in the TEMP are modified and or expanded, as necessary, throughout the program's life cycle.
14. The TEMP and the integrated T&E schedule follow the direction and guidance as defined in DoD 5000.1, DoDI 5000.02, and the DAG.

This factor is typically evaluated using a combination of the offeror's SOW, SEP, IMP/IMS plus IMP Narratives and Management Volume. Section L of the RFP describes in detail the contents of each volume of the proposal.

3.6.4. Price or Cost Factor

Government source selection teams have placed more emphasis on evaluating the reasonableness of the offerors' proposed price or cost. There has been considerable emphasis on cost estimating, parametric analysis, Basis of Estimates (BOEs), and using historical and past performance data on topics such as software code, hardware design complexity, T&E, and manufacturing costs. However, T&E tasks and costs have not been subject to the same analytical attention or scrutiny over the years. T&E personnel should consider the following five areas in support of the cost proposal evaluation.

- The T&E cost estimates correlate with the proposed solution and T&E program. Make sure the program proposed is the one in the cost estimate and that it is reasonable and realistic. The program cost, schedule and performance must be balanced and synchronized.
- The processes, the organization, T&E tasks, and products proposed in other sections of the proposal are adequately resourced and included in the cost.
- Cost estimates for T&E work and products are supported by the offeror's domain experience and past performance.
- T&E manpower estimates and Basis of Estimates (BOE) must be adequate and reasonable for the organization, tasks and schedule as reflected in the IMP/IMS and SOW. The skill level of the proposed manpower should reflect the complexity of the tasks. BOE supporting rationale should be based upon credible historical data, past experience, and/or expert judgment.
- Time phasing of the resources (manpower, facilities and infrastructure) must be consistent with the IMP Events and the IMS tasks and the TEMP's T&E approach.

Since costs are normally provided by WBS element, the Program WBS is a valuable tool in understanding the cost proposal. The Government normally includes a Program WBS (PWBS) (based on MIL-HDBK-881) in the RFP. This PWBS must contain elements for T&E tasks along with the other elements (e.g., product, engineering, and sustainment). The RFP directs offerors to expand this Government PWBS into a Contract WBS (CWBS).

3.6.5. Past Performance

In a competitive environment, the Government relies upon the offeror's past performance record to demonstrate that the team possesses the skill and experience to perform well on the new contract. To gain this confidence, source selection groups, such as the Air Force's Performance Confidence Assessment Group (PCAG) utilize a structured approach driven by the respective Source Selection Evaluation Criteria to ensure it fully understands each offeror's strengths and weaknesses. This, in turn, will allow the source selection team to project how those strengths and weaknesses will affect the proposed effort. Test and evaluation planning, leadership and execution must have a prominent role in the Section M Factors and Sub-factors and it must be considered in the past performance evaluation. A contractor with experienced personnel in the applicable domain, bolstered with a credible past performance record, should result in better contract performance (e.g., lower risk and cost while still achieving the user's performance requirements). Following is a sample Section M followed by a sample Section L for the Past Performance.

Table 3-9 T&E Concerns for Section M – Past Performance

Section M-Past Performance
The source selection group conducts a past performance assessment which evaluates the offeror's relevant experience as a prime or subcontractor, as well as the performance demonstrated by divisions and subcontractors who will participate in contract performance if the offeror's proposal is selected. Based on the assessment the source selection group determines a confidence rating indicating the probable level of successful performance in planned effort; and identifies issues that may be a concern for the procurement.

Following is an example of typical past performance confidence assessment criteria and rating scale. Components may have their own and more expansive assessment criteria, especially when considering C4ISR systems, SoS, or FoS experiences.

Table 3-10 Example of a Rating Scale for Past Performance

	Performance Assessment Criteria
Rating	**Description**
High Confidence	Based on the offeror's performance record, the Government has high confidence the offeror will successfully perform the required effort.
Significant Confidence	Based on the offeror's performance record, the Government has significant confidence the offeror will successfully perform the required effort.
Satisfactory Confidence	Based on the offeror's performance record, the Government has confidence the offeror will successfully perform the required effort. Normal contractor emphasis should preclude any problems.

	Performance Assessment Criteria
Rating	**Description**
Unknown Confidence	No performance record is identifiable.
Little Confidence	Based on the offeror's performance record, substantial doubt exists that the offeror will successfully perform the required effort.
No Confidence	Based on the offeror's performance record, extreme doubt exists that the offeror will successfully perform the required effort.

Table 3-11 T&E Concerns in Section L –Past Performance

Section L-Past Performance
A source selection group is convened to accomplish a performance risk assessment of offerors' relevant contract performance. The offerors' T&E performance record determines what level of confidence the source selection group has in the ability of each offeror to perform all aspects of the Contract, to include T&E. Offerors must submit information on contracts considered relevant in demonstrating the ability to perform the proposed effort including rationale supporting the assertion of relevance. Section M evaluation Factors and Sub-factors will be used to evaluate past performance and assess performance risk.

Most past performance assessments include a questionnaire that requests specific information relative to a contractor's past performance from selected previous customers of the offeror. Questions specifically for technical planning, leadership, T&E, and execution should be included when appropriate. See attachment C for a sample questionnaire.

Not all contracts included in the offeror's Past Performance Volume need to be "highly relevant" to past performance but a few examples should be highly relevant to the planned effort. See the FAR 15.305(a) (2) regarding evaluating past performance mandatory and discretionary requirements. However, having limited T&E of a similar system, past performance results, or lack of domain experience can be a serious risk.
The T&E team need to consider the following six areas in support of the past performance proposal evaluation.

- Focus on those contracts that are “relevant or highly relevant” and closely evaluate that the performance is clearly applicable to the proposed program. Contracts that are similar in scope, apply the same corporate processes, and present successful results are the most powerful evidence of past performance.
- Review the allocation of T&E tasks to teammates and subcontractors and determine that their T&E experience is relevant and connected to the past performance examples.
- Most Past Performance evaluations include a questionnaire that is sent to select previous customers. Evaluate responses against the Technical and Management Evaluation Criteria in Section M.
- Systems engineering and associated T&E is a required element in government acceptable contractor performance assessment reports. This information is available to the past performance evaluation team. Trends and systemic issues across several contractor performance evaluations may indicate potential strengths and/or weaknesses in expected performance.
- For any program rated low, determine if there is a “corrective action” plan between the Government and contractor and if the corrective action is on schedule. Low contractor performance assessment rating with no “corrective action” plan is a “red light” and risk indicator.
- The team should evaluate, not only the information provided by the offerors, but information obtained from other sources (e.g., CPARs, questionnaires, internal Governmental information).

3.6.6. Proposal Risk Assessment (T&E Risks). Normally the source selection team establishes a proposal risk for each of the factors established in Section M. The proposal risk is typically established at the factor level, e.g., technical and management; however, the risks are identified at the sub-factor level and summed to the factor during the evaluation. This risk assessment establishes the risk associated with the offeror’s proposed program to include the technical approach, technical performance, testability and measurability of the performance requirements, management approach, application and integration of management and technical processes, program schedule, and cost/resource allocations. The following is a list of nine considerations when assessing the risks during the proposal risk assessment.

- Claims of performance are supported by credible analyses, trade studies, LDTs, and/or modeling and simulation results.
- The offeror’s domain experience supports the program approach and the T&E challenges on the program.
- The T&E processes and best practices are mature and stable, modifications to the standard processes (as reflected in corporate procedures) are appropriate to the program, and should not increase cost, schedule or technical risk.

- T&E processes, described in the TEMP, are stable and mature (including technical hardware and software readiness levels (TRLs) maturity ratings, e.g., for MS B a TRL of 6 is required) and corporate plans for continued process improvement.
- The key T&E processes determined critical to program success have been integrated into the program management and T&E approach. Examples include: configuration management, requirements management, performance baseline control, risk management, technology insertion/obsolescence planning, modeling and simulation planning. These are flowed down to teammates, subcontractors, and vendors.
- The T&E processes, as appropriate, are integrated with the other functional processes.
- The risk associated with executing the T&E activities have been evaluated with respect to their relationship to the program's critical path.
- The risk associated with the offeror's costs are consistent with their proposed T&E effort, tasks and products, organization and personnel resources, personnel experience levels.
- The T&E program schedule is reasonable and realistic and is consistent with the planned execution of the program; the T&E activities are on and near the program's critical path, and the supported by the offeror's past performance.

4.0. CONTRACT EXECUTION

The contents of this section will help you focus on and consider the most important contractual T&E items as you transition from the solicitation phase to contract execution.

The key to contract success is sound leadership, sound planning, and application of the contractor's corporate processes during execution. The T&E processes will develop, capture, document, and archive all of the T&E data. The T&E processes must be tightly integrated with the engineering and management processes and schedules that control the conduct of the program which will ultimately define, produce, and deliver the product to the user.

Program start up can be hectic. New personnel are assigned; facilities are being established and during all this turmoil, real program work needs to be accomplished. Program startup and personnel ramp-up are almost always risk areas. It is essential that the program quickly transition into execution. During the first few weeks after contract award it is important that the Government and contractor T&E team have an interactive face-to-face meeting, usually the kick-off meeting, and the T&E leaders step forward and set the tone for the program. Focus areas during initial meetings with the contractor should include the following seven topics:

- Leadership completing the merger of the Government and contractor T&E personnel into a functioning integrated team; recognition of the responsibilities inherently residing with the contractor and Government (program office, user, evaluator, tester and DCMA).*
- Review of the program T&E strategy and approach.
- Review of the system performance specification, KPPs, and CTPs, to ensure a mutual understanding of the functional baseline.
- Reinforcement of the importance of implementing the contractor's T&E "best practices" and domain experience
- Review and establishment of the initial set of T&E product and process metrics.
- Review of the plans for event-based reviews (along with entry, exit, and measure of success criteria) documented in the IMP; review of the technical tasks and resulting products documented in the IMS; and ensuring T&E correlation with the SEP, IMP/IMS, and the EVMS in preparation for the Integrated Baseline Review (IBR).
- Review of and discussion of all the source selection T&E related findings to ensure they are resolved.

* There are different teaming arrangements in which T&E SMEs participate. There are oversight teams, requirements teams, program management teams, and then program specific teams such as combined T&E Task Force (CTF), combined test teams (CTTs) or integrated test teams (ITTs). Regardless of the team's title, the team can have a T&E

specific focus, or not. The charter is the key document to define the team structure and should list the roles, responsibilities, products, and membership.

4.1. Test and Evaluation Team

At contract award the Government/contractor T&E team must begin the integration into an organizational structure to promote the execution of the program's T&E processes and products. The authority for the Government and contractor must be clearly established. The contractor has likely identified a planned organizational structure in their proposal. The roles and responsibilities of Government personnel within the program's structure have to be defined and working relationships established. One of the first tasks is to make the appropriate assignments of Government personnel and to get the team physically together so introductions and working relationships can be established at the onset. If the program organization includes a T&E IPT, it is often responsible for delivery of the completed TES and or TEMP and is responsible for the functioning of the T&E processes across the program. It must be a strong team, staffed with experienced personnel from both Government and the contractor. The respective team uses the approved performance baseline (e.g., APB criteria) that is allocated to the product/system. It is the team responsibility to support the many major system reviews (SRR, SFR, PDR, CDR, etc.) with T&E results, and risk assessments which will support the evolving technical baseline and product/system definition. Government participation on the respective teams is generally governed by the following eight guidelines:

- The Government *does not* lead or manage the contractor's T&E effort.
- Government participants serve primarily as "customer representatives" and one of their contributions is to reduce the cycle time of contractor/Government communications and decisions. The Government participants are there to facilitate the Government's acquisition related guidance and direction to meet program commitments in a timely manner.
- They convey their knowledge/expertise on T&E strategy, performance requirements; operations, maintenance and other important topics.
- They interface and coordinate the activities with other Government organizations that participate in the program, ensuring they understand the overall T&E approach and their participation supports program objectives.
- They control and facilitate identification and delivery of Government Furnished Equipment (GFE), Government supplied data and services.
- They should be participants in the risk management process.
- Government IPT participants can offer personal and expert opinion from the customer's perspective; however, they cannot authorize any changes, waivers, or deviations to or from the contract requirements, which must be made by the contracting officer.
- Government IPT members cannot authorize contractors to perform work that is beyond the contract. Any such changes must be made by the contracting officer.

4.1.1. T&E Team Responsibilities

The contract defines the responsibilities of the contractor versus the Government. However, the contract should not be expected to address all of the roles and responsibility issues that arise during the test program execution. It is the responsibility of all parties, but especially the Government representatives, to understand the roles, authority, and span of control of each of the team representatives. The contractor is only required to execute the contract, and not required to do anything above that minimum requirement. If the contractor has total system performance responsibility, then they also have responsibility for any interface issues that may arise. The contractor should have responsibility for identifying any interface issues that may arise involving other contractors or with Government furnished equipment or supplies. Otherwise, the issue of responsibility for addressing interface issues will need to be worked out on an ad hoc basis.

Other common issue areas include the providing of people, spares, and consumables. The responsibilities for data authentication and data access also need to be addressed. Who will capture the raw data and convert into useful data products? If the contractor is responsible for first generation data processing (data authentication process), will they only be responsible for the data that they intend to analyze, or will they be responsible for processing all data and providing it to the appropriate Government or contractor for analysis and evaluation? The contractor may interpret their responsibility as only providing data authentication services for specification compliance related data, where the Government may have assumed that the contractor would have provided authentication for all data. In this case, it may help to make it clear that while the contractor will have to provide data authentication services for all test participants, they will only be responsible for analyzing the data that is necessary to show compliance with the contract.

4.1.2. T&E Team Participants and Roles

The participants in the T&E team are anyone and everyone necessary to successfully execute the test program, or that has a stake in the outcome of the test program (i.e. Joint Forces Command (JFCOM)). Different acquisition programs may have several teams working T&E issues, but the basic issues to be addressed are management and execution. The T&E WIPT is generally the team that addresses the strategy and overall management of the T&E program, while a Combined Test Force (CTF) or Integrated Test Team (ITT), or something similar, will handle the execution of the test program. The T&E WIPT will include all stakeholders for the strategy and status of T&E. At a minimum, T&E WIPT participants include the program manager and staff representatives, oversight organizations, contractor and major subcontractors, the responsible test organization, Operational Test Agencies (OTA's) system evaluator, and appropriate user representatives. The ITT or CTF participants include the responsible test organization, the OTA, and the contractor. These three major groups will provide the day-to-day management, execution, and logistics support necessary to plan, execute, analyze data, and report test results. As you can see from the list of participants, all of these teams represent different perspectives and perhaps different detailed objectives, so good team management skills will be necessary to establish common goals, deconflict roles and responsibilities, and execute a timely, efficient, and effective T&E program.

4.2. Contractor Performance Information

The FAR Part 42.15 identifies the requirement to record and maintain contractor performance information. DoD policy requires the periodic assessment of contractor past performance. Most Components use the Contractor Performance Assessment Report (CPAR), which should be a valuable tool to evaluate contractor past performance during source selections. Other Components should have some form of accepted documentation to record and maintain contractor performance information. Poor performance documented in the CPAR, or other contractor performance document, will influence source selection decisions and can result in non selection. Excellent performance can significantly enhance the likelihood of winning a future source selection. Contractors are very sensitive to these facts and usually are motivated to improve poor performance. Used correctly and actively, contractor performance information can be an excellent management incentive tool.

4.3. Award Fee Implementation

There are several award fee activities that may require T&E involvement to sustain contractor and Government attention and interest in successful execution of the T&E approach to the program. These include interim and final evaluations for each award fee period, establishment of criteria for the upcoming terms, and providing feedback to Government officials and the contractor. It is particularly important to develop well defined criteria applicable to each term, especially when award fee is rolled over (an element of many award fee plans is the ability to "roll-over" unearned award fee money from one period to another[reference l])to a subsequent term. The DFARS, Service Supplements and guides provide details regarding administration of award fee programs.

4.4. Defense Contract Management Agency (DCMA) Support

The fundamental responsibility of DCMA is to:

- assess compliance with contractual terms for cost, schedule and technical performance in the areas of design, development and production, and,
- evaluate the adequacy and perform surveillance of contractor engineering efforts that relate to design, development, production, subcontract management, reliability & maintainability, configuration management.

Since DCMA is normally onsite with the contractor they are uniquely situated to be involved in the day to day contractor activities. They are intimately familiar with the inner workings of the contractor's capability, processes, personnel and facilities. They can be the "eyes and ears" of the program office and can be a valuable asset to the Government

Test and Evaluation Lead. As part of the pre-contract activity, a Memorandum of Agreement should have been coordinated with the DCMA field office detailing their specific tasks related to program participation after the contract is issued. This activity should include how DCMA will participate in the execution of the T&E processes, and enlisting DCMA's support in the implementation of various management tools/systems (WBS, IMP, IMS, EVM). The following three topics should be clearly addressed early in the T&E strategy development effort, as appropriate, to the product/system under development.

- Production Acceptance T&E. DCMA usually is responsible for production acceptance testing. This responsibility and process should be verified and captured in the T&E process and approach.

- Flight Release. DCMA usually issues the flight release (in the case of aircraft programs), that permit even developmental test aircraft to enter the flight test program. This responsibility and process needs to be captured early in the T&E effort and schedule for the decision points that lead up to issuance of the flight release.

- Contractor Personnel Management. DCMA will sometimes be the approving authority for contractor flight crews to fly in developmental tests. This issue and the relative DCMA processes and policies regarding training and certifying contractors to operate the system being developed must be captured early in the T&E process and approach.

4.5. Test Operations

The actual execution of test events presents numerous contractor/Government detail-type issues that must be addressed to successfully complete the program, and the contract. The following items are potential conflict areas, and should be addressed early, to ensure clarity and completeness as to contractor and Government responsibilities and expectations for the T&E effort throughout the acquisition process. These areas may or may not be specifically spelled out in the contract, but should have been considered during the preparation of the SOW in some form or fashion.

4.5.1. Test Personnel

Since contractor and Government personnel work closely together during the execution of test events, it is important to have a clear understanding of what each party is providing in terms of personnel, and how they will be managed. The skill sets needed for executing the program need to be identified prior to the start of the test program. Depending on the product/system under test there may be a requirement for some specific skills sets to fully exercise the product/system. Once the personnel requirement is established then the source of the personnel should be clearly established. For example, which skills will the contractor acquire for the test program, or from the Government? In some programs, the contractor brings the test managers and the Government provides the maintenance personnel. Whatever the actual arrangement is between contractor versus Government supplied personnel, clear expectations need to be set as to skill sets and quantity of personnel. Additionally, the contractor and Government management role and responsibilities must be clear. Do contractor personnel supervise Government personnel? – If so, what are the rules of engagement such as work hour expectations and disputes? Do Government personnel oversee contractor personnel – if so, how do we keep from unintentionally making constructive changes to the contract? For operational testing and evaluation, Title 10 USC 2399(d), Impartiality of Contractor Testing Personnel, specifically prohibits system contractor involvement in the conduct of the operational test and evaluation unless the Secretary of Defense plans for persons employed by that contractor to be involved in the operation, maintenance, and support of the system being tested when the system is deployed in combat. Consequently, system contractor personnel may not participate in data authentication groups (DAGs) or reliability, availability, and maintainability (RAM) scoring conferences, nor act as data collectors, reducers, or processors.

4.5.2. Test Safety Issues

The actual testing of equipment in a lab or on a test range introduces personnel safety issues and concerns. For example, the F-16 used hydrazine, a toxic chemical, to power the emergency power unit. When the emergency power unit was tested on the ground, it exposed the ground personnel near the aircraft to a potentially hazardous environment from hydrazine in the power unit exhaust, and when hydrazine was spilled during servicing of the aircraft, the safety related aspects were not clear in terms of how to clean it up, safe exposure levels, etc. So the Government and contractor roles and responsibilities for the conduct and approval of test-related safety issues and analysis need to be clearly defined. Note that in addition to safety analyses for personnel and test article risks, these analyses should also address environmental impacts related to the conduct of tests. Some of these environmental issues are at the state and local level, so the complete list of environmental laws may not be known prior to contract award, so the contract needs to allow for these types of analyses and impacts to the execution of the test program.

4.5.3. Risk Acceptance Authority

The conduct of safety analyses will assist in identifying and clarifying the risks involved in the test program. Detailed test planning should establish test conditions and test procedures which should mitigate most of the significant risks. However, some residual risk will remain, and the question then becomes one of who has the authority to accept the residual risk and allow the test to proceed. The approval authority can be different, depending upon the levels of risk established (e.g. low, medium, or high risk). For example, most flight tests involve a routine or relatively low level of residual risk, so the operations officer or the test team lead has the authority to approve a flight with that level of risk. However, flight tests such as high angle-of-attack (or stall) testing are usually considered to be high risk tests, since the aircraft behavior in the stall regime is not well known, and the risk of losing the aircraft is very likely. In this case, the range commander, or their equivalent, would be the approval authority to fly that particular test event. Since the approval (or lack of approval) to conduct tests is not within the contractor's control, the contract needs to account for that possibility. Components may use different risk matrixes, such as 3-tier versus 4 tier or dollar/injury/mission impact thresholds. These different matrixes may also have their own risk decision authority decision levels. This becomes very important when contracting for a program that will cross DT and OT lines, as well as Multi-Service Operational Test and Evaluations (MOT&Es).

4.5.4. Accident/Incident Investigation/Reporting

In the unfortunate event of an accident or incident, the accident / incident reporting and investigation procedures and process must be clearly defined. This process should include authority, documentation, and who is accountable for the test article in case of an accident/incident; for example, if a test aircraft crashes, who is going to be held responsible for that test article? Will the accident investigation be conducted according to Government procedures, or contractor? How is the contractor expected to support the accident investigation? Will the Government indemnify the contractor for the loss of the test asset, or is the contractor expected to procure insurance to cover the risk of losing the test asset?

4.5.5. Detailed Test Planning

This area refers to detailed test plans, or the test plans that are actually constructed and used to execute the test events and acquire the necessary data. Higher levels of test planning, such as T&E strategies and system level test plans, have more of a management focus and insufficient detail to actually execute a test event. So when it comes to actual test operations, the detailed test plans drive the actions of the testers. Therefore, the roles and responsibilities for the development of detailed test plans must be defined. This area includes: processes for detailed test planning, especially with integrated testing; who writes the test plan; and who approves the test plan. A key consideration is when the contractor writes the detailed test plans, how does the Government ensure that the contractor does not become responsible for doing more testing than required for the contract? This is part of defining the Government's role in approving detailed test plans.

4.5.6. Test Execution

The roles and responsibilities for the actual conduct of a test must be defined. Essentially, define who controls the conduct of tests – Government or contractor, or shared. This area includes such items as deleting or adding test points, expectations for a particular priority when it comes to range or range asset availability, and will there be a contractor or Government run-through of the data collection instrumentation prior to the actual test to verify operational status

4.5.7. Test Data Access, Authentication, and Sharing

The access to, process for authentication, and sharing of all test data must be clearly established. There should be no restrictions to Government access to all test data and agreement on the process to authenticate test data. The contract should clearly describe the collection, authentication, and availability process. If a data authentication group (DAG) is established, define the leader, where the data will be stored, and how the authenticated data will be made available for all stakeholders. This is an area that will potentially invoke contractor intellectual property issues, so that part of the contract needs to be clearly understood by the test team.

4.5.8. Test Data Analysis and Evaluation

Data analysis and evaluation responsibilities, process, and products must be identified and adhered to throughout the testing effort. The process should clearly identify what the contractor is responsible for versus the Government and the process for adjudicating conflicting evaluations. Especially in the case of integrated testing, there will be a lot of data collected. The contractor should only be responsible for analyzing sufficient data to demonstrate compliance with the specification and statement of work. This is an area that requires a very clear contractual understanding and specifics identify the type, format, schedule, and approving and coordinating authorities for all T&E reports. The contractor reports should be listed as contract deliverables, for example, if the government is expecting or relying on a contractor report to satisfy an acquisition milestone or decision review, then that needs to be communicated to the contractor.

4.6. Change Management

Change is inevitable in any test program. Changes to product/system performance criteria (such as: new requirements, deviations and waivers to existing performance criteria) have to be clearly and completely documented, incorporated into the contract, and adhered to. There should be an approved change management process defining the authority controlling the change process and configuration management of test assets. This is sometimes called a configuration control process, but a distinction needs to be made between the configuration control process that is part of the systems engineering process and focused on the design configuration; and the configuration control process that is focused on test asset configuration. The latter will include design changes in addition to deviations or waivers resulting from the production process, and even changes to the test instrumentation. The integrity of the test results rests on understanding and maintaining control of the configuration of the test assets as the test program progresses. Unknown or undocumented configuration changes can invalidate data and introduce safety risks. This is especially true with software changes. For more specifics on this topic see FARS Part 48 – Value Engineering at:
http://www.acquisition.gov/far/current/html/FARTOCP48.html

4.7. Reporting

This is an area that requires a very clear contractual understanding and specifics. Identify the type, format, schedule, and approving and coordinating authorities for all T&E reports. The contractor's reports should be listed in the contract as CDRL. For example, if the Government is expecting or relying on a contractor report to satisfy an acquisition milestone or decision review, then that needs to be communicated to the contractor and perhaps clauses made in the contract to incentivize the contractor to make that happen.

5.0 Summary

This Guide provides you the major T&E items and or requirements to consider as you develop and or review a SOO, SOW, RFP, and contract. The various lists provide you a baseline for discussions, decisions, and review for T&E items and or requirements. These lists, coupled with your Component's specific T&E contractual direction, guidance, and requirements should help you address all the necessary T&E contents for a SOO, SOW, and RFP for your program. As mentioned in the beginning of this Guide --the key understanding to remember is that if a T&E item or requirement is not in the SOW, it probably will not be in the RFP, and if not in the RFP, it probably will not be in the contract. If it is not in the contract – ***do not expect it!*** You must be involved early and stay involved with the PM, the SE, and the other PMO leads throughout the contracting process to ensure the T&E policies, practices, procedures, and requirements are understood, accepted, and included in the contract as necessary for program success.

Attachment A – Acronym List

AFARS	Army Federal Acquisition Regulation Supplement
AFFARS	Air Force Federal Acquisition Regulation Supplement
AIS	Automated Information System
AOA	Analysis of Alternatives
AT&L	Acquisition, Technology and Logistics
BOE	Basis of Estimate
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAD	Computer Aided Design
CDD	Capability Definition Document
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CLIN	Contract Line Item
CMF.	Critical Mission Function
CONOPS	Concept of Operations
COTS	Commercial Off-the-Shelf
CPAR	Contractor Performance Assessment Report
CR	Concept Refinement
CTT	Combined or Contractor Test Team
CTF	Combined T&E Task Force
CTP	Critical Technical Parameters
CWBS	Contract Work Breakdown Structure
DAG	Defense Acquisition Guidebook or Data Authentication Group
DCMA	Defense Contract Management Agency
DFARS	Defense Federal Acquisition Regulation Supplement
DIACAP	DoD Information Assurance and Certification Accreditation Process
DID	Data Item Description
DoD	Department of Defense
DR	Deficiency Reporting
DT&E	Development, Test and Evaluation
EVM	Earned Value Management
FAR	Federal Acquisition Regulation
GEIA	Government Electronics and Information Technology Association
GOTS	Government Off the Shelf
IA	Information Assurance
IBR	Integrated Baseline Review
ICD	Initial Capabilities Document
IEEE	Institute of Electrical and Electronic Engineers
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IOT&E	Initial Operational Test & Evaluation
IPT	Integrated Product Team
ITT	Integrated Test Team
JCIDS	Joint Capabilities Integration and Development System

JFCOM	Joint Forces Command
JITC	Joint Interoperability Test Command
KO	Contracting Officer
LDT	Limited Development Test
LFT&E	Live-Fire Test &Evaluation
M&C	Monitor and Control
MDA	Milestone Decision Authority
MOSA	Modular Open Systems Approach
MOT&E	Multi-Service Operational Test and Evaluation
M&S	Modeling and Simulation
NDI	Non-Developmental Item
NR-KPP	Net-Ready Key Performance Parameter
OTA	Operational Test Agency
OT&E	Operational Test and Evaluation
OUSD	Office of the Under Secretary of Defense
PCAG	Performance Confidence Assessment Group
PDR	Preliminary Design Review
PGI	(DEFARS) Procedures, Guidance, and Information
PWBS	Program Work Breakdown Structure
RAM	Reliability, Availability and Maintainability
RFI	Request for Information
RFP	Request for Proposal
RMP	Risk Management Plan
RPP	Reliability Program Plan
RTM	Requirements Testability Matrix
SDD	System Development and Demonstration
SEP	Systems Engineering Plan
SFR	System Functional Review
SME	Subject Matter Expert
SOO	Statement of Objectives
SOW	Statement of Work
SRR	System Requirements Review
SSP	Source Selection Plan
TD	Technology Demonstration or Technical Data
TDS	Technology Development Strategy
TEMP	Test and Evaluation Master Plan
TPM	Technical Performance Measurement
TRR	Test Readiness Review
TSPR	Total System Performance Responsibilities
VV&A	Verification, Validation, and Accreditation
WBS	Work Breakdown Structure

Attachment B - References

a. Defense Acquisition University (DAU) Test and Evaluation Management Guide, January 2005 (http://www.dau.mil/pubs/gdbks/test_evalu_guide.asp)

b. DFARS websites: http://www.acq.osd.mil/dpap/dars/dfarspgi/current/index.html; DFARS Procedures, Guidance, and Information (PGI) Web Site http://www.acq.osd.mil/dpap/dars/pgi/index.htm

c. Defense Acquisition University's Acquisition Community Connection https://learn.dau.mil/html/clc/Clc1.jsp?cl=

d. Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide V0.9, October 21, 2005 (http://www.acq.osd.mil/sse/docs/IMP_IMS_Guide_v9.pdf)

e. FAR website: http://www.acquisition.gov/comp/far/index.html

f. Defense Acquisition University's Acquisition Community Connection Practice Center web site: https://acc.dau.mil/CommunityBrowser.aspx

g. USD (AT&L), subject: Final Report of the Defense Science Board (DSB) Task Force on Developmental Test and Evaluation, dated June 6, 2008.

h. Defense Acquisition University's Acquisition Community Connection web site for sample RAM contract language https://acc.dau.mil/CommunityBrowser.aspx?id=219127&lang=en-US.

i. OUSD(AT&L) memorandum, subject: Proper use of Award Fee Contracts and Award Fee Provisions, April 24, 2007

j. OUSD(AT&L)A/T and DOTE memorandum, subject Definition of Integrated Testing, April 25, 2008

k. Acquisition Streamlining and Standardization Information System (ASSIST) website -http://assist.daps.dla.mil/online/start/

l. OUSD(AT&L) memorandum, subject: Award Fee Contracts FAR 16, DFARS 215, DFARS 216, March 29, 2006

m. Defense Acquisition University's "Award and Incentive Fees" Community of Practice (CoP) website: https://acc/dau.mil/awardandincentivefees.

n. Office of the Deputy Under Secretary of Defense for Acquisition Reform, "Incentive Strategies for Defense Acquisitions" dated April 2001.

Attachment C – Sample Checklist for Evaluating a Reliability Program Plan (RPP)

Checklist is not meant to be all inclusive, but rather, a tool to guide your discussions and decisions relative to RAM planning, accountability, and reporting for your program.

Reliability Program Plan (RPP)

- Implements with appropriate methods, tools, and Best Practices, the Reliability Activities described herein in order to accomplish the four objectives?
- Includes procedures for verifying planned Reliability Activities are implemented?
- Manage risks due to new technologies?
- Includes decision-making criteria and plans for intensifying reliability-improvement efforts?
- Periodic updates coordinated with customer/user?

System Reliability Model

- Build & refine model throughout the life cycle?
- Routinely update model as failure definitions are updated, failure modes are identified, operational & environmental load estimates are updated, and as design or manufacturing changes are made?
- Detailed component stress & damage models included?
- Model used to (1) update allocations, (2) aggregate reliability, (3) ID single points of failure, (4) identify reliability-critical items and the need for additional design or testing activities?

Systems-Engineering Integration

- Reliability Activities integral to system engineering process throughout life cycle?
- Reliability-improvement actions routinely incorporated during design, production, and in the field?
- Reliability impact of design changes and supplier change notices monitored & evaluated throughout the life cycle?
- Manage and control reliability-critical items?
- Design rules that impact reliability adhered to?

System-Level Operational & Environmental Life-Cycle Loads

- Develop and periodically update load estimates throughout life cycle?
- Estimates verified on instrumented systems/products with operationally-realistic conditions applied in time for Reliability Verification?
- Use estimates in reliability modeling, assessment, verification?
- Coordinate estimates with Systems Engineering?

Life-Cycle Loads on Assemblies, Subassemblies, and Components

- Develop and periodically update these load estimates based on operational & environmental loads applied at the system-level?
- Verify load estimates on instrumented systems/products/assemblies with operationally-realistic conditions applied?

- Flow down estimates and updates to designers, integrators of commercial-off-the-shelf (COTS), non-developmental items (NDI), government-furnished equipment (GFE), and suppliers?
- Use estimates to identify failure modes & mechanisms, and in assessments and verification?

Identify and Characterize Failure Modes & Mechanisms

- Identify failure modes & mechanisms throughout the life cycle?
- Begin to identify failure modes & mechanisms as soon as development begins using realistic life-cycle operational & environmental loads in conjunction with engineering- and physics-based models?
- Teams developing assemblies, subassemblies, and components for system identify and confirm failure modes and distributions with analysis, test, or accelerated test?
- Teams selecting/integrating assemblies, subassemblies, and components for system (including COTS, NDI, and GFE) identify and confirm failure modes and distributions with analysis, test, or accelerated test?
- Identify and confirm failure modes induced by manufacturing variation and errors?
- Identify and confirm failure modes induced by user or maintainer errors?
- All test and field failures analyzed to root cause?

Closed-Loop Failure-Mode Mitigation

- Analyze and map to the customer-specified Failure Definitions and Scoring Criteria (FDSC) all failure modes in order to formulate corrective actions throughout the life cycle?
- Aggressively mitigate failure modes until reliability requirements are met?
- Employ a mechanism for monitoring and communicating the implementation and effectiveness of corrective actions that is accessible by the customer?
- Include failure modes that may occur during the life cycle in the system reliability model?

Reliability Assessment

- Assess reliability requirements feasibility using the System Reliability Model in conjunction with expert judgment?
- Reliability requirements allocated to lower indenture levels and flowed to subcontractors/suppliers?
- Periodically assess reliability of system throughout the life cycle using the reliability model, the life-cycle operational & environmental load estimates, and the customer-specified FDSC?
- Reliability values to be achieved at various points in the program included?
- Reliability assessments from analysis, modeling & simulation, test, and the field tracked as a function of time and compared to allocations and customer reliability requirements?
- Monitor and evaluate the implementation of corrective actions as well as other changes to the design or manufacture of the systems/product that may impact reliability?
- All assessments include COTS, NDI, and GFE?

Reliability Verification

- Develop and periodically refine a Reliability Requirements Verification Strategy/Plan that is an integral part of the systems-engineering verification and is coordinated and integrated across all phases?
- Strategy ensures reliability requirements will be verified during design and will not degrade during production or in the field?
- Includes reliability values to be achieved at various points during development?
- Verification based on analysis, modeling & simulation, testing, or a mixture, and operationally realistic?
- Verified System-Level Operational & Environmental Life-Cycle Loads will be used?
- Customer-specific requirements, if any, included?

Failure Definitions

- Understand customer-specified FDSC?
- Design to avoid failures due to user or maintainer errors?
- RPP integrates customer-specified FDSC with (1) system reliability model, (2) ID of failure modes & mechanisms, (3) closed-loop failure-mitigation process, (4) reliability assessment, and (5) reliability verification throughout life cycle?

Technical Reviews

- RPP specifies how and when technical reviews will be conducted throughout the life cycle?
- Conduct periodic interchanges with customer/user that promotes understanding of operational environment?
- Technical reviews scheduled and conducted to (1) assure progress towards achieving reliability requirements, (2) verify that planned Reliability Activities are implemented, and (3) compare status and outcomes of Reliability Activities?
- Independent peer review conducted by SMEs?
- Conduct & participate in reviews with customer/user that address identification, analysis, classification, and mitigation of failure modes?

Methods & Tools

- Reliability Activities implemented with methods & tools from RPP?
- Reliability Best Practices implemented and adhered to?
- Changes in methods, tools, or Best Practices included in RPP update and approved by customer?

Outputs and Documentation

- Planning for RPP updates?
- Continuous customer access to status and outputs from all Reliability Activities?
- Outputs appropriately scheduled and documented in Reliability Case?

Attachment D – Sample T&E Award Fee Checklist

Checklist not meant to be all inclusive, but rather, a sample to guide your discussions and decisions relative to award fee planning, accountability, and reporting for your program.

EXCELLENT	VERY GOOD	SATISFACTORY	UNSATISFACTORY
T&E reviews met all the entry , exit , and success criteria (including teammates, vendors and subcontractors reviews) Reviews were successful. Program proceeded as planned.	T&E reviews met most of the entry, exit, and success criteria. Only minor omissions. TES/TEMP is consistent with the SEP. Reviews were successful although there were minor re-reviews but no significant delays to subsequent events.	T&E reviews met most of the entry, exit, and success criteria. Reviews were successful although a few items required subsequent re-review. T&E strategy and approach is consistent with the SEP. Program experienced some rework with no program impacts to the critical path.	Technical reviews did not meet some of the entry and exit criteria. Omissions are considered significant. Is not consistent with SEP, as appropriate. Subsequent re-reviews required. Program delays and cost increases experienced. Critical path was impacted.
T&E baseline data package is complete with no tbds, omissions, or incorrect data. Requirements management process is actively used with minimal change rate, no technical discrepancies and only a few administrative discrepancies. Baselines established ahead of schedule.	T&E baseline data package is mature and stable with only minor tbds, omissions, or incorrect data. Requirements management process is in place and used with acceptable change rate with only minor technical discrepancies. Baselines established on schedule.	T&E baseline data package is well defined, mostly mature and stable with no serious tbds, omissions, or incorrect data. Requirements management process is in place and used with acceptable change rate and no serious technical discrepancies. Baselines established on schedule	T&E baseline data package only partially defined. Requirements management process experiences high change rate and in the state of flux. Program delays or cost increases incurred. Critical path is impacted.
TEMP reflects best practices. Best practices are flowed down to subs, teammates and vendors. Program execution applies the documented program processes. TEMP is kept current.	TEMP reflects best practices, reflect the program specific needs. Best practices are flowed down to principle subs, vendors and teammates. Program execution applies critical documented program processes. TEMP is periodically updated	TEMP reflects best practices which are critical to high risk program areas. Best practices are flowed down to critical subs, vendors and teammates. Program execution usually applies the documented program processes. TEMP is updated prior to major milestones.	TEMP reflects best practices. Best practices are not flowed down to critical subs, vendors and teammates. Program has deviated from the documented program processes. TEMP is outdated.
Critical path is defined and actively managed. Proactive risk management processes applied across the program to include, subs, vendors, teammates and Government participants risks. Risk mitigation plans are in place and on schedule.	Critical path is defined and managed. Risk management process includes subs, vendors, teammates and Government participants Risk mitigation plans are in place incorporated into the program. Only minor delays to risk mitigation schedules.	Critical path is defined and managed. Risk management process includes critical subs, vendors and teammates. Risk mitigation plans are focused on critical path and incorporated into the program. There is need for occasional modification of or addition of risk mitigation plans.	Critical path is ill defined, not well managed. Risk management plans are not well defined and do not include the subs, vendors or teammates. There is need for continual modification of or addition of risk mitigation plans that impact the critical path.

Attachment E – Sample Past Performance Questionnaire

Questionnaire not meant to be all inclusive, but rather, a tool to guide your discussions and decisions regarding ranking contractor past performance relative to your program.

Sample Past Performance Questionnaire

Based on your knowledge of the contract identified above, please provide your assessment of how well the contractor performed on each of the following topics. Only performance in the past five (5) years is relevant. Please check the appropriate rating and comment on all responses other than those rated Satisfactory or N/A.

Performance Rating Definitions:

Exceptional (E)	***Very Good (V)***	***Satisfactory (S)***	***Marginal (M)***	***Unsatisfactory (U)***	***N/A***
Indicates performance clearly exceeded requirements. Area of evaluation contains few minor problems for which corrective action appears highly effective.	*Indicates performance exceeded some requirements. Area of evaluation contains few minor problems for which corrective action appears effective.*	*Indicates performance meets contractual requirements. The area of evaluation contains some minor problems for which the corrective actions appear satisfactory.*	*Indicates performance meets contractual requirements. The area of evaluation contains a serious problem for which corrective actions have not yet been identified, appear only marginally effective, or have not been fully implemented.*	*Indicates the contractor is in danger of not being able to satisfy contractual requirements and recovery is not likely in a timely manner. The area of evaluation contains serious problems for which the corrective actions appear ineffective.*	*Neutral or Unknown*

<u>Sample Questions</u>

Was there a single test and evaluation authority designated for the program with clear lines of authority and responsibility to the program manager?	***E***	***V***	***S***	***M***	***U***	***N/A***
Did the contractor include Government test and evaluation personnel on the IPTs to create an integrated team approach?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did the contractor maintain a balanced set of system performance, cost and schedule requirements during the program?	***E***	***V***	***S***	***M***	***U***	***N/A***
Did the contractor use his "best practice" software development process work across the total industry team?	***E***	***V***	***S***	***M***	***U***	***N/A***
How effective was their interface management and control?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did they manage technical risk? Was it focused on the risks associated with the critical path?	***E***	***V***	***S***	***M***	***U***	***N/A***
Did they complete all theT&E entry/exit criteria for major design reviews effectively? Were action items established and expeditiously closed?	***E***	***V***	***S***	***M***	***U***	***N/A***
Did they deliver quality T&E products (reports, analyses, trade studies, LDTs, and specifications) in a timely mannor?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did the contractor manage event-basedl reviews with their subcontractors, teammates and vendors?	***E***	***V***	***S***	***M***	***U***	***N/A***
Did the contractor include SMEs inT&E reviews on higher rsik areas of the program?	***E***	***V***	***S***	***M***	***U***	***N/A***
Did the contractor apply the corporate "bestT&E practices" and use their experienced personnel?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did the contractor adhere to the program TES/TEMP in the execution of the program?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did the contractor maintain the program TES/TEMP ? Was it updated with the results of continuous process improvement efforts for company processes?	***E***	***V***	***S***	***M***	***U***	***N/A***
Were the TES/TEMP requirements extended down to subcontractors, teammates and vendors?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did the contractor integrate theT&E t processes & tools in the management of the program (SEP, IMP, IMS, EVM, Risk Management)?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did the contractor manage theperformance baselines of the program?	***E***	***V***	***S***	***M***	***U***	***N/A***
How well did the contractor employ metrics to manage performance baseline maturity?	***E***	***V***	***S***	***M***	***U***	***N/A***
How timely, complete and usable was theT&E data package for the definedperformance baselines? Was theT&E data package completeto support theprogram's technical and acquisitiont strategy ?	***E***	***V***	***S***	***M***	***U***	***N/A***

How well did the contractor manage the requirements and apply any requirements management tool? Did the program experience an unusually high requirements change rate?	***E***	***V***	***S***	***M***	***U***	***N/A***

Appendix 3.4 Revised Format for the Test and Evaluation Master Plan

See http://www.acq.osd.mil/sse/dte/guidance.html

Defense Acquisition Guidebook ANNEX

Note: This new format applies to new start programs, programs that are being restructured, and any other program at their discretion.

TEST AND EVALUATION MASTER PLAN
FOR
PROGRAM TITLE/SYSTEM NAME
ACAT Level

Program Elements
Xxxxx

****

SUBMITTED BY

______________________________________ __________

Program Manager DATE

CONCURRENCE

______________________________________ __________

Program Executive Officer DATE
or Developing Agency (if not under the Program Executive Officer structure)

______________________________________ __________

Operational Test Agency DATE

______________________________________ __________

User's Representative DATE

DoD COMPONENT APPROVAL

______________________________________ __________

DoD Component Test and Evaluation Director DATE

______________________________________ __________

DoD Component Acquisition Executive (Acquisition Category I) DATE
Milestone Decision Authority (for less-than-Acquisition Category I)

Note: For Joint/Multi Service or Agency Programs, each Service or Defense Agency should provide a signature page for parallel staffing through its CAE or Director, and a separate page should be provided for OSD Approval

****

OSD APPROVAL

______________________________________ __________

DUSD(AT&L)/SSE DATE

______________________________________ __________

D,OT&E DATE

TABLE OF CONTENTS

1. PART I - INTRODUCTION

1.1. Purpose. State the purpose of the Test and Evaluation Master Plan (TEMP). Identify if this is an initial or updated TEMP. State the Milestone (or other) decision the TEMP supports. Reference and provide hyperlinks to the documentation initiating the TEMP (i.e., Initial Capability Document (ICD), Capability Development Document (CDD), Capability Production Document (CPD), Acquisition Program Baseline (APB), Acquisition Strategy Report (ASR), Concept of Operations (CONOPS), etc). State the Acquisition Category (ACAT) level, operating command(s), and if listed on the OSD T&E Oversight List (actual or projected)

1.2. Mission Description. Briefly summarize the mission need described in the program capability requirements documents in terms of the capability it will provide to the Joint Forces Commander. Describe the mission to be accomplished by a unit equipped with the system using all applicable CONOPS and Concepts of Employment (CONEMP)1. Incorporate an OV-1 of the system showing the intended operational environment. Also include the organization in which the system will be integrated as well as significant points from the Life Cycle Management Plan, the Information Support Plan, and Program Protection Plan. Provide links to each document referenced in the introduction. For business systems, include a summary of the business case analysis for the program.

1.3. System Description. Describe the system configuration. Identify key features and subsystems, both hardware and software (such as architecture, system and user interfaces, security levels, and reserves) for the planned increments within the Future Years Defense Program (FYDP).

1.3.1. System Threat Assessment. Succinctly summarize the threat environment (to include cyber-threats) in which the system will operate. Reference the appropriate threat documents for the system.

1.3.2. Program Background. Reference the Analysis of Alternatives (AoA), the APB and the materiel development decision to provide background information on the proposed system. Briefly describe the overarching Acquisition Strategy (for space systems, the Integrated Program Summary (IPS)), and the Technology Development Strategy (TDS). Address whether the system will be procured using an incremental development strategy or a single step to full capability. If it is an evolutionary acquisition strategy, briefly discuss planned upgrades, additional features and expanded capabilities of follow-on increments. The main focus must be on the current increment with brief descriptions of the previous and follow-on increments to establish continuity between known increments.

1.3.2.1. Previous Testing. Discuss the results of any previous tests that apply to, or have an effect on, the test strategy.

1.3.3. Key Capabilities. Identify the Key Performance Parameters (KPPs) and Key System Attributes (KSAs) for the system. For each listed parameter, provide the threshold and objective values from the CDD/CPD and reference the paragraph.

1.3.3.1. Key Interfaces. Identify interfaces with existing or planned systems' architectures that are required for mission accomplishment. Address integration and modifications needed for commercial items. Include interoperability with existing and/or planned systems of other Department of Defense (DoD) Components or Allies. Provide a diagram of the appropriate DoD Architectural Framework (DoDAF) system operational view from the CDD or CPD.

1.3.3.2. Special test or certification requirements. Identify unique system characteristics or support concepts that will generate special test, analysis, and evaluation requirements (e.g., security test and evaluation and Information Assurance (IA) Certification and Accreditation (C&A), post deployment software support, resistance to chemical, biological, nuclear, and radiological effects; resistance to

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[1] ***To include Maintenance Concepts.***

countermeasures; resistance to reverse engineering/exploitation efforts (Anti-Tamper); development of new threat simulation, simulators, or targets.

1.3.3.3. Systems Engineering (SE) Requirements. Reference all SE-based information that will be used to provide additional system evaluation targets driving system development. Examples could include hardware reliability growth and software maturity growth strategies.

2. PART II – TEST PROGRAM MANAGEMENT AND SCHEDULE

2.1 T&E Management. Discuss the test and evaluation responsibilities of all participating organizations (such as developers, testers, evaluators, and users). Describe the role of contractor testing in early system development. Describe the role of governmental developmental testers to assess and evaluate system performance. Describe the role of the Operational Test Agency (OTA) /operational testers to confirm operational effectiveness, operational suitability and survivability.

2.1.1. T&E Organizational Construct. Identify the organizations or activities (such as the T&E Working-level Integrated Product Team (WIPT) or Service equivalent, LFT&E IPT, etc.) in the T&E management structure, to include the sub-work groups, such as a modeling & simulation, or reliability. Provide sufficient information to adequately understand the functional relationships. Reference the T&E WIPT charter that includes specific responsibilities and deliverable items for detailed explanation of T&E management. These items include TEMPs and Test Resource Plans (TRPs) that are produced collaboratively by member organizations.

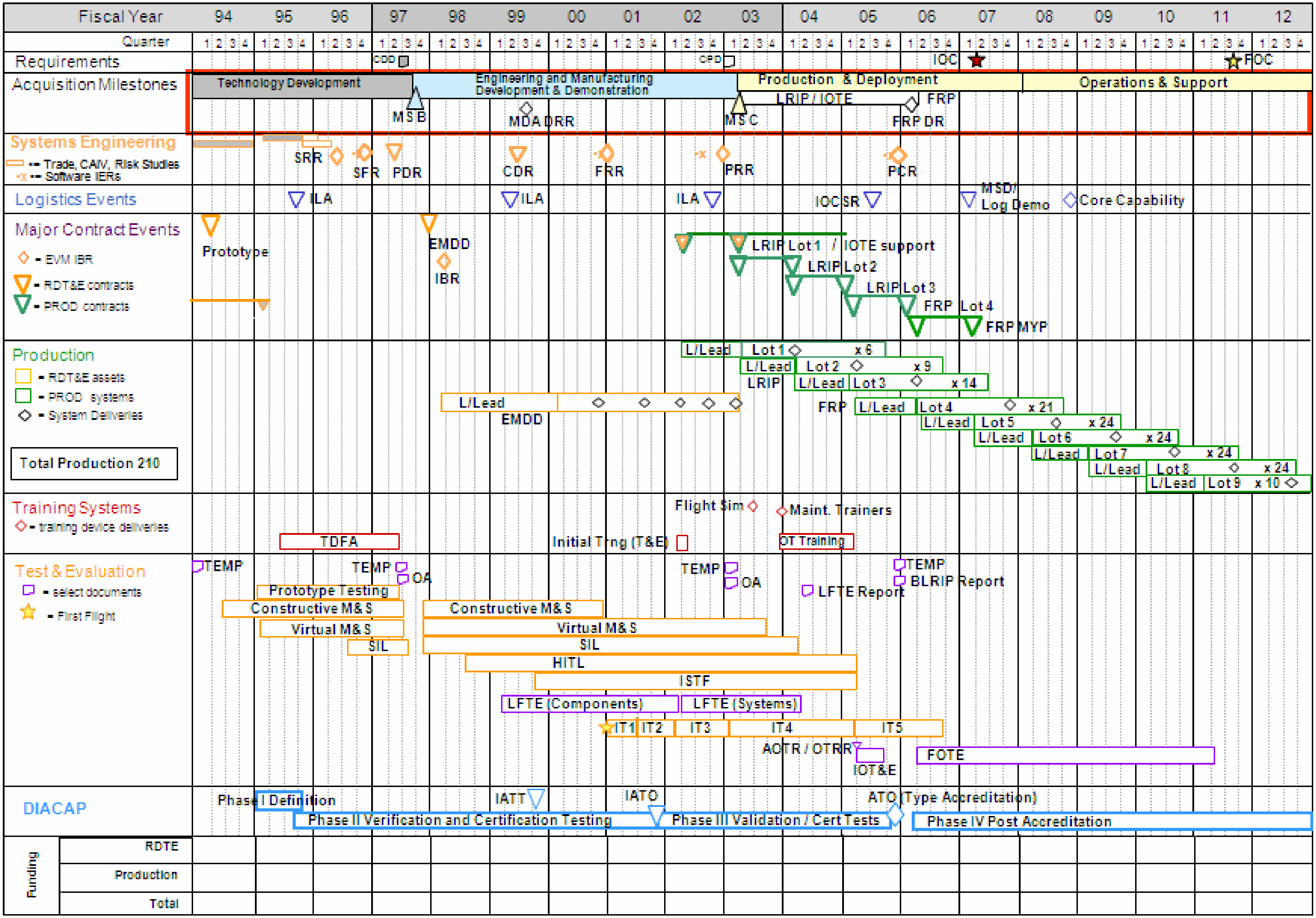
2.2. Common T&E Database Requirements. Describe the requirements for and methods of collecting, validating, and sharing data as it becomes available from the contractor, Developmental Test (DT), Operational Test (OT), and oversight organizations, as well as supporting related activities that contribute or use test data (e.g., information assurance C&A, interoperability certification, etc.). Describe how the pedigree of the data will be established and maintained. The pedigree of the data refers to understanding the configuration of the test asset, and the actual test conditions under which the data were obtained for each piece of data. State who will be responsible for maintaining this data.

2.3. Deficiency Reporting. Briefly describe the processes for documenting and tracking deficiencies identified during system development and testing. Describe how the information is accessed and shared across the program.

2.4. TEMP updates. Reference instructions for complying with DoDI 5000.02 required updates or identify exceptions to those procedures if determined necessary for more efficient administration of document. Provide guidelines for keeping TEMP information current between updated. For a Joint or Multi-Service TEMP, identify references that will be followed or exceptions as necessary.

2.5. Integrated Test Program Schedule. Display (see Figure 2.1) the overall time sequencing of the major acquisition phases and milestones. Include the test and evaluation major decision points, related activities, and planned cumulative funding expenditures by appropriation by year. Include event dates such as major decision points as defined in DoD Instruction 5000.02, e.g., operational assessments, preliminary and critical design reviews, test article availability; software version releases; appropriate phases of DT&E; LFT&E; Joint Interoperability Test Command (JITC) interoperability testing and certification date to support the MS-C and Full-Rate Production (FRP) Decision Review (DR). Include significant Information Assurance certification and accreditation event sequencing, such as Interim Authorization to Test (IATT), Interim Authorization to Operate (IATO) and Authorization to Operate (ATO). Also include operational test and evaluation; Low-Rate Initial Production (LRIP) deliveries; Initial Operational Capability (IOC); Full Operational Capability (FOC); and statutorily required reports such as the Live-Fire T&E Report and Beyond Low-Rate Initial Production (B-LRIP) Report. Provide a single schedule for multi-DoD Component or Joint and Capstone TEMPs showing all related DoD Component system event dates.

Figure 2.1 SAMPLE Integrated Program Test Schedule



3. PART III – TEST AND EVALUATION STRATEGY

3.1 T&E Strategy. Introduce the program T&E strategy by briefly describing how it supports the acquisition strategy as described in Section 1.3.2. This section should summarize an effective and efficient approach to the test program. The developmental and operational test objectives are discussed separately below; however this section must also address how the test objectives will be integrated to support the acquisition strategy by evaluating the capabilities to be delivered to the user without compromising the goals of each major kind of test type. Where possible, the discussions should focus on the testing for capabilities, and address testing of subsystems or components where they represent a significant risk to achieving a necessary capability. As the system matures and production representative test articles are available, the strategy should address the conditions for integrating DT and OT tests. DODI 5000.02 requires evaluation to include comparison with current mission capability using existing data, so that measurable improvements can be determined. Describe the strategy for achieving this comparison and for ensuring data are retained and managed for future comparison results of evolutionary increments or future replacement capabilities. When such comparison evaluation is cost prohibitive, identify an alternative evaluation strategy. To present the program's T&E strategy, briefly describe the relative emphasis on methodologies (e.g., Modeling and Simulation (M&S), Operational Assessment Report (OAR), Systems Integration Laboratory (SIL), Interface Simulation and Test Facility (ISTF), Hardware-In-the-Loop Test (HILT), Measurement Facility (MF)).

3.2. Evaluation Framework. Describe the overall evaluation approach focusing on key decisions in the system lifecycle and addressing key system risks, program unique Critical Operational Issues (COIs) or Critical Operational Issue Criteria (COIC), and Critical Technical Parameters (CTPs). Specific areas of evaluation to address are related to the:

(1) Development of the system and processes (include maturation of system design)
(2) System performance in the mission context
(3) OTA independent assessments and evaluations
(4) Survivability and/or lethality
(5) Comparison with existing capabilities, and
(6) Maturation of highest risk technologies

Describe any related systems that will be included as part of the evaluation approach for the system under test (e.g., data transfer, information exchange requirements, interoperability requirements, and documentation systems). Also identify any configuration differences between the current system and the system to be fielded. Include mission impacts of the differences and the extent of integration with other systems with which it must be interoperable or compatible. Describe how the system will be evaluated and the sources of the data for that evaluation. The discussion should address the key elements for the evaluations, including major risks or limitations for a complete evaluation of the increment undergoing testing. The reader should be left with an understanding of the value-added of these evaluations in addressing both programmatic and warfighter decisions or concerns. This discussion provides rationale for the major test objectives and the resulting major resource requirements shown in Part IV - Resources.

Include a Top-Level Evaluation Framework matrix that shows the correlation between the KPPs/KSAs, CTPs, key test measures (i.e., Measures of Effectiveness (MOEs) and Measures of Suitability (MOSs)), planned test methods, and key test resources, facility or infrastructure needs. When structured this way, the matrix should describe the most important relationships between the types of testing that will be conducted to evaluate the Joint Capabilities Integration and Development System (JCIDS)-identified KPPs/KSAs, and the program's CTPs. Figure 3.1 shows how the Evaluation Framework could be organized. Equivalent Service-specific formats that identify the same relationships and information may also be used. The matrix may be inserted in Part III if short (less than one page), or as an annex. The evaluation framework matrix should mature as the system matures. Demonstrated values for measures should be included as the acquisition program advances from milestone to milestone and as the TEMP is updated.

The suggested content of the evaluation matrix includes the following:

- Key requirements & T&E measures – These are the KPPs and KSAs and the top-level T&E issues and measures for evaluation. The top-level T&E issues would typically include COIs/Critical Operational Issues and Criteria (COICs), CTPs, and key MOEs/MOSs. System-of-Systems issues should also be included, either in the COI column or inserted as a new column. Each T&E issue and measure should be associated with one or more key requirements. However, there could be T&E measures without an associated key requirement or COI/COIC. Hence, some cells in figure 3.1 may be empty.
- Overview of test methodologies and key resources – These identify test methodologies or key resources necessary to generate data for evaluating the COIs/COICs, key requirements, and T&E measures. The content of this column should indicate the methodologies/resources that will be required and short notes or pointers to indicate major T&E phases or resource names. M&S should be identified with the specific name or acronym.
- Decisions Supported – These are the major design, developmental, manufacturing, programmatic, acquisition, or employment decisions most affected by the knowledge obtained through T&E.

Figure 3.1, Top-Level Evaluation Framework Matrix

Key Requirements and T&E Measures				Test Methodologies/Key Resources (M&S, SIL, MF, ISTF, HITL, OAR)	Decision Supported
Key Reqs	**COIs**	**Key MOEs/ MOSs**	**CTPs & Threshold**		
KPP#1:	**COI #1.** Is the XXX effective for…	**MOE 1.1.**	Engine thrust	Chamber measurement Observation of performance profiles OAR	PDR CDR
	COI #2. Is the XXX suitable for…		Data upload time	Component level replication Stress and Spike testing in SIL	PDR CDR
	COI #3. Can the XXX be…	**MOS 2.1.**			MS-C FRP
		MOE 1.3.			Post-CDR FRP
		MOE 1.4.	Reliability based on growth curve	Component level stress testing Sample performance on growth curve Sample performance with M&S augmentation	PDR CDR MS-C
KPP #2		**MOS 2.4.**	Data link		MS-C SR
KPP #3	**COI #4.** Is training….	**MOE 1.2.**		Observation and Survey	MS-C FRP
KSA #3.a	**COI #5.** Documentation	**MOS 2.5.**			MS-C FRP
ETC					
ETC					

3.3. Developmental Evaluation Approach. Describe the top-level approach to evaluate system and process maturity, as well as, system capabilities and limitations expected at acquisition milestones and decision review points. The discussion should include logistics, reliability growth, and system performance aspects. Within this section, also discuss:

1) rationale for CTPs (see below for a description of how to derive CTPs),
2) key system or process risks,
3) any certifications required (e.g. weapon safety, interoperability, spectrum approval, information assurance),
4) any technology or subsystem that has not demonstrated the expected level of technology maturity at level 6 (or higher), system performance, or has not achieved the desired mission capabilities for this phase of development,
5) degree to which system hardware and software design has stabilized so as to determine manufacturing and production decision uncertainties,
6) key issues and the scope for logistics evaluations, and
7) reliability thresholds when the testing is supporting the system's reliability growth curve.

CTPs are measurable critical system characteristics that, if not achieved, preclude the fulfillment of desired operational performance capabilities. While not user requirements, CTPs are technical measures derived from desired user capabilities. Testers use CTPs as reliable indicators that the system is on (or behind) the planned development schedule or will likely (or not likely) achieve an operational capability. Limit the list of CTPs to those that support the COIs. Using the system specification as a reference, the chief engineer on the program should derive the CTPs to be assessed during development.

3.3.1. Mission-Oriented Approach. Describe the approach to evaluate the system performance in a mission context during development in order to influence the design, manage risk, and predict operational effectiveness and operational suitability. A mission context focuses on how the system will be employed. Describe the rationale for the COIs or COICs.

COIs must be relevant to the required capabilities and of key importance to the system being operationally effective, operationally suitable and survivable, and represent a significant risk if not satisfactorily resolved. A COI/COIC is typically phrased as a question that must be answered in the affirmative to properly evaluate operational effectiveness (e.g., "Will the system detect the threat in a combat environment at adequate range to allow successful engagement?") and operational suitability (e.g., "Will the system be safe to operate in a combat environment?"). COIs/COICs are critical elements or operational mission objectives that must be examined. COIs/COICs should be few in number and reflect total operational mission concerns. Use existing documents such as capability requirements documents, Business Case Analysis, AoA, APB, war fighting doctrine, threat assessments and CONOPS to develop the COIs/COICs. COIs/COICs must be formulated as early as possible to ensure developmental testers can incorporate mission context into DT&E. If every COI is resolved favorably, the system should be operationally effective and operationally suitable when employed in its intended environment by typical users.

3.3.2. Developmental Test Objectives. Summarize the planned objectives and state the methodology to test the system attributes defined by the applicable capability requirement document (CDD, CPD, CONOPs) and the CTPs that will be addressed during each phase of DT as shown in Figure 3.1, Top-Level Evaluation Framework matrix and the Systems Engineering Plan. Subparagraphs can be used to separate the discussion of each phase. For each DT phase, discuss the key test objectives to address both the contractor and government developmental test concerns and their importance to achieving the exit criteria for the next major program decision point. If a contractor is not yet selected, include the developmental test issues addressed in the Request For Proposals or Statement of Work. Discuss how developmental testing will reflect the expected operational environment to help ensure developmental testing is planned to integrate with operational testing. Also include key test objectives related to logistics testing. All objectives and CTPs should be traceable in the Top-Level Evaluation Framework matrix to ensure all KPPs/KSAs are addressed, and that the COIs/COICs can be fully answered in operational testing. Summarize the developmental test events, test scenarios, and the test design concept. Quantify the testing sufficiently (e.g., number of test hours, test articles, test events, test firings) to allow a valid cost estimate to be created. Identify and explain how models and simulations, specific threat systems, surrogates, countermeasures, component, or subsystem testing, test beds, and prototypes will be used to determine whether or not developmental test objectives are achieved. Identify the DT&E reports required to support decision points/reviews and OT readiness. Address the system's reliability growth strategy, goals, and targets and how they support the Evaluation Framework. Detailed developmental test objectives should be addressed in the System Test Plans and detailed test plans.

3.3.3. Modeling & Simulation (M&S). Describe the key models and simulations and their intended use. Include the developmental test objectives to be addressed using M&S to include any approved operational test objectives. Identify data needed and the planned accreditation effort. Identify how the developmental test scenarios will be supplemented with M&S. Identify who will perform M&S verification, validation, and accreditation. Identify developmental M&S resource requirements in Part IV.

3.3.4. Test Limitations. Discuss any developmental test limitations that may significantly affect the evaluator's ability to draw conclusions about the maturity, capabilities, limitations, or readiness for dedicated operational testing. Also address the impact of these limitations, and resolution approaches.

3.4. Live Fire Test and Evaluation Approach. If live fire testing is required, describe the approach to evaluate the survivability/lethality of the system. Include a description of the overall live fire evaluation strategy to influence the system design (as defined in Title 10 U.S.C. § 2366), critical live fire evaluation issues, and major evaluation limitations. Discuss the management of the LFT&E program, to include the shot selection process, target resource availability, and schedule. Discuss a waiver, if appropriate, from full-up, system-level survivability testing, and the alternative strategy.

3.4.1. Live Fire Test Objectives. State the key live fire test objectives for realistic survivability or lethality testing of the system. Include a matrix that identifies all tests within the LFT&E strategy, their schedules, the issues they will address, and which planning documents will be submitted for DOT&E approval and which will be submitted for information and review only. Quantify the testing sufficiently (e.g., number of test hours, test articles, test events, test firings) to allow a valid cost estimate to be created.

3.4.2. Modeling & Simulation (M&S). Describe the key models and simulations and their intended use. Include the LFT&E test objectives to be addressed using M&S to include operational test objectives. Identify data needed and the planned accreditation effort. Identify how the test scenarios will be supplemented with M&S. Identify who will perform M&S verification, validation, and accreditation. Identify M&S resource requirements in Part IV

3.4.3. Test Limitations. Discuss any test limitations that may significantly affect the ability to assess the system's vulnerability and survivability. Also address the impact of these limitations, and resolution approaches.

3.5. Certification for Initial Operational Test and Evaluation (IOT&E). Explain how and when the system will be certified safe and ready for IOT&E. Explain who is responsible for certification and which decision reviews will be supported using the lead Service's certification of safety and system material readiness process. List the DT&E information (i.e., reports or summaries) that provides predictive analyses of expected system performance against specific COIs and the key system attributes - MOEs/MOSs. Discuss the entry criteria for IOT&E and how the DT&E program will address those criteria.

3.5.1. For all ACAT 1D programs and special interest programs, outline the process for the conduct of the OSD independent Assessment of Operational Test Readiness (AOTR).

3.6. Operational Evaluation Approach. Describe the approach to conduct the independent evaluation of the system. Identify the periods during integrated testing that may be useful for operational assessments and evaluations. Outline the approach to conduct the dedicated IOT&E and resolution of the COIs.

3.6.1. Operational Test Objectives. State the key MOEs/MOSs that support the COIs/COICs. Ensure the operational tests can be identified in a way that allows efficient DOT&E approval of the overall OT&E effort in accordance with Title 10 U.S.C. § 139(d). Describe the scope of the operational test by identifying the test mission scenarios and the resources that will be used to conduct the test. Summarize the operational test events, key threat simulators and/or simulation(s) and targets to be employed, and the type of representative personnel who will operate and maintain the system. Identify planned sources of information (e.g., developmental testing, testing of related systems, modeling, simulation) that may be used to supplement operational test and evaluation. Quantify the testing sufficiently (e.g., number of test hours, test articles, test events, test firings) to allow a valid cost estimate to be created.

3.6.2. Modeling & Simulation (M&S). Describe the key models and simulations and their intended use. Include the operational test objectives to be addressed using M&S. Identify data needed and the planned accreditation effort. Identify how the operational test scenarios will be supplemented with M&S. Identify who will perform the M&S verification, validation, and accreditation. Identify operational M&S resource requirements in Part IV.

3.6.3. Test Limitations. Discuss test limitations including threat realism, resource availability, limited operational (military; climatic; Chemical, Biological, Nuclear, and Radiological (CBNR), etc.) environments, limited support environment, maturity of tested systems or subsystems, safety, etc., that may impact the resolution of affected COIs. Describe measures taken to mitigate limitations. Indicate if any system contractor involvement or support is required, the nature of that support, and steps taken to ensure the impartiality of the contractor providing the support according to Title 10 U.S.C. §2399. Indicate the impact of test limitations on the ability to resolve COIs and the ability to formulate conclusions regarding operational effectiveness and operational suitability. Indicate the COIs affected in parenthesis after each limitation.

3.7. Other Certifications. Identify key testing prerequisites and entrance criteria, such as required certifications (e.g. DoD Information Assurance Certification and Accreditation Process (DIACAP) Authorization to Operate, Weapon Systems Explosive Safety Review Board (WSERB), flight certification, etc.)

3.8. Reliability growth. Since reliability is a driver during system development, identify, in tabular form, the amount of operating time being accrued during the each of the tests listed in the Figure 2.1. Table should contain the system configuration, operational concept, etc. Reference and provide hyperlinks to the reliability growth planning document.

3.9. Future Test and Evaluation - Summarize all remaining significant T&E that has not been discussed yet, extending through the system life cycle. Significant T&E is that T&E requiring procurement of test assets or other unique test resources that need to be captured in the Resource section. Significant T&E

can also be any additional questions or issues that need to be resolved for future decisions. Do not include any T&E in this section that has been previously discussed in this part of the TEMP.

4. PART IV-RESOURCE SUMMARY

4.1. Introduction. Testing will be planned and conducted to take full advantage of existing DoD investment in ranges, facilities, and other resources wherever practical. Provide a list in a table format (see Table 4.1) including schedule (Note: ensure list is consistent with figure 2.1 schedule) of all key test and evaluation resources, both government and contractor, that will be used during the course of the current increment. Include long-lead items for the next increment if known. Specifically, identify the following test resources and identify any shortfalls, impact on planned testing, and plan to resolve shortfalls.

4.1.1. Test Articles. Identify the actual number of and timing requirements for all test articles, including key support equipment and technical information required for testing in each phase of DT&E, LFT&E, and OT&E. If key subsystems (components, assemblies, subassemblies or software modules) are to be tested individually, before being tested in the final system configuration, identify each subsystem in the TEMP and the quantity required. Specifically identify when prototype, engineering development, or production models will be used.

4.1.2. Test Sites and Instrumentation. Identify the specific test ranges/facilities and schedule to be used for each type of testing. Compare the requirements for test ranges/facilities dictated by the scope and content of planned testing with existing and programmed test range/facility capability. Identify instrumentation that must be acquired specifically to conduct the planned test program.

4.1.3. Test Support Equipment. Identify test support equipment and schedule specifically required to conduct the test program. Anticipate all test locations that will require some form of test support equipment. This may include test measurement and diagnostic equipment, calibration equipment, frequency monitoring devices, software test drivers, emulators, or other test support devices that are not included under the instrumentation requirements. Identify and describe the management plan for support and equipment needed to conduct testing acquired as Government Furnished Equipment (GFE).

4.1.4. Threat Representation. Identify the type, number, availability, fidelity requirements, and schedule for all representations of the threat (to include threat targets) to be used in testing. Include the quantities and types of units and systems required for each of the test phases. Appropriate threat command and control elements may be required and utilized in both live and virtual environments. The scope of the T&E event will determine final threat inventory.

4.1.5. Test Targets and Expendables. Specify the type, number, availability, and schedule for all test targets and expendables, (e.g. targets, weapons, flares, chaff, sonobuoys, smoke generators, countermeasures) required for each phase of testing. Identify any shortfalls and associated evaluation risks. Include threat targets for LFT&E lethality testing and threat munitions for vulnerability testing.

4.1.6. Operational Force Test Support. For each test and evaluation phase, specify the type and timing of aircraft flying hours, ship steaming days, and on-orbit satellite contacts/coverage, and other operational force support required. Include supported/supporting systems that the system under test must interoperate with if testing a system-of-systems or family-of-systems. Include size, location, and type unit required.

4.1.7. Models, Simulations, and Testbeds. For each test and evaluation phase, specify the models and simulations to be used, including computer-driven simulation models and hardware/software-in-the-loop test beds. Identify opportunities to simulate any of the required support. Identify the resources required to validate and accredit their usage, responsible agency and timeframe.

4.1.8. Joint Mission Environment. Describe the live, virtual, or constructive components or assets necessary to create an acceptable environment to evaluate system performance against stated joint requirements. Describe how both DT and OT testing will utilize these assets and components.

4.1.9. Special Requirements. Identify requirements and schedule for any necessary non-instrumentation capabilities and resources such as: special data processing/data bases, unique mapping/charting/geodesy products, extreme physical environmental conditions or restricted/special use air/sea/landscapes. Briefly list any items impacting the T&E strategy or government test plans that must be put on contract or which are required by statute or regulation. These are typically derived from the JCIDS requirement (i.e., Programmatic Environment, Safety and Occupational Health Evaluation (PESHE) or Environment, Safety and Occupational Health (ESOH)). Include key statements describing the top-level T&E activities the contractor is responsible for and the kinds of support that must be provided to government testers.

4.2. Federal, State, and Local Requirements. All T&E efforts must comply with federal, state, and local environmental regulations. Current permits and appropriate agency notifications will be maintained regarding all test efforts. Specify any National Environmental Policy Act documentation needed to address specific test activities that must be completed prior to testing and include any known issues that require mitigations to address significant environmental impacts. Describe how environmental compliance requirements will be met.

4.3. Manpower/Personnel Training. Specify manpower/personnel and training requirements and limitations that affect test and evaluation execution. Identify how much training will be conducted with M&S.

4.4. Test Funding Summary. Summarize cost of testing by FY separated by major events or phases and within each Fiscal Year (FY) DT and OT dollars. When costs cannot be estimated, identify the date when the estimates will be derived.

Table 4.1 Test Sites and Instrumentation Example

Fiscal Year	06	07	08	09	10	11	12	TBD
TEST EVENT / TEST RESOURCE	IT-B1	IT-B2	IT-B2 / IT-C1	IT-C1	IT-C1	IT-C2	OT-C1	OT-D1
Integration Lab	X	X	X	X	X	X		
Radar Integration Lab	X	X	X	X	X	X		
Loads (flights)								
Operating Area #1 (flights)		X (1)	X (1)				X (1)	X (2)
Operating Area #2 (flights)		50 (1)	132 (1)	60	100	140	X (1)	X (2)
Northeast CONUS Overland (flights)		10					X (1)	X (2)
SOCAL Operating Areas (flights)				X		X		
Southeast CONUS Overland (flights)		X (1)	X (1)				X (1)	X (2)
Shielded Hangar (hours)			160			160		
Electromagnetic Radiation Facility (hours)			40			40		
Arresting Gear (Mk 7 Mod 3)(events)				10		10		
White Sands Missile Range (flights)			5	5	5			
NAS Fallon				5	5	A/R	X (1)	X (2)
Link-16 Lab, Eglin AFB							X	
Link-16 Lab, USA Redstone							X	
NAWCAD WD, China Lake Range							X	
Eglin AFB ESM Range							X	

1. Explanations as required.
2. Enter the date the funding will be available.

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Appendix 4 RIWG Charter

OFFICE OF THE SECRETARY OF DEFENSE

1000 DEFENSE PENTAGON
WASHINGTON, DC 20301-1000

MEMORANDUM FOR COMPONENT ACQUISITION EXECUTIVES

SUBJECT: Reliability Improvement Working Group

We ask you to support a working group to implement recommendations to improve Reliability, Availability, and Maintainability (RAM) performance in DoD weapon systems.

Recent Test and Evaluation (T&E) related reports have highlighted poor operational suitability of weapon systems, primarily as a result of RAM deficiencies. Also, a Defense Science Board (DSB) task force on Developmental T&E is currently examining RAM issues as one part of their investigation. Now is the appropriate time to change how we do business with regard to RAM. Specifically, we are establishing this working group to:

- Ensure programs are formulated to execute a viable systems engineering strategy from the beginning, including a RAM growth program, as an integral part of design and development.
- Ensure government organizations reconstitute a cadre of experienced T&E and RAM personnel.
- Implement mandated integrated DT and OT, including the sharing and access to all appropriate contractor and government data and the use of operationally representative environments in early testing.

It is essential to include both Service T&E and acquisition staff representatives in the working group. Ideally, the representatives will be familiar with the DSB Task Force and have access to RAM and contracting expertise. The working group shall provide an implementation report by July 31, 2008.

Mr. Chris DiPetto and Dr. Ernest Seglie will co-lead the working group. Please identify your representative(s) to Mr. DiPetto at Christopher.DiPetto@osd.mil, or (703) 695-4421 by February 21.

Charles S McQueary

Dr. Charles E. McQueary FEB 0 6 2008
Director, Operational Test & Evaluation

James I. Finley FEB 1 5 2008
Deputy Under Secretary of Defense
for Acquisition and Technology

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Appendix 5 Executive Summary, Defense Science Board Report Task Force on Developmental Test and Evaluation

The Executive Summary follows.

The complete report is available at:
http://www.acq.osd.mil/sse/dte/docs/USD-ATLMemo-Final-DSB-Rpt-DTE-6Jun08.pdf

I. EXECUTIVE SUMMARY

A Defense Science Board (DSB) Task Force on Developmental Test and Evaluation (DT&E) was convened in the summer of 2007 to investigate the causal factors for the high percentage of programs entering Initial Operational Test and Evaluation (IOT&E) in recent years which have been evaluated as both not operationally effective and not operationally suitable. The following are the specific issues which the Task Force was asked to assess:

- Office of the Secretary of Defense (OSD) organization, roles, and responsibilities for Test and Evaluation (T&E) oversight. Compare organization, roles, and responsibilities in both DT&E and Operational Test and Evaluation (OT&E). Recommend changes that may contribute to improved DT&E oversight, and facilitate integrated T&E.
- Changes required to establish statutory authority for OSD DT&E oversight. Title 10 United States Code (USC) has an OT&E focus, and does not address OSD authority in oversight of DT&E. Recommend changes to Title 10 or other U.S. statutes that may improve OSD authority in DT&E oversight.
- Many IOT&E failures have been due to lack of operational suitability. Specific problems have been in the materiel readiness sustainment areas of reliability, maintainability, and availability. Recommend improvements in DT&E process to discover suitability problems earlier, and thus improve likelihood of operational suitability in IOT&E.

PROBLEM DEFINITION

In recent years, there has been a dramatic increase in the number of systems not meeting suitability requirements during IOT&E. Reliability, Availability and Maintainability (RAM) deficiencies comprise the primary shortfall areas. DoD IOT&E results from 2001 to 2006 are summarized in Figures 1 through 3. These charts graphically depict the high suitability failure rates during IOT&E resulting from RAM deficiencies. Figure 4 is a comparison of Army systems that met or did not meet reliability requirements.

Program	Service	ACAT	IOT&E Result		Reason
			FY 2001		
F-15 TEWS	USAF	II	Effective	Not Suitable	Reliability, Maintainability, Availability
V-22 Osprey	Navy	1D	Effective	Not Suitable	Reliability, Availability, Maintainability (RAM), Human Factors, BIT
Joint Direct Attack Munitions (JDAM)	USAF	1C	Effective only with legacy fuses	Not Suitable	Integration with delivery platforms
M2A3 Bradley Fighting Vehicle	Army	1D	Effective	Suitable	
			FY 2002		
Joint Primary Aircraft Training System (JPATS)	USAF	1C	Effective with deficiencies	Not Suitable	RAM, Safety, Human Factors
Cooperative Engagement Capability (CEC)	Navy	1D	Effective	Suitable	
Multiple Rocket Launcher System (MLRS)	Army	1C	Effective	Suitable	
MH-60S	Navy	1C	Effective	Not Suitable	RAM, excessive administrative and logistic repair time impacted RAM
			FY 2003		
B-1B Block E Mission Upgrade Program	USAF	1D	Effective	Not Suitable	16% decrease in weapons release rate, reduction in accuracy of Mark 82 low drag weapons, 14% hit rate on moving targets
Sea wolf Nuclear Attack Submarine	Navy	1D	Effective	Suitable	Several requirement thresholds were not met but overall system effective and suitable

Figure 1. DoD IOT&E Results FY 2001-2003.

Program	Service	ACAT	IOT&E Result		Reason
			FY 2004		
Evolved Sea sparrow Missile	Navy	II	Effectiveness unresolved	Suitable	Testing was not adequate to determine effectiveness.
Stryker	Army	1D	Effective	Suitable	
Advanced SEAL Delivery System (ASDS)	Navy	1D	Effective with restrictions	Not suitable	Effective for short duration missions; not effective for all missions and profiles. Not suitable due to RAM.
Tactical Tomahawk	Navy	1C	Effective	Suitable	
Stryker Mortar Carrier-B (MC-B)	Army	1D	Effective	Not Suitable	RAM and safety concerns.
			FY 2005		
CH-47F Block I	Army	1C	Effective	Not Suitable	RAM; communications system less suitable than CH-47D; did not meet Information Exchange Requirements for Block I.
F/A-22	USAF	1D	Effective	Not Suitable	RAM; needed more maintenance resources and spare parts; BIT
Joint Stand-Off Weapon-C	Navy	1C	Not Effective		Not effective against moderately hardened targets; mission planning time was excessive.
Guided-MLRS	Army	1C	Effective	Suitable	
High Mobility Attack Rocket System (HMARS)	Army	1C	Effective	Suitable	
V-22 Osprey	Navy	1D	Effective	Suitable	
EA-6B (ICAP III)	Navy	II	Effective	Suitable	

Figure 2: DoD IOT&E Results FY 2004-2005.

Program	Service	ACAT	IOT&E Result		Reason
CY 2006					
Common Missile Warning System (CMWS)	Army	1C	Effective	Suitable	Effective and suitable in the OIF/OEF environment but needs further testing outside of the OIF/OEF environment.
Deployable Joint Command and Control (DJC2)	Navy	1AM	Effective	Not Suitable	Operational Test Agency, COTF, reported effective, not suitable. BLRIP not complete.
Integrated Defensive Electronic Countermeasures	Navy	II			Test suspended due to reliability problems.
Surface Electronic Warfare Improvement Program (SEWIP) Block 1A	Navy	II	Not Effective	Not Suitable	Block 1A Upgrade does not make the AN/SLQ-32 EWS operationally effective and suitable but does enhance ability to protect ships
C-130J	USAF	1C	Effective single ship; Not effective in formation	Suitable with shortfalls	Effective single ship; not effective in formation air land / air drop; not effective in non permissive threat environment. Shortfalls in suitability due to maintainability issues
Small Diameter Bomb (SDB) Increment 1	USAF	1D	Effective with limitations	Suitable with limitations	Limited effectiveness and suitability due to bomb rack reliability and deficiencies in software used to predict optimum fuzing solutions. Oct 2006 flight operations suspended

Figure 3: DoD IOT&E Results for 2006.

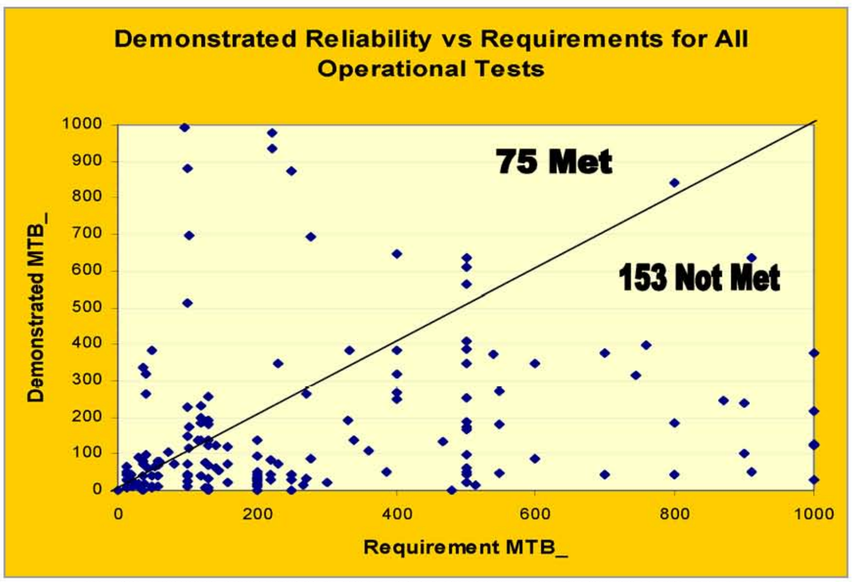

Figure 4: Army Systems Failing Reliability during Operational Testing (1997-2006).

Early in the DSB study, it became obvious that the high suitability failure rates were the result of systemic changes that had been made to the acquisition process; and that changes in developmental test and evaluation could not remedy poor program formulation. Accordingly, the Task Force study was expanded to address the broader programmatic issues, as well as the above issues identified in the Terms of Reference (TOR).

A number of major changes in the last 15 years have had a significant impact on the acquisition process. First, Congressional direction in Fiscal Year (FY) 1996, 1997, 1998 and 1999 Defense Authorization Acts reduced the acquisition workforce (which includes developmental test and evaluation). Several changes resulted from the implementation of Acquisition Reform in the late 1990s. The use of existing commercial specifications and standards was encouraged, unless there was justification for the use of military specifications. Industry was encouraged to use commercial practices. Numerous military specifications and standards were eliminated in some Service acquisition organizations. The requirement for a reliability growth program during development was also deemphasized, and in most cases, eliminated. At the same time, systems became more complex, and systems-of-systems integration became more common. Finally, there was a loss of a large number of the most experienced management and technical personnel in government and industry without an adequate replacement pipeline. The loss of personnel was compounded in many cases by the lack of up-to-date standards and handbooks, which had been allowed to atrophy, or in some cases, eliminated. It should be noted that Acquisition Reform included numerous beneficial initiatives. There have been many programs involving application of poor judgment in the last 15 years that can be attributed to acquisition/test workforce inexperience and funding reductions. It is probable that these problems would have occurred independently of most Acquisition Reform initiatives.

All Service acquisition and test organizations experienced significant personnel cuts, the magnitude varying from organization to organization. Over time, in-house DoD offices of subject matter experts (who specialized in multiple areas, such as promoting the use of proven reliability development methods) were drastically reduced, and in some cases, disestablished. A summary of reductions in developmental test personnel follows. The Army essentially eliminated their military Developmental Testing (DT) component and declared the conduct of DT by the government to be discretionary in each program. The Navy reduced their DT workforce by 10% but no shift of "hands-on" government DT to industry DT occurred. The trend within the Air Force gave DT conduct and control to the contractor. Air Force test personnel have been reduced by approximately 15% and engineering personnel supporting program offices have been reduced by as much as 60% in some organizations. The reduction of DT personnel in the Services occurred during a time when programs have become increasingly complex (e.g., significant increases in software lines of code, off-board sensor data integration, and systems of systems testing). Congressional actions to cut the DOD acquisition workforce are also discussed in a recent National Research Council sponsored study.[1]

[1] Paul Kaminski, et al, Pre-Milestone A and Early Phase Systems Engineering: A Retrospective Review and Benefits for Future Air Force Acquisition, Washington, D.C., National Research Council, 2008.

PRINCIPAL FINDINGS AND RECOMMENDATIONS

RELIABILITY, AVAILABILITY, AND MAINTAINABILITY (RAM)

As a result of industry recommendations in the early 1970's, the Services began a concerted effort to implement reliability growth testing as an integral part of the development process. This implementation consisted of a reliability growth process wherein a system is continually tested from the beginning of development, reliability problems are uncovered, and corrective actions are taken as soon as possible. The Services captured this practice in their reliability regulations, and the Department of Defense (DoD) issued a new military standard on reliability, which included reliability growth and development testing as a best practice task. The goal of this process from 1980 until the mid-1990's was to achieve good reliability by focusing on reliability fundamentals during design and manufacturing rather than merely setting numerical requirements and testing for compliance towards the end of development.

The general practice of reliability growth was discontinued in the mid-to-late 1990's, concurrent with the implementation of Acquisition Reform. This discontinuance may not be a direct result of Acquisition Reform, but may be related instead to the loss of key personnel and experience, as well as short-sighted attempts to save acquisition funds at the expense of increased life cycle costs. With the current DoD policy, most development contracts do not include a robust reliability growth program. The lack of failure prevention during design, and the resulting low initial Mean Time Between Failure (MTBF) and low growth potential are the most significant reasons that systems are failing to meet their operational reliability requirements.

An OSD Cost Analysis Improvement Group (CAIG) study[2] shows operations and sustainment account for two-thirds or more of a system's life-cycle cost. According to Army studies[3], almost 90% of the sustainment costs are directly correlated with the reliability of the system. Given the amount of resources consumed during sustainment, investments in reliability enhancements can provide a very large return on that investment. A case study[4] conducted by the Logistics Management Institute (LMI), provided data that indicated an investment in total program reliability equal to twice the average production unit cost would yield an approximate 35% reduction in support costs.

FINDINGS

- Acquisition personnel reductions combined with acquisition system changes in the last 15 years had a detrimental impact on RAM practices
  - With some exceptions, the practice of reliability growth methodologies was discontinued during System Design and Development (SDD)
  - Relevant military specifications, standards and other guidance were not used
  - Suitability criteria, including RAM, were de-emphasized

[2] See Appendix I. Costs based on data reported in recent DoD Visibility and Management of Operating and Support Costs (VAMOSC) for programs, projected over the probable service lives of the systems.
[3] Michael Cushing, David Mortin, and Steve Yuhas, Improving Army Materiel Reliability: A Business Case Approach, Washington, D.C., AEC and AMSAA, 2007.
[4] Jim Forbes, Presentation on Empirical Relationships Between Reliability Investments and Life-Cycle Support Costs, Washington, D.C., LMI Government Consulting, 2007.

- Improved RAM decreases life cycle costs and reduces demand on the logistics system
- The Deficiency Report (DR) can be a valuable tool for early identification of RAM-related suitability problems, when used in conjunction with an adequately resourced deficiency correction system

RECOMMENDATIONS

The single most important step necessary to correct high suitability failure rates is to ensure programs are formulated to execute a viable systems engineering strategy from the beginning, including a robust RAM program, as an integral part of design and development. No amount of testing will compensate for deficiencies in RAM program formulation. To this end, the following RAM-related actions are required as a minimum:

- Identify and define RAM requirements during the Joint Capabilities Integration Development System (JCIDS), and incorporate them in the Request for Proposal (RFP) as a mandatory contractual requirement
- During source selection, evaluate the bidders' approaches to satisfying RAM requirements
  - Ensure flow-down of RAM requirements to subcontractors
  - Require development of leading indicators to ensure RAM requirements are met
- Make RAM, to include a robust reliability growth program, a mandatory contractual requirement and document progress as part of every major program review
- Ensure that a credible reliability assessment is conducted during the various stages of the technical review process and that reliability criteria are achievable in an operational environment
- Strengthen program manager accountability for RAM-related achievements
- Develop a military standard for RAM development and testing that can be readily referenced in future DoD contracts
- Ensure a adequate cadre of experienced RAM personnel are part of the Service acquisition and engineering office staffs

ROLES AND RESPONSIBILITIES OF GOVERNMENT TEST AND EVALUATION ORGANIZATIONS

The role of the government in the DT process has evolved over the past 50 years. Historical catalysts for change have included technological advances, acquisition policy changes, government resource availability and, in recent years, the Global War on Terrorism (GWOT). The most significant acquisition policy changes in the past several decades were made as a part of Acquisition Reform in the mid-to-late 1990's. With some exceptions, there has been a significant decrease in government involvement in test planning, conduct and execution.

The traditional role of the government during the DT planning phase included the identification of the test resource requirements and government test facilities, the development of the test strategy and detailed test and evaluation plans, as well as the actual conduct of T&E. When a program moved from the planning phase to the test execution phase, the government traditionally participated in test conduct and analysis; performing an evaluation of the test results for the program office. With some exceptions, this is no longer the case. Until recently, it was recognized that there should be some level of government involvement and oversight even when the contractor has the primary responsibility regarding planning and execution of the DT program.

In addition to the reduction in the number of government acquisition and test personnel, the experience level of both government and industry personnel has steadily diminished in recent years. A significant percentage of the workforce became eligible to retire since 2000, and due to prior downsizing, there has not been a steady pipeline of younger technical personnel to replace them. As an example, Appendix I is a chart depicting near-term retirement eligibility for Major Range and Test Facility Base (MRTFB) personnel. Two-thirds or more of the senior civil service personal are eligible for retirement.

FINDINGS

The changes in the last 15 years, when aggregated, have had a significant negative impact on DoD's ability to successfully execute increasingly complex acquisition programs. Major contributors include massive workforce reductions in acquisition and test personnel, a lack of up-to-date process guidance in some acquisition organizations, acquisition process changes, as well as the high retirement rate of the most experienced technical and managerial personnel in government and industry without an adequate replacement pipeline.

- Major personnel reductions have strained the pool of experienced government test personnel
- A significant amount of developmental testing is currently performed without a needed degree of government involvement or oversight and in some cases, with limited government access to contractor data

RECOMMENDATIONS

- As a minimum, government test organizations should develop and retain a cadre of experienced T&E personnel to perform the following functions:
  - Participate in the translation of operational requirements into contract specifications, and in the source selection process, including RFP preparation
  - Participate in DT&E planning including Test and Evaluation Master Plan (TEMP) preparation and approval
  - Participate in technical review processes
  - Participate in test conduct, data analysis, and evaluation and reporting; with emphasis on analysis and reporting
- Utilize red teams, where appropriate, to compensate for shortages in skilled, experienced T&E domain and process experts
- Develop programs to attract and retain government personnel in T&E career fields so that the government can properly perform its role as a contract administrator and as a "smart buyer"

INTEGRATED TEST AND EVALUATION

Integrated testing is not a new concept within the Department of Defense, but its importance in recent years has been highlighted, due in part to the growth of asymmetric threats and the adoption of net-centric warfare. The December 2007 OSD Test and Evaluation Policy Revisions memorandum reinforces the need for integrated testing.[5] Implementation of integrated test concepts has been allowed to evolve on an ad-hoc basis. The time has come to pursue more consistency in integrated test planning and execution.

Collaboration between developmental and operational testers to build a robust integrated test program will increase the amount of operationally relevant data that can be used by both communities. DT and Operational Test (OT) planning is separate and this inhibits efforts by the Services to streamline test schedules, thereby increasing the acquisition timeline and program test costs.

Additionally, there is a widely held assumption by many in the OT community that only data from independent OT is acceptable for operational evaluation purposes. While not all information from DT may be useable by the Operational Test Agency (OTA) to support IOT&E, a significant amount of developmental test data can be used to partially satisfy OT requirements. More importantly, an operational perspective earlier in the developmental process has often proven to be a catalyst to early identification and correction of problems.

DoD policy should mandate integrated test planning and execution on all programs to the extent possible. To accomplish this, programs must establish a team made up of all relevant organizations (including contractors, developmental and operational test and evaluation communities) to create and manage the approach to incorporate integrated testing into the T&E Strategy and the TEMP.

FINDINGS

- Service acquisition programs are incorporating integrated testing to a limited degree through varying approaches
- Additional emphasis on integrated testing will result in greater T&E process efficiency and program cost reductions

RECOMMENDATIONS

- Implement OSD and Service policy[6] mandating integrated DT&E/OT&E planning and execution throughout the program
  - Require sharing and access to all appropriate system-level and selected component-level test and model data by government DT and OT organizations, as well as the prime contractor, where appropriate
  - Integrate test events, where practical, to satisfy OT and DT requirements

OPERATIONAL TEST READINESS REVIEW (OTRR)

Each Service has an Operational Test Readiness Review (OTRR) process. Although it varies from Service to Service, the process generally results in in-depth reviews of readiness to undergo an IOT&E event.

[5] See Appendix D.
[6] See Appendix D.

FINDINGS

- Department of Defense Instruction (DoDI) 5000.2 requires that "the Service Acquisition Executive (SAE) shall evaluate and determine materiel system readiness for IOT&E"
  - Decision authority is frequently delegated to the appropriate Program Executive Officer (PEO)
  - Materiel developer is also required to furnish DT&E report to the Under Secretary of Defense for Acquisition, Technology and Logistics (USD[AT&L]) and Director, Operational Test and Evaluation (DOT&E)
- Shortcomings in system performance, suitability, and RAM are usually identified during the OTRR
- In most cases, the operational test readiness certifying authority is well aware of the risk of not meeting OT criteria when major shortcomings exist
- Because of funding constraints, the low priority given to sustainment, as well as the urgency in recent years to get new capabilities to the Warfighter, major suitability shortcomings have rarely delayed the commencement of dedicated IOT&E

RECOMMENDATIONS

- Conduct periodic operational assessments to evaluate progress and the potential for achieving pre-determined entrance criteria for operational test events
- Conduct an independent Assessment of Operational Test Readiness (AOTR) prior to the OTRR (included in latest draft DODI 5000.2)
- Include a detailed RAM template in preparation for the OTRR
- Require the Command Acquisition Executive (CAE) to submit a report to OSD that provides the rationale for the readiness decision

OSD TEST AND EVALUATION ORGANIZATION

The Task Force was asked to assess OSD roles and responsibilities for T&E oversight. T&E has been a visible part of OSD since the early 1970's, reporting to the Research and Engineering command section when it was in charge of acquisition oversight and subsequently to the Under Secretary of Defense for Acquisition (now AT&L). The early T&E office was responsible for all T&E, ranges, resources oversight, and policy. In 1983, Congress established an independent Director, Operational Test and Evaluation (DOT&E) organization, reporting directly to the Secretary of Defense (SECDEF), responsible for operational test and evaluation policy, budget review, and assessments of operational effectiveness and suitability. The Live Fire Test (LFT) oversight function was created and added to the DT&E office responsibilities in the mid 1980's. Later, the LFT oversight function was moved to the DOT&E organization.

In 1999, the DT&E organization was dismantled by DoD. Many functions were moved to DOT&E, including test ranges and resources, and joint T&E oversight. Some of the remaining T&E personnel billets were eliminated to comply with a congressionally mandated (AT&L) acquisition staff reduction. The residual DT&E policy and oversight functions were separated and moved lower in the AT&L organization.

A 2000 DSB Task Force Study on Test and Evaluation Capabilities recommended that DoD create a test and evaluation resource enterprise within the office of the DOT&E to provide more centralized management of T&E facilities. This recommendation ultimately led to removing the test ranges and resources oversight from DOT&E, abandoning the notion of centralized management, and the establishment of the Test Resource Management Center (TRMC) in AT&L (as directed by the National Defense Authorization Act for Fiscal Year 2003).

FINDINGS

Current policy as of December 2007 mandates that developmental and operational test activities be integrated and seamless throughout the system life cycle. There must be enough experts in OSD with the ability to understand and articulate lessons learned in early testing and the ability to execute the new T&E policy. That policy is to "take into account all available and relevant data and information from contractors and government sources" in order to "maximize the efficiency of the T&E process and effectively integrate developmental and operational T&E."[7]

- Currently there is not an OSD organization with comprehensive DT oversight responsibility, authority or staff to coordinate with the operational test office
  - The historic DT organization has been broken up and residual DT functions were moved lower in organization in 1999, and lower yet in 2002
  - Programmatic DT oversight is limited by staff size and often performed by generalists vice T&E experts
  - Recruitment of senior field test personnel is hampered by DT's organizational status
  - Existing residual organizations are fragmented and lack clout to provide DT guidance
  - System performance information and DT lessons learned across DoD has been lost
  - DT is not viewed as a key element in AT&L system acquisition oversight
  - Documentation of DT results by OSD is minimal
- Access to models, data, and analysis results is restricted by current practice in acquisition contracting, and the lack of expertise in the DT organization
- TRMC has minimal input to program-specific questions or interaction with oversight organizations on specific programs
  - Organizational separation is an impediment

RECOMMENDATIONS

- Implementation of integrated and seamless DT and OT will require, at a minimum, greater coordination and cooperation between all testing organizations
- Consolidate DT-related functions in AT&L to help reestablish a focused, integrated, and robust organization[8]
  - Program oversight and policy, and Foreign Comparative Test (FCT)
  - Have Director, DT&E directly report to Deputy Under Secretary of Defense, Acquisition and Technology (DUSD[A&T])

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[7] See Appendix D.
[8] Three Task Force members out of fourteen voted against consolidation.

  - Restore TEMP approval authority to Director, DT&E
- Integrate TRMC activities early into DT program planning
  - Make TRMC responsible for reviewing the resources portion of the TEMP
- If such an organization is established and proves itself effective, consider as part of a future consolidation moving LFT back to its original DT location (this would require congressional action and DOT&E concurrence)

Most of the organizational changes recommended above are within the purview of AT&L. The LFT change requires the concurrence of DOT&E and a legislative change to Title 10 because of the change in reporting official. All the other recommendations made throughout the report can be implemented within current DoD authority.

OTHER ISSUES

Several other issues were addressed as a part of the study. A discussion of each of the following topics, along with findings and recommendations, may be found in the body of the report.

- Program Structure
- Requirements Definition
- Contractual Performance Requirements
- Alignment of DoD Technology with Systems Engineering Procedures
- Commercial Off-The-Shelf (COTS)
- Systems of Systems (SoS)

DEPARTMENT OF DEFENSE

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