Reintegration of Sustainment into Systems Engineering During the Department of Defense Acquisition Process

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SUMMARY & CONCLUSIONS

One of the major unintended consequences of Acquisition Reform efforts during the 1990s was a reduction in rigor of sustainment planning and effectiveness throughout materiel development programs. As the evidence of this problem mounted over the past decade, the Department of Defense (DoD) initiated efforts to rejuvenate sustainment planning during the early phases of program development. This article provides brief descriptions of the actions that have been taken, or that are being planned, to achieve this goal.

BACKGROUND

Starting in the mid-1990s, the DoD acquisition community recognized and documented two disturbing trends across Major Defense Acquisition Programs (MDAPs): A decreasing percentage of systems were meeting their established reliability requirements, and the cost of supporting fielded systems was increasingly higher than expected. Two major reports, one by the Government Accountability Office (GAO) and the second by a Defense Science Board (DSB) task force, recommended significant changes in acquisition policies to address these issues.

The GAO report, “Setting Requirements Differently Could Reduce Weapon Systems’ Total Ownership Costs” [1], concluded that the requirements generation process should:

• Include “…total ownership cost, especially operating and support cost, and weapon system readiness rates as performance parameters equal in priority to any other performance parameters for any major weapon system before beginning the acquisition program”;

• Require “…the product developer establish a firm estimate of a weapon system’s reliability based on demonstrated reliability rates at the component and subsystem level no later than …the system-level critical design review” and “…at the system level no later than the full-rate production decision”; and

• Structure “…contracts for major systems acquisitions so that…the product developer has incentives to ensure that proper trades are made between reliability and performance prior to the production decision.”

The second report, “Report of the Defense Science Board Task Force on Developmental Test and Evaluation” [2], examined the cause of the increasing trend in unsuitable system reliability performance. The related recommendation of the DSB report included the following: “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.” The remaining parts of this article describe the steps taken by DoD to address these recommendations.

THE RELIABILITY IMPROVEMENT WORKING GROUP

DoD chartered the Reliability Improvement Working Group (RIWG) to implement the recommendations of the DSB. The RIWG operated for 6 months in 2008 and published its report on September 4, 2008. Chaired by DOT&E and AT&L, the RIWG membership was drawn from stakeholders across DoD and the Services. Some relevant RIWG outputs are discussed below.

1.1 RAM Policy Memo

In July 2008, the Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L) issued a memo defining Reliability, Availability, and Maintainability (RAM) policy [3]. In part, the memo directs that “…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. In addition, RAM shall be integrated within the systems engineering processes, documented in the program’s System Engineering Plan and Life Cycle Sustainment Plan, and assessed during technical reviews, test and evaluation, and Program Support Reviews.”

1.2 Sample Contract Language

The RIWG identified a need for RAM-specific language to be included in DoD acquisition contracts. To facilitate this, the RIWG created tailorable samples for Statements of Work (Section C), Proposal Instructions (Section L), and Evaluation Factors for Award (Section M) along with a checklist for evaluating Reliability Program Plans [4].

1.3 Implementation of the AMSAA Scorecard

One problem that often faces government source selection teams is how to evaluate the ability of an offeror to develop a “viable RAM strategy.” The RIWG adapted an Army tool, the
Army Materiel Systems Analysis Activity (AMSAA) Scorecard [5], to help in the assessment of both the program office and contractor’s system reliability efforts. The scorecard includes focus areas for reliability requirements and planning; reliability testing; failure tracking and reporting; and verification and validation. Applied early in the program, the scorecard can identify areas for improvement before significant problems emerge.

CURRENT SUSTAINMENT POLICY

1.4 DoDI 5000.02 Revision

The RIWG products and recommendations, including the RAM Policy Memo, were incorporated into DoD Instruction 5000.02, “Operation of the Defense Acquisition System,” dated December 8, 2008. This update also shifted systems engineering activities, including the RAM and sustainment activities, to earlier in the system development process. The process now starts with a Materiel Development Decision and progresses through the Milestone A, B, and C points. An effect of this change is the need to develop initial Sustainment Key Performance Parameter (KPP) and Key System Attribute (KSA) values before Milestone A, refined to final values by Milestone B, and demonstrated by Milestone C. Subsystem and component reliability must be demonstrated before the end of the Engineering and Manufacturing Development phase, and system-level reliability must be demonstrated by the Full-Rate Production decision point.

1.5 CJCSM 3170.01 Revisions

In June 2009 the Chairman of the Joint Chiefs of Staff (CJCS) released a revised version of CJCSM 3170.01, which fully implemented the direction of DoD Instruction 5000.02. Also included in this change were revised definitions of the elements of the Sustainment KPP. The KPP is now Availability with two subcomponents: Materiel Availability ($A_M$) and Operational Availability ($A_O$). The Materiel Availability KSA has been changed to Reliability with components of mission reliability to support Operational Availability and logistics (or basic) reliability to support Materiel Availability. The major relationship between $A_M$ and $A_O$ is described in paragraph 4.3. The Ownership Cost KSA description now indicates that the elements listed are the minimum set that must be covered.

1.6 Defense Acquisition Program Support Methodology, Version 2.0

One of the major systems engineering activities of the DoD acquisition process is the application of a systematic program review process throughout the development cycle. These reviews are led by the program support office, recently reorganized under the Director, Defense Research and Engineering (DDR&E) within OUSD(AT&L). One of the major tools the program support teams use is the Defense Acquisition Program Support (DAPS) Methodology. The current DAPS, V2.0, includes a section on RAM (5.2 Suitability) that reflects the direction of 5000.02 and 3170.01.

The Suitability section includes subsections on Reliability, Availability, and Maintainability (RAM). Each subsection contains program phase-specific questions that are answered during the evaluation process. Program managers and RAM engineers should review the DAPS as appropriate when preparing for the mandated system reviews.

SUSTAINMENT KPP AND THE RAM-C RATIONALE REPORT MANUAL

1.7 Origins

The Sustainment KPP was originally included in the May 2007 version of CJCSM 3170.01, but implementation across DoD acquisition has been slow because of confusion about how Materiel Availability was different from Operational Availability. The problem became so acute that elements of OUSD(AT&L) began to develop a how-to manual in late 2007. The resulting RAM-C Rationale Report Manual was released in June 2009 [6]. The manual describes how the program manager and combat developer work together to develop and demonstrate valid sustainment requirements based on stated user needs.

1.8 Availability Considerations in the Sustainment KPP

Combat developers usually focus on operational requirements during requirements generation. While this is appropriate for identifying the user’s needs, it can and does lead to incomplete definition of system RAM requirements. Creating RAM metrics based on a subset of fielded systems—such as a combat brigade or squadron—leaves out the very important question of how those metrics are met. For instance, since availability is a function of both the reliability of the system in the assigned use environment and the time it takes to restore a failed system to operational status (i.e., the Maintenance Downtime or MDT), one approach to gain higher $A_O$ is to decrease the MDT through larger support organizations (more spares, more repair personnel, buying system level spares, etc.). The issue at hand is that for most major programs, life cycle support costs can be 75% or more of the program’s life cycle costs. It is in the best interest of all stakeholders to optimize the elements of RAM in order to provide warfighters with the capability they need at a price that the Service or Developing Agency can afford and sustain.

$A_M$ facilitates the optimization process through developing trade space between the elements of reliability, availability, maintainability, and cost. The major difference between $A_M$ and $A_O$ is that $A_M$ applies to the entire population of the system being developed vice the unit-level focus of $A_O$. An example of the problem would be that a unit with 20 systems and an $A_O$ requirement of 0.95 would need an average of 19 systems operationally ready at any time. One way to meet this requirement would be to have multiple system-level spares held in reserve to replace failed systems. Another way would be to have spare parts and maintenance personnel available in sufficient numbers to quickly restore the failed systems. Yet another approach would be to increase system reliability to the point at which the requirement will be met.
through low failure rates. From the unit’s point of view, it doesn’t matter if a failed system is replaced with a spare or repaired within the acceptable MDT as either method will provide the required $A_o$.

From the acquisition management point of view the question should be: Which of the three methods is the best way to meet the user’s need? A much broader view is required to answer this correctly, since the total acquisition cost will be affected by how many systems are purchased, which is related to the support approach. Acquisition costs could also be affected by the design reliability goals—although it has been shown that costs required to increase reliability during system design or update are almost universally recovered through lower ownership cost—but the development horizon of most defense acquisition efforts leads the program manager to focus on reducing acquisition costs even if it results in increased life cycle costs. The analyses required by the Sustainment KPP are meant to provide the proper visibility to life cycle costs during system design when the opportunity for cost reduction through relatively inexpensive redesign are most available.

1.9 Example of Trade Space Between $A_O$ and $A_M$

Consider a procurement program in which 120 systems are going to be acquired with a yearly use profile of one-third operational, one-third ready for use, and one-third in reset. The user community requirement is a threshold $A_O$ of 95% and an objective of 97.5% for the operational and ready-for-use systems. The systems in reset are considered as down. The threshold value requires 76 of the 80 operational or ready-for-use systems to be up while the objective requires 78 to be up. Thus the $A_M$ values associated with the threshold and objective are 0.633 and 0.650 respectively. The program manager must determine the optimal mix of spare systems and support activities required to provide the operational capability the user needs. The optimal mix will be based on life cycle costs of the various alternatives. An approach addressing the problem through additional spare systems will have greater acquisition and ownership costs. Implementation of a design for reliability program will nearly always reduce ownership costs while increasing operational performance at the cost of a smaller increase in acquisition cost. Early evaluation of these costs to allow informed decisions about the program under development is the result of proper application of the Sustainment KPP.

REFERENCES


BIOGRAPHY

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