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FY 2012 Annual Report

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Department of Defense Systems Engineering FY 2012 Annual Report

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1 EXECUTIVE SUMMARY

Systems engineering is a methodical and disciplined approach for the specification, design, development, realization, technical management, operations, and retirement of a system. The Deputy Assistant Secretary of Defense for Systems Engineering (DASD(SE)) provides this report in response to 10 U.S.C. 139b and 2430 note addressing the systems engineering capabilities of the Department of Defense (DoD) and systems engineering activities relating to the Major Defense Acquisition Programs (MDAPs). This report includes:

- A discussion of the extent to which the MDAPs are fulfilling the objectives of their systems engineering plans.
- A discussion of the waivers of and deviations from requirements in Systems Engineering Plans (SEPs) that occurred during the preceding year with respect to such programs; any concerns raised by such waivers or deviations; and the actions that have been taken or are planned to be taken to address such concerns.
- An assessment of the organization and capabilities of the DoD for SE and development planning with respect to such programs.
- Any comments on such report that the Secretary of Defense considers appropriate.

This report presents an overview of the Department's FY 2012 progress in implementing Section 139(b) of the Weapon Systems Acquisition Reform Act (WSARA) as well as plans and focus areas for FY 2013. The Department continues its commitment to advance the practice of systems engineering as a key enabler of successful acquisition throughout the Department.

Section 2 summarizes DASD(SE)'s major activities in the areas of policy and guidance, program engagement, and workforce development, through which DASD(SE) continues its efforts to improve the Department's systems engineering capability. DASD(SE) also sponsored the DoD Systems Engineering Forum, bringing together systems engineering leaders from across the Department.

DASD(SE) is nearing completion of a major update to Chapter 4, "Systems Engineering," of the Defense Acquisition Guidebook (DAG), the Department's primary guidance document. In addition, DASD(SE) developed a new DAG chapter, "Program Protection," to support the Department's trusted systems and networks strategy. DASD(SE) continued to implement policy and guidance to improve reliability and maintainability (R&M) throughout the Department.

DASD(SE) is supporting the requirements development and program initiation process by implementing development planning policy. During FY 2012, DASD(SE) leveraged the Department-wide Development Planning Working Group (DPWG) to develop a common understanding of development planning across the Department and to enable consistent implementation of development planning activities. DASD(SE)'s pre-Materiel Development Decision activities focus on ensuring programs have realistic requirements and expectations by shaping program technical strategies, identifying capability gaps, and ensuring the AoA effort assesses technical risks in areas such as R&M, manufacturing readiness, and schedule.

DASD(SE) continued to work closely with MDAP and Major Automated Information System (MAIS) teams on effective technical planning and program execution. DASD(SE) provides structured reviews of formal acquisition documents and performs technical reviews and assessments throughout the acquisition life cycle. DASD(SE) also conducts in-depth reviews of software and integration risk to enhance software rigor, to emphasize the systems engineering integration process, and to look for systemic issues.

Section 3 summarizes the Military Departments' systems engineering self-assessments, provided in their entirety in appendices A through C. The report highlights the progress of the Military Departments in establishing systems engineering leadership, aligning their organizations to enable effective technical authority and execution, and developing and implementing systems engineering policy to support acquisition programs during all phases of the acquisition life cycle. Each Military Department has outlined its approach to implementing key provisions of the WSARA, including development planning and early systems engineering, R&M, and systems engineering support to the Joint Capabilities Integration and Development System (JCIDS) and contracting.

The Military Departments, in partnership with DASD(SE), continue to make workforce development a priority for effective systems engineering through a diverse set of initiatives to attract and retain a qualified systems engineering workforce and support the implementation of Key Leadership Position (KLP) legislation and policy. The Department's current systems engineering workforce projections continue to remain steady, with little growth through FY 2018. DASD(SE) continues to ensure that certification standards meet the Department's needs and that the standards continue to be refreshed to meet emerging demands.

Section 4 contains assessments of 46 selected MDAPs, MAISs, and special interest programs that were the focus of significant DASD(SE) activity in FY 2012. The assessments provide a brief status of program SEPs, Program Protection Plans (PPPs), requirements, and measurable performance criteria. The assessments also summarize DASD(SE) involvement in program reviews.

By developing systems engineering and development planning policy, guidance, and performance measures, and by implementing and continuously assessing the effectiveness of these initiatives, the Department has demonstrated a commitment to improving systems engineering as a critical function to support defense acquisition. The Department's FY 2012 achievements and FY 2013 plans captured in this report are a further step toward implementing and institutionalizing WSARA provisions to improve systems engineering, as acknowledged in the recent GAO Report 13-103, "Weapons Acquisition Reform: Reform Act Is Helping DoD Acquisition Programs Reduce Risk, but Implementation Challenges Remain" (December 2012). The Department understands it will continue to face the challenge of budgetary pressures and remains committed to sustaining the progress made to date in growing the Department's systems engineering capability.

2 DASD(SE) ACTIVITIES

In FY 2012, DASD(SE) was involved in developing and implementing systems engineering and related specialty engineering policy and guidance to better balance warfighter needs against cost, schedule, and risk while improving program execution and delivery of needed capabilities.

DASD(SE) maintains continuous engagement with the defense systems engineering community through activities including the DoD Systems Engineering Forum. As required by DoDI 5134.16, DASD(SE) leads regular forum meetings to encourage collaboration, leverage systems engineering activities within and across the Components, and institutionalize systems engineering and development planning across the Department. The forum includes senior-level representatives from the Military Departments and the Office of the Secretary of Defense as well as other Government agencies with strong systems engineering interest. DASD(SE) chaired five DoD Systems Engineering Forum meetings during FY 2012, focusing on the initiatives described in this report. The following paragraphs further summarize significant DASD(SE) activities.

2.1 Policy and Guidance

DASD(SE) developed, updated, and continued implementing systems engineering policy and guidance across the Department in response to issues and risks identified during program execution. DASD(SE) continued implementing the development planning and reliability and maintainability (R&M) policies released in the past 2 years. DASD(SE) is preparing a major update to the Defense Acquisition Guidebook (DAG) Chapter 4, "Systems Engineering," and coordinated with the Joint Staff on its update of CJCSI 3170.01H, "Joint Capabilities Integration and Development System." DASD(SE) also released new and updated policy and guidance in areas that influence engineering design, development, and life cycle support of systems, including open systems architecture, counterfeit prevention, value engineering, manufacturing, system safety, system security engineering, and modeling and simulation.

2.1.1 Development Planning

DASD(SE) continues to implement Directive-Type Memorandum (DTM) 10-017, "Development Planning to Inform Materiel Development Decision (MDD) Reviews and Support Analyses of Alternatives (AoA)," which established policy that enables the Milestone Decision Authority to make informed decisions based on a sound technical foundation at the earliest stages of an acquisition program. Section 2.2, Program Engagement and Oversight, describes DASD(SE)'s engagement with the operational and capability sponsors early in the acquisition life cycle.

DASD(SE) continued the Department-wide Development Planning Working Group (DPWG) during FY 2012. The group includes representatives from the three Military Departments, the Office of the Director for Cost Assessment and Program Evaluation (CAPE), Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) organizations such as DASD for Strategic and Tactical Systems and the Defense Threat Reduction Agency, and the Joint Staff. In FY 2012, the DPWG focused on clarifying the definition and content of Materiel Solution Analysis phase technical activities and developing guidance. The goal of this effort was to develop a common understanding

of development planning across the Department and to enable consistent implementation of development planning activities. The DPWG serves as a forum to facilitate the sharing of current and emerging information across the development planning community of practice.

2.1.2 DTM 11-003, "Reliability Analysis, Planning, Tracking, and Reporting"

The purpose of DTM 11-003 is to amplify the procedures in DoD Instruction (DoDI) 5000.02, "Operation of the Defense Acquisition System," to improve reliability analysis, planning, tracking, and reporting by institutionalizing reliability planning methods and reporting requirements aligned with key acquisition activities. In FY 2012, DASD(SE) undertook several efforts in the areas of policy, guidance, and workforce development to continue implementing this policy.

1. To track and monitor reliability growth throughout the acquisition process, DTM 11-003 mandated the reporting of reliability growth status at Defense Acquisition Executive Summary (DAES) reviews. DASD(SE) has taken the lead in this effort and is working with stakeholders to define requirements and capabilities needed to incorporate reliability growth status into a Department-wide data system.
2. To assist MDAPs in implementing the R&M engineering activities mandated by DTM 11-003, DASD(SE) is developing detailed lower-level R&M guidance. The guidance describes R&M tasks and activities by life cycle phase and program functional area. The guidance also contains sample contracting language for R&M engineering activities that can be tailored by acquisition life cycle phase and program acquisition strategy. The guidance will be released in FY 2013.
3. To strengthen the R&M engineering capacity and capability in the acquisition workforce, DASD(SE), in collaboration with the Defense Acquisition University (DAU) and Military Department R&M leadership, is developing a human capital strategy. The human capital strategy includes defining the R&M engineering competencies and skills and creating an R&M learning architecture aimed at defining specific competencies, courses, certifications, experiences, and professional training required for R&M engineers executing R&M activities during different phases of the acquisition life cycle.

2.1.3 Systems Engineering in Joint Capabilities Integration and Development System

In FY 2012, DASD(SE) increased its engagement with the Joint Staff to promote greater awareness of systems engineering principles during requirements development. DASD(SE) contributed to the update of CJCSI 3170.01H, "Joint Capabilities Integration and Development System," in January 2012. DASD(SE) reviews Initial Capabilities Documents (ICDs) and provides feedback to the Joint Staff. DASD(SE) participation provides additional and earlier opportunities for systems engineering engagement with the Joint Staff as it defines the Department's requisite capabilities, including the capabilities' key attributes. This early communication provides for a disciplined approach to analyzing alternative solutions and balances technical risks in selecting achievable key performance parameters (KPPs).

2.1.4 Defense Acquisition Guidebook Chapter 4

In FY 2012, DASD(SE) launched a major effort to rewrite DAG Chapter 4, "Systems Engineering." The goal for the update is to provide overarching guidance that sets expectations and offers clear direction on applying systems engineering fundamentals. The chapter will be released in FY 2013.

The chapter supports the program manager and systems engineer, ensuring systems engineering processes are flexible, effective, and tailored for the complexity and risk of the system under development. The chapter provides guidance to help programs execute a balanced systems engineering approach in delivering capability to the warfighter while systematically increasing system maturity and reducing technical risk over the acquisition life cycle. The update reflects recent policy changes, including the USD(AT&L) Better Buying Power initiatives, and emphasizes how the systems engineer contributes to establishing and achieving affordable programs. Changes to the chapter are informed by lessons learned and by findings from the Military Departments, program engagement, and practitioner insight, all of which help ensure the update addresses the challenges of program implementation.

2.1.5 Additional Engineering Policy and Guidance

To help manage acquisition program risk and reduce costs, DASD(SE) led or supported efforts to identify needed policy and guidance in areas including open systems architecture, counterfeit prevention, value engineering, manufacturing, system safety, system security engineering, and modeling and simulation. These efforts respond to directed legislation, support the USD(AT&L) Better Buying Power initiatives, or align with DASD(SE)'s responsibility for standardization as the Defense Standardization Executive.

Open Systems Architecture. DASD(SE) continues to contribute to the Open Systems Architecture Data Rights Team to mature the DoD Open Systems Architecture Contract Guidebook for Program Managers and associated technical data rights guidance. The increased use of modular, open architectures will enable competition for upgrades, as required by statute and emphasized in the USD(AT&L) Better Buying Power initiatives. The guidance is intended to improve the adoption of open systems architectures in DoD systems. The team released draft version 0.1 of the guidebook for program managers to use to incorporate open systems architecture principles into programs.

Counterfeit Prevention. DASD(SE) was a primary contributor to the USD(AT&L) memorandum "Overarching DoD Counterfeit Prevention Guidance," approved on March 16, 2012. The memorandum responds to the FY 2012 National Defense Authorization Act (NDAA), Section 818. It formally defines counterfeit materiel, directs use of the Program Protection Plan (PPP) to evaluate and implement countermeasures, and leverages reporting of suspected or confirmed counterfeit items through the Government-Industry Data Exchange Program (GIDEP). This policy emphasizes early detection to prevent the introduction of counterfeit materiel into the DoD supply chain commensurate with the risk associated with system performance or operation, the preservation of life, and safety of operating personnel.

Value Engineering. DASD(SE) manages the value engineering program, which received renewed emphasis with the USD(AT&L) memorandum "Value Engineering and Obtaining Greater Efficiency

and Productivity in Defense Spending," December 6, 2011. The memorandum responds to 41 U.S.C. section 432 and directs the establishment of annual value engineering targets with quarterly progress updates. These efforts identified a combined actual savings and cost avoidance of $4.7 billion during FY 2011. During FY 2012, DoD recognized organizations that executed in-house value engineering proposals and accepted contractor-initiated value engineering change proposals.

Manufacturing. DASD(SE) supported the Joint Service and Industry Manufacturing Readiness Level Working Group with the development and release of the Manufacturing Readiness Level Deskbook, Version 2.2 in July 2012. This deskbook, updated in response to the FY 2011 NDAA, Section 812, focuses on identifying risks and updating the knowledge areas related to quality, supply chain, and diminishing manufacturing sources and material shortages (DMSMS).

System Safety. DASD(SE) supported a major update to the military standard MIL-STD-882E, "System Safety," approved on May 11, 2012. This system safety standard practice identifies the DoD approach for identifying hazards and assessing and mitigating associated risks encountered in the development, test, production, use, and disposal of defense systems. This revision incorporates changes to meet Government and industry requests to reinstate task descriptions; aligns the standard practice with current DoD policy; supports DoD strategic plans and goals; and adjusts the organizational arrangement of information to improve hazard management practices. This standard strengthens the integration of other functional disciplines into systems engineering to improve the consistency of hazard management practices across acquisition programs.

System Security Engineering. DASD(SE) spearheaded the revitalization of system security engineering to establish it as a recognized, necessary discipline within systems engineering. In support of this effort, DASD(SE) collaborated closely with the DoD Chief Information Officer (CIO) on DoDI 5200.44, "Protection of Mission Critical Functions to Achieve Trusted Systems and Networks (TSN)," released November 5, 2012. This instruction implements the DoD's TSN strategy to provide uncompromised weapons and information systems through program protection and information assurance (IA) implementation.

The TSN strategy integrates robust systems engineering, supply chain risk management (SCRM), security, counterintelligence, intelligence, information assurance, hardware and software assurance, and information system security engineering disciplines to manage risks to system integrity and trust. DASD(SE) established a framework for program managers, engineers, and system security engineers to perform risk-based assessment and mitigation as part of DoD's systems engineering practice. This framework is aligned with implementation of the Department's Trusted Defense Systems Strategy and DoD's acquisition policy on program protection planning.

DASD(SE) wrote the new DAG Chapter 13, "Program Protection," released in October 2012, and created a DAU seminar for program managers on implementing system security engineering methods during the early phases of the acquisition life cycle. DASD(SE) delivered the seminar to program offices and engineering staffs in the Military Departments and at two industry events.

Software assurance (SwA) is one focus area within system security engineering. DASD(SE) partnered with DoD CIO and the National Security Agency to establish an enterprise-level community of practice (CoP) for SwA as part of the DoD SwA strategy. The SwA CoP finds and promulgates best practices and supports key DoD SwA initiatives. Its objectives are to provide

program managers with an operational framework that more efficiently incorporates SwA within acquisition processes; enable access to SwA tools and their use; and develop education and training content for the acquisition workforce. In FY 2012, DASD(SE) engaged the CoP in developing the new DAG chapter on program protection planning and to establish a DoD definition for SwA to underpin a more uniform software security framework across the Department. DASD(SE) also initiated a state-of-the-art study of static and dynamic code analysis tools and processes for software test that addresses hardware, software, and their interoperation. This study is scheduled to conclude in 2013.

Modeling and Simulation. DASD(SE), working with the Acquisition Modeling and Simulation Working Group, increased the emphasis on modeling and simulation within defense acquisition with the release of three documents in FY 2012: DoDI 5000.70, "Management of DoD Modeling and Simulation Activities," in May 2012; the updated military standard MIL-STD-3022, "Documentation of Verification, Validation, and Accreditation (VV&A) for Models and Simulations," in April 2012; and the "Systems Engineering Modeling, Simulation, and Analysis Fundamentals" in July 2012 (updated January 2013). Collectively, these documents emphasize the importance of modeling and simulation capabilities to address joint and system of systems (SoS) requirements during system design, interoperability, and activities across the acquisition life cycle.

2.2 Program Engagement and Oversight

DASD(SE) engages with MDAPs and Major Automated Information System (MAIS) programs and provides engineering oversight throughout all phases of the acquisition life cycle. This oversight supports DASD(SE)'s statutory responsibility to provide engineering advice to the Secretary of Defense, obligation to support USD(AT&L) acquisition decisions, and goal to assist programs in engineering capable and affordable systems. Figure 2-1 shows key DASD(SE) life cycle engagements. DASD(SE) program development planning efforts include pre-Milestone A activities such as review of the program ICD and the AoA study guidance and plan.

DASD(SE) participates in AoA Senior Advisory Group meetings, Systems Engineering Working Integrated Product Team (SE WIPT) meetings, and Systems Engineering Technical Reviews (SETRs) (including Preliminary Design Review (PDR)/Critical Design Review (CDR) assessments), and conducts program assessments to support program milestone decisions. Systems Engineering Plans (SEPs) and requirements documents serve as the principal roadmap to assist program managers in performing a coordinated effort encompassing systems engineering, development, production, and requirements verification. The DASD(SE) is the approval authority for all MDAP and MAIS program SEPs. DASD(SE) uses its Defense Acquisition Program Support (DAPS) methodology to independently assess program planning and execution. Results of assessments are documented and used to inform subsequent analysis with the goal of influencing future policy and guidance.

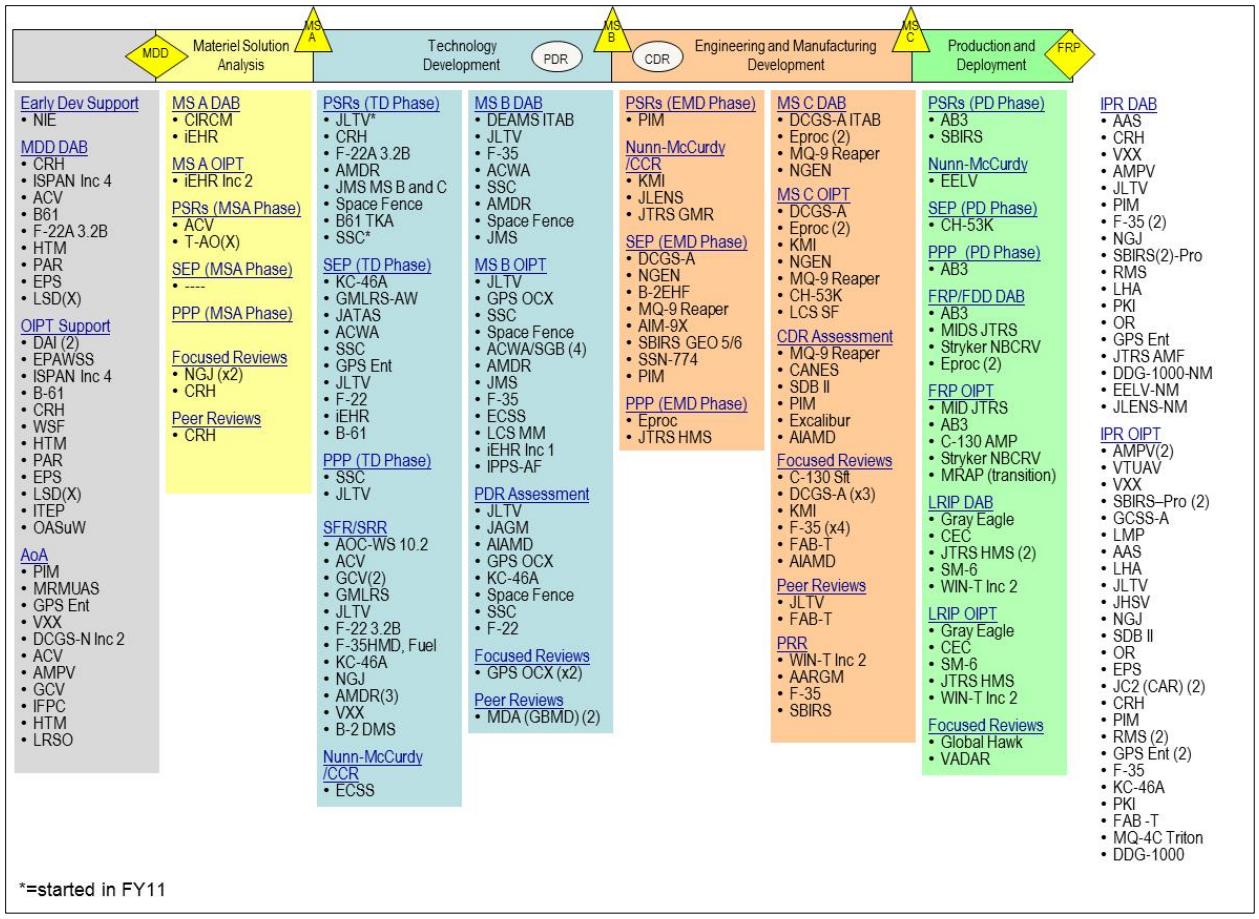

Figure 2-1. DASD(SE) Program Engagements

2.2.1 Development Planning

DASD(SE) conducts pre-MDD activities as part of the development planning effort to help shape program technical strategies and establish programs with realistic requirements and expectations. Systems engineering objectives include understanding the capability gaps and ensuring the AoA assesses technical risks in areas such as reliability, maintainability, manufacturing readiness, and schedule. In FY 2012, DASD(SE) reviewed 14 ICDs prior to Joint Requirements Oversight Council (JROC) approval, provided direct support to 9 pre-MDAPs preparing for an MDD review, and supported 55 AoA working group meetings (Table 2-1).

Table 2-1. Development Planning (Early SE)

ICDs Reviewed	AoA Engagement	MDDs	Draft CDDs
14	55 (18 programs)	9	5

Early systems engineering efforts continue through the Milestone A decision. DASD(SE) normally conducts a Program Support Review (PSR) before the milestone decision to help shape the Technology Development (TD) phase technical approach and identify risks. DASD(SE) works with the program office to develop the SEP. DASD(SE) engages with program offices and Military Department sponsors of draft Capability Development Documents (CDDs) to review the draft requirements that will shape the TD phase efforts, enabling informed requirements trade decisions that balance cost and performance. DASD(SE) informs senior leaders of engineering risks and concerns, ensuring they have a well-founded assessment of the technical risks to enable knowledgeable program decisions.

2.2.2 Performance Measures and Metrics

As confirmed by GAO Report 13-103, "Weapons Acquisition Reform: Reform Act Is Helping DoD Acquisition Programs Reduce Risk, but Implementation Challenges Remain," DASD(SE) completed the action directed in the Weapon Systems Acquisition Reform Act (WSARA) to develop systems engineering performance measures and metrics to assess each program's ability to execute its SEP and address risks identified in prior reviews. Programs are required to provide an overview of their technical performance measures (TPMs) and other metrics in the SEP along with the program's approach to monitor execution to the established plan. DASD(SE) reviews these metrics in assessing a program's systems engineering planning and track's the program's execution to the plan.

2.2.3 Systems Engineering Plan Development, Review, and Approval

DASD(SE) reviews and approves SEPs for MDAPs and MAIS programs. DASD(SE) provides technical guidance and assistance and also participates in Program Management Office (PMO)-organized SE WIPTs, to help shape technical planning and documentation of the SEP. Table 2-2 summarizes these FY 2012 SEP-related activities. DASD(SE) will engage PMOs approximately 6 to 12 months before the program's next milestone review, to support SEP development. Typically, SEPs developed and reviewed in one fiscal year are approved in the following year, as programs will engage DASD(SE) up to a year before a major milestone event to support SEP development and formal approval. In FY 2012, DASD(SE) reviewed 34 program SEPs and approved 19.

Table 2-2. FY 2012 SEP Review and Approval Activity

Major Programs	SEPs Reviewed	SEPs Approved*
Total ACAT I Programs	34	19

*Note: 10 SEPs reviewed in FY 2011 were approved in FY 2012, and 22 SEPs reviewed in FY 2012 are expected to be approved in FY 2013.

The 2011 SEP Outline and guidance includes specific attention to program dependencies and management of external relationships in recognition that it is critical to ensure that acquisition programs consider impacts of operational and system context in their technical planning. In FY 2012, DASD(SE) reviewed 47 programs and conducted an analysis of the treatment of SoS by MDAPs to identify areas for attention.

The analysis revealed that acquisition programs of all types (systems, platforms, and SoS) are addressing SoS considerations in their SEPs. However, the analysis identified areas that needed attention by the programs for adequate SoS planning, including understanding system context and managing external relationships. Platform issues include the integration of hardware from external programs, particularly size, weight, power, and cooling (SWAP-C) considerations. SoS program issues concern the complexities of an acquisition dependent on multiple independent players. DASD(SE) will provide increased reinforcement in these areas and will work with the Military Departments, Agencies, and DAU to reinforce proper SoS planning across the acquisition and systems engineering community.

2.2.4 Program Protection Plan

The PPP Outline emphasizes full life cycle planning and execution of all security activities in an acquisition program. To facilitate the review of the PPP, DASD(SE) developed a review methodology similar to the one used to review a program SEP. Engaging early with programs, in FY 2012, DASD(SE) reviewed and supported development of 30 PPPs. The USD(AT&L) approved five PPPs.

2.2.5 Systems Engineering Technical Reviews and Assessments

DASD(SE) provides systems engineering technical oversight, guidance, and assessments through continuous program engagements, PSRs, and focused independent reviews of major programs. DASD(SE) engagement during SETRs and SE WIPTs provides technical insight into program performance and health. In technical support reviews such as PSRs, DASD(SE) uses the DAPS methodology (see Section 2.2.6) to assess program health. Reviews are conducted on major programs before and in support of an Overarching Integrated Product Team (OIPT) or DAB review. Typically, reviews focus on the PMO to help shape a program's technical and management processes to ensure positive outcomes, assess program health, and increase the probability of program success. DASD(SE) engagements are balanced across Military Departments, system domains, and the product development life cycle.

DASD(SE) conducted the following types of systems engineering activities in FY 2012:

1. Program Support Reviews (PSRs) – PSRs are conducted on Acquisition Category (ACAT) ID and ACAT IAM programs in accordance with DoDI 5000.02. DASD(SE) engineers, with support from other Office of the Secretary of Defense (OSD) organizations, meet with the program office and the prime contractor's engineering staffs (when appropriate) to discuss either the program's technical planning and management approaches or progress demonstrated during the acquisition phase as well as plans to mitigate technical risks and issues. PSRs are conducted in advance of acquisition milestones in order to inform program planning and resolve issues well before a milestone decision and, when possible, are conducted in conjunction with Military Department-level reviews. PSR results then support and inform leadership decisions at the OIPT and the DABs. DASD(SE) conducted 13 PSRs in FY 2012.
2. Nunn-McCurdy (N-M) Certification Reviews and Critical Change Reviews (CCR) – DASD(SE) typically assesses program management, risk management, and systems engineering processes to support the USD(AT&L) in certifying that the management structure of the program is adequate

to manage and control costs. As with PSRs, DASD(SE) uses the DAPS methodology for Nunn-McCurdy certification reviews and CCRs. DASD(SE) supported five such reviews in FY 2012.

3. Focused Reviews – These focused reviews are typically directly tasked engineering assessments requested by Service, Program, or OSD leadership. In FY 2012, these included a cost benefit analysis, program software reviews, follow-ups to a previously conducted Integrated Program Assessment, two technology maturation assessments, a reliability and maintainability review, a request for proposal (RFP) review, a manufacturing assessment, a systems engineering deep-dive, a design review analysis, and a post-operational assessment quick-look of a program. DASD(SE) conducted 18 focused technical reviews in FY 2012.
4. Systems Engineering Technical Reviews (SETRs), and Preliminary Design Review (PDR) and Critical Design Review (CDR) Assessments – DASD(SE) participates in technical reviews of MDAPs, particularly those such as the PDR and CDR, which result in reports to the USD(AT&L) as the Milestone Decision Authority. DASD(SE) provides an independent assessment of PDR and CDR system-level reviews, and in the case of the PDR, informs the Milestone Decision Authority's 10 U.S.C. 2366b certification activities. In FY 2012, DASD(SE) conducted eight PDR and six CDR system-level assessments and attended five PDRs and four CDRs that were system-level reviews. DASD(SE) also attended nine PDRs and nine CDRs that were subsystem reviews not requiring an independent assessment. In summary, DASD(SE) supported 113 SETRs, which included 27 PDRs/CDRs, and 86 other program SETRs. DASD(SE) also attended subsystem SETRs, which led to a system-level review in a building block approach, and delta or engineering change proposal reviews that do not require a formal assessment.
5. DPAP Request for Proposal (RFP) Peer Reviews – DASD(SE) supports the Director, Defense Procurement and Acquisition Policy (DPAP) as a team member during DPAP-led competitive pre-award peer reviews for contracts with an estimated value of $1 billion or more. Pre-award peer reviews are conducted in three phases: (1) prior to issuance of the solicitation; (2) prior to request for final proposal revisions; and (3) prior to contract award. DASD(SE) supported five RFP peer reviews in FY 2012 to ensure the proposals reflected systems engineering rigor and objectives.

Table 2-3 provides a summary of the major DASD(SE) engagement areas in support of MDAPs and MAIS programs in FY 2012.

Figure 2-2 shows the number of engagements across Military Departments, domain areas, and types of activity. DASD(SE) is engaged Department-wide, across all major system portfolios and across all phases of the acquisition life cycle.

Table 2-3. FY 2012 DASD(SE) Technical Reviews and Assessment Summary

Major Program	PSRs	N-M Reviews	Focused Reviews	SETRs	PDR Assessment	CDR Assessment	DPAP RFP Peer Reviews
MDAP/Pre-MDAP	12	3	14	102	8	5	3
MAIS/MDAP	1	2	4	11	0	1	2
Total	13	5	18	113	8	6	5

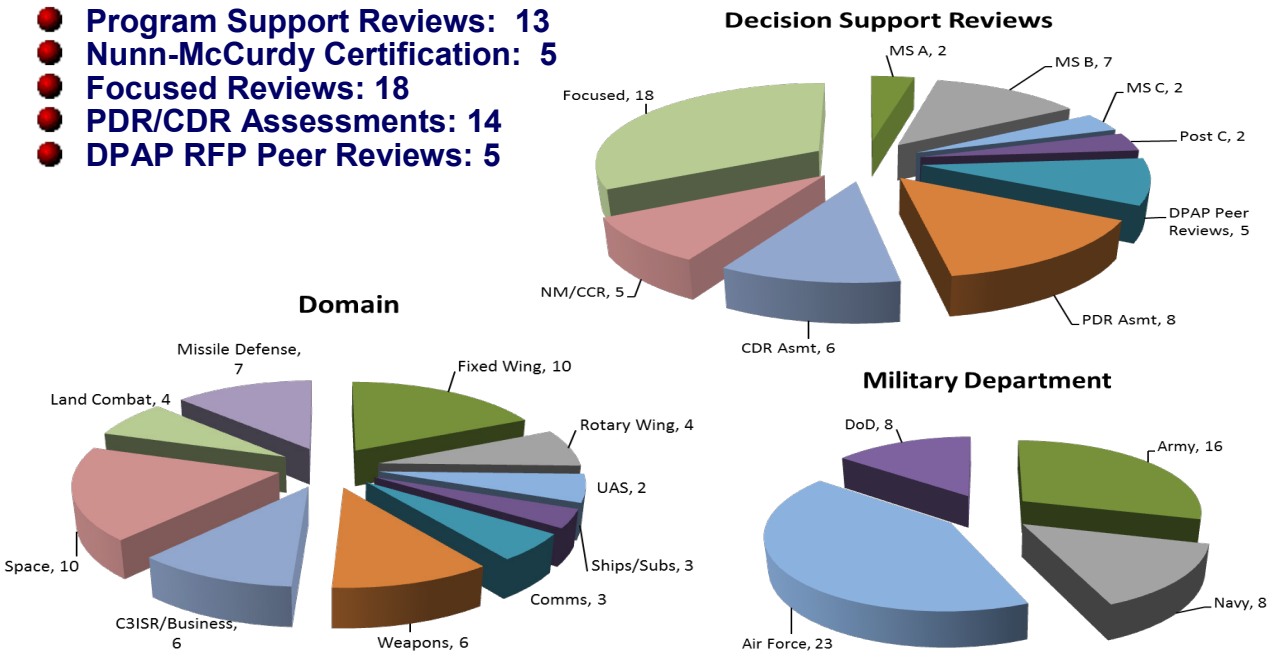

Figure 2-2. FY 2012 DASD(SE) Technical Reviews and Assessments by Domain and Military Department

Table 2-4 provides a list of major programs detailing the systems engineering activities, technical reviews and assessments, and support to other OSD reviews in FY 2012. The activities highlight DASD(SE) involvement in WIPTs and working groups to support acquisition document development, technical reviews, and assessments. DASD(SE) involvement in these activities is essential for the office to be able to provide independent assessments and recommendations throughout the program acquisition life cycle. DASD(SE) develops engineering analyses highlighting issues and programmatic risks and briefs the analyses internally to inform leadership in advance of formal OSD reviews. OSD reviews include CAPE-led AoA Senior Advisory Group meetings and program Integrating Integrated Product Teams (IIPTs), which are working-level meetings typically held prior to formal senior official OIPT meetings. The OIPT informs the DAB and Milestone Decision Authority.

Table 2-4. FY 2012 DASD(SE) Program List and Activity Details

Program Name (Acronym)	SE Activities			Technical Review and Assessments												DASD(SE) Support to OSD Reviews		
	SE Activities	SEP	PPP	PSR	Focused	NM/CCR	RFP Peer Review	PDR Sub Sys	PDR Sys	PDR Asmt	CDR Sub Sys	CDR Sys	CDR Asmt	DAES Asmt	Tech	SAG	OIPT	DAB/ITAB
AARGM														8	2			
AB3	3		1	1										16	1		1	1
ACV	7			1											2	3		1
ACWA		1												8	4		4	1
AIAMD					1					1	4	1	1	8				
AMDR	1			1											9		1	1
AOC-WS 10.2	3														3			
B-2 DMS															2			
B61 TKA		1		1													1	1
CANES													1	6				
CH-53K	3	1												8			1	
CRH	1			1	1		1										2	2
DCGS-A	1	1			3									2	2		1	1
DEAMS	1								1			1		4				1
E-2D AHE														8				
ECSS	1					1											1	
Excalibur											2		1	8				
F-22 3.2B	1	1		1					1	1					3			1
F-35	1				4			2						8	1		2	3
GCV	3														9	4		
JASSM ER	2													8				
JLTV		1	1	1			1		1	1					1		2	2
JMS				1													1	1
JTRS HMS			1											8			1	2
KC-46A		1						6	1	1				6	1		1	
KMI	1				1	1								7	1		1	1
LCS MM	2													8			1	
LCS Seaframes														5			1	
MIDS JTRS														2	1		1	1
MQ-1C	1													8			1	1
MQ-4C	1													8	2		1	
MQ-9		1										1	1	8			1	1
NGJ	1				2										1		1	1

Program Name (Acronym)	SE Activities			Technical Review and Assessments												DASD(SE) Support to OSD Reviews		
	SE Activities	SEP	PPP	PSR	Focused	NM/CCR	RFP Peer Review	PDR Sub Sys	PDR Sys	PDR Asmt	CDR Sub Sys	CDR Sys	CDR Asmt	DAES Asmt	Tech	SAG	OIPT	DAB/ITAB
OCX					2					1	2						1	
OR	5																1	1
P-8A	7													8	3			
PIM	2	1		1								1	1	2	5	1	1	1
RMS	5													8	2		2	1
SBIRS		1		1										8	1		2	2
SDB II	2												1	8	2		1	
SF				1					1	1							1	1
SSC	1	1	1	1						1					1		1	1
SSN-774 (VCS)	2	1												8				
T-AO(X)	3			1														
VXX	4														1	1	1	1
WIN-T Inc 2	4													8	2		1	1
Other	29	7	1		4	3	3	1		1	1			505	24	19	38	23
Grand Total	**98**	**19**	**5**	**13**	**18**	**5**	**5**	**9**	**5**	**8**	**9**	**4**	**6**	**707**	**86**	**28**	**77**	**55**

SE WIPT – Systems Engineering Working Integrated Product Team
SEP – Systems Engineering Plan
PPP – Program Protection Plan
RFP Peer Reviews – DPAP RFP Peer Reviews
PSR – Program Support Review
N-M/CCR – Nunn-McCurdy / Critical Change Review certification
PDR Sub Sys – Preliminary Design Review subsystem-level reviews
PDR Sys – Preliminary Design Review system-level reviews
PDR Asmt – Preliminary Design Review assessment complete
CDR Sub Sys – Critical Design Review subsystem-level reviews
CDR Sys – Critical Design Review system review
CDR Asmt – Critical Design Review assessment complete
DAES – Defense Acquisition Executive Summary assessments for performance and production
Other – Other SETRs, including System Requirements Reviews (SRRs), System Functional Reviews (SFRs), Technical Information Meetings (TIMs)
AoA SAG – Analysis of Alternatives Senior Advisory Group review meetings
OIPT – Overarching Integrated Product Team
DAB/ITAB – Defense Acquisition Board/Information Technology Acquisition Board

2.2.6 Defense Acquisition Program Support (DAPS) Methodology

The DAPS methodology is the DASD(SE) authoritative process for conducting PSRs and other technical reviews to assist programs in preparing for milestone decisions. First published in October 2004, the DAPS methodology defines a robust listing of programmatic and technical areas, sub-areas, factors, and assessment criteria, developed to be both broad in scope and sufficiently detailed to be applicable to programs of all types. The DAPS methodology was derived from numerous sources in the defense acquisition community and reflects knowledge and acquisition experience from both Government and industry. DASD(SE) employs the DAPS methodology to ensure a consistent program assessment approach and sufficient depth in all relevant review areas, adapted to the current development phase and intrinsic conditions.

DASD(SE) uses the DAPS methodology to structure the scope and focus of review areas. Review teams visit program offices and contractor facilities, and conduct on-site interviews with relevant discussions in context, all informed by prior analysis of program documentation. PSR team members strive to identify program strengths, weaknesses, risks, and issues, while assessing root causes as the basis for findings and recommendations. DASD(SE) briefs and adjudicates findings and recommendations with the program managers before finalizing the report, which is then provided to the program office, briefed internally, and summarized at the OIPT. The results also are captured in a database for systemic analysis. DASD(SE) is developing an automated DAPS methodology tool to facilitate consistency in team assessments and reporting from technical reviews.

In FY 2012, DASD(SE) revised the DAPS methodology to version 3.0. The revision reflects the current DoD acquisition model (e.g., competitive prototyping and PDR before Milestone B). In addition, the revision includes updates in the areas of program protection planning (e.g., system security engineering), modeling and simulation, manufacturing, software, reliability, and development planning.

2.2.7 In-Depth Evaluation of Software and Integration Risk

Throughout its interactions with the programs, DASD(SE) conducted in-depth reviews of software and integration risks. DASD(SE) provided details of findings to program managers and their staffs, and worked with them to develop mitigation plans to offset these risks.

Software Assessment. During FY 2012, DASD(SE) assessed program software engineering efforts to enhance software rigor within acquisition programs and identify systemic issues. DASD(SE) focuses on software early in the developmental planning stages to ensure the software requirements and functions are traced to the operational context (e.g., CONOPS, mission threads, architecture) and to ensure the program conducts critical technical activities and manages software risk. DASD(SE) focuses on promoting and using software metrics in acquisition documents (e.g., SEPs) and using parametric analysis to quantitatively assess the execution of the software process. DASD(SE) assesses software maturity during program engagements and tracks software metrics to enable trend analysis and benchmarking across warfare domains.

Through these program engagements, DASD(SE) identified systemic issues in the areas of:

- Software requirements analysis
- Software staffing
- Software schedule planning
- Predictive software metrics and related quantitative management
- Software quality assurance
- Software maturity
- Hardware/Software integration

Integration Risk Assessment. The systems engineering and integration process is defined as the planning, interface management, and execution necessary to create the whole from its many parts. In the course of program engagement and oversight activities, DASD(SE) emphasizes the systems engineering integration process, through which improvements in methodology and competence are helping programs avoid costly integration-related mistakes through better planning and consequently more efficient execution. Identifying and managing risks is an essential part of the management and technical processes. In FY 2012, DASD(SE) assessed integration progress and risks at 13 PSRs and 27 PDR/CDR technical reviews.

2.2.8 Systemic Root Cause Analysis

DASD(SE) archives findings, recommendations, and associated root causes from DASD(SE) assessments (e.g., PSRs, Focused Reviews and Nunn-McCurdy reviews) in a relational database. This database enables DASD(SE) to perform systemic root cause analysis (SRCA) to identify both positive and negative findings. The 2012 draft DAG Chapter 4, "Systems Engineering," revision reflects recommendations to address systemic issues DASD(SE) has observed during program engagements, to improve the state of the practice within the Department.

In FY 2012, DASD(SE) added nearly 900 new findings from 13 reviews to the systemic analysis database. The most prevalent negative systemic issues observed in 2012 are related to:

- Inadequate program office or contractor staffing levels
- Programs' difficulty meeting key schedule events
- Poorly defined requirements and/or requirements growth
- Poor communications between Government and contractor
- Inadequate collection and management of metrics to monitor progress/health

2.3 Workforce

DASD(SE) strives to ensure the Department's engineering workforce is trained, certified, and qualified to meet the needs of complex systems engineering efforts. As part of this activity, DASD(SE) provides oversight of the Defense Acquisition Workforce Improvement Act (DAWIA) Systems Planning, Research, Development, and Engineering (SPRDE) Systems Engineering/ Program Systems Engineer (SE/PSE) career paths and the Production, Quality, and Manufacturing (PQM) career field workforce certification standards for education, training, and experience. As Functional Leader for the SPRDE-SE/PSE career paths and PQM career field, in FY 2012 DASD(SE) continued to provide advocacy, oversight, and guidance to elements of the acquisition workforce responsible for systems engineering, development planning, and life cycle management and sustainability functions.

In FY 2012, the Under Secretary of Defense for Personnel and Readiness (USD(P&R)) assigned DASD(SE) the responsibility to manage the civilian Engineering (Non-Construction) Workforce as a strategic asset. DASD(SE) supports USD(P&R) responsibilities in defining the DoD Strategic Workforce Plans for the Engineering (Non-Construction) functional community. This Strategic Workforce Plan is being developed in parallel with the Defense Acquisition Strategic Workforce Plan to ensure consistent messaging, aligned strategies, and overall mission assurance.

2.3.1 DAWIA Career Paths and Career Fields

In the role as Functional Leader for the SPRDE-SE and PSE career paths and the PQM career field, DASD(SE) is responsible for ensuring the workforce education, training, and experience certification standards are relevant and valid for the workforce functions. In addition, DASD(SE) is responsible for ensuring the DAU courses for the career paths are appropriate, current, technically accurate, and consistent with current systems engineering policy and guidance.

With respect to the certification standards, the SPRDE Functional Integrated Product Team (FIPT), consisting of the Services and applicable Defense Agencies, reviewed the SPRDE-SE career path education, training, and experience certification requirements and, at the request of the Components, engineering support technicians (Occupational Career Codes 0802 – Engineering Technician and 0856 – Electronics Technician). As a result, Engineering and Electronics Technicians now may be coded to acquisition positions in SPRDE-SE and will be able to obtain Level I SPRDE-SE certification. Previously, technicians were not coded to SPRDE-SE acquisition positions because they often do not have baccalaureate degrees required for SPRDE-SE certification. This action will allow these technical support workforce members to gain knowledge of both the DoD acquisition and the systems engineering process, as well as provide them with opportunities for career advancement.

At the direction of DASD(SE), the SPRDE FIPT examined the SPRDE-PSE career path certification standards and determined that it would be most effective for all SPRDE-SE and PSE workforce members to be held to the same education, training, and experience standards in the future. As a result, the PSE career path will be phased out starting in FY 2014. The PSE workforce, consisting of fewer than 500 individuals, will be subsumed into SPRDE-SE. In the next year, the SPRDE FIPT will examine and address concerns with phasing out the PSE career path to ensure a smooth dissolution by October 1, 2013. The FIPT also will reexamine the current SPRDE-SE career path

requirements. Particularly, it will examine changing the experience standards so they are more descriptive of the needed experience. In addition, the FIPT will examine increasing the required years of experience for the various SPRDE-SE levels.

The PQM FIPT is examining the PQM career field with respect to how the workforce can be better served through the DAWIA certification program. The FIPT is considering allowing engineers currently coded to the PQM career field to enter the SPRDE-SE career path. The intent is to recognize engineers who perform design functions as part of their work in the SPRDE-SE career path.

DASD(SE) continued to collaborate with DAU to ensure the technical currency of the SPRDE curriculum. In FY 2012, the following courses were revised to reflect the latest DoD policy:

- SYS 101, Fundamentals of Systems Planning, Research, Development, and Engineering: Revised to include a brief discussion of USD(AT&L) memorandum "Should-Cost and Affordability."
- SYS 203, Intermediate Systems Planning, Research, Development, and Engineering, Part I and Part II: Revised to include USD(AT&L) memorandum "Should-Cost and Affordability." No changes were made to the SYS 202 on-line course.
- SYS 302, Technical Leadership in Systems Engineering: Revised to include content and brief discussion on the PDUSD(AT&L) memorandum "Roles and Responsibilities of Office of the Secretary of Defense Overarching Integrated Product Team Leaders and Teams"; USD(AT&L) memorandum "Document Streamlining–Program Protection Plan"; DTM 11-003 on reliability and maintainability; MIL-STD-881 C, "Work Breakdown Structures for Materiel Items"; USD(AT&L) memorandum and discussion on "Should-Cost and Affordability"; Manufacturing Readiness Levels (MRL) Deskbook V2.2; and additional discussion and materials on CJCSI 3170.01H, "Joint Capabilities Integration and Development System"; and CJCSI 6212.01F, "Net Ready Key Performance Parameter (NR KPP)."
- PQM 201B, Intermediate Production, Quality, and Manufacturing, Part B: Revised to include a brief discussion of USD(AT&L) memorandum "Should-Cost and Affordability."
- PQM 301, Advanced Production, Quality, and Manufacturing: Revised to include USD(AT&L) memorandum "Should-Cost and Affordability"; discussion on Manufacturing Readiness Levels (MRL) Deskbook V2.2.

2.3.2 Engineering Workforce Initiatives

DASD(SE) led and supported workforce development initiatives intended to address the growing challenges to the Department and the Defense Industrial Base (DIB) for attracting and retaining qualified engineering leaders. Initiatives included supporting the ASD(R&E) science, technology, engineering, and mathematics (STEM) strategic and implementation plans; defining Key Leadership Position (KLP) functional and cross-functional competencies; working with the defense industry and engineering professional organizations on education and training initiatives; and engaging in national and international workshops exploring lessons learned in systems engineering education, training, and development.

DASD(SE) continued to collaborate with DAU regarding the 21st Century Engineering Workforce Development project, which envisions an engineering workforce with the capability, capacity, and competence needed to address 21st century acquisition technical and programmatic challenges. The goals are to establish a process that leverages workforce development and robust certification and qualification as the foundations for cultural and technical revitalization of the DoD engineering enterprise and to determine the essential technical knowledge, skills, and abilities needed by practicing DoD systems engineers to contribute to the technical success of acquisition programs across all experience levels.

2.3.3 Systems Engineering Research Supporting Workforce Initiatives

DASD(SE) and other stakeholders, including DAU and the Military Departments, are sponsoring several collaborative systems engineering research projects summarized below, focused on improving DoD workforce performance:

1. The Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE) project supports an ongoing systems engineering community effort to establish (1) an authoritative Guide to the Systems Engineering Body of Knowledge (SEBoK) and (2) a broad consensus-based Graduate Reference Curriculum for Systems Engineering (GRCSE) for a systems engineering master's degree, based in part on the SEBoK. Improvements in the DoD systems engineering workforce depend, in part, on having a foundation of community-accepted systems engineering knowledge that contributes to a "standard language" upon which to base competencies, education, training, and professional certification. The 1.0 version of the SEBoK was released for worldwide use on September 14, 2012. Version 1.0 of SEBoK is available at www.sebokwiki.org. Version 1.0 of GRCSE is scheduled for release in FY 2013.
2. The Systems Engineering Capstone Program seeks to develop a new model to enable universities and military-affiliated students and faculty in "traditional" engineering programs (e.g., mechanical, electrical, chemical) opportunities to apply systems engineering methods, processes, and tools within a multidisciplinary capstone project. One anticipated outcome is that the students' better understanding of the DoD/DIB work environment will lead some of these engineers to join the DoD workforce. In addition, it is expected that faculty and schools will use lessons learned and promising practices to incorporate systems engineering principles into their curricula to provide a continuing benefit from the Systems Engineering Capstone Program.
3. The Technical Leadership effort will develop a DAU advanced course in the systems engineering curriculum, SYS 350, to help aspiring technical leaders develop and refine their skills in analyzing complex technical problems, finding solutions, and making sound judgments in the presence of high ambiguity, rapid change, and challenging nontechnical constraints. The course will be divided into three modules reflecting the different "lenses" required for effective technical leadership. SYS 350A presents the technical systems lens, SYS 350B the business lens, and SYS 350C the enterprise lens. This initiative is applicable to senior technical leaders in systems engineering across all acquisition communities.
4. The Experience Accelerator project will develop a simulator-based learning experience that puts the learner in an immersive state to test the hypothesis that "by using technology we can create a simulation that will put the learner in an experiential, emotional state and effectively compress time and greatly accelerate the learning of a systems engineer faster than would occur naturally

on the job." This initiative seeks to transform the professional development of systems engineers by creating new methods and tools to provide the skills necessary to address emerging systems challenges in an economically attractive manner. Moreover, the goal of the research project is to create a self-sustaining open source community that would maintain and update the core Experience Accelerator software with a growing number of new and different learning experiences.

5. The Workforce Evolution project will collect and publish analytically sound demographic data on the SPRDE workforce, and the systems engineers that are part of that workforce. This research task will span several years, tracking changes to the workforce, drawing on objective, already extant data when possible. Having a current understanding of the systems engineering workforce will allow DoD to determine how the workforce can better support the acquisition of defense systems, and identify the specific impact of efforts to improve the systems engineering workforce, such as recruiting and retention programs.
6. The Vehicle Systems Engineering and Integration Activities effort (completed 2012) was initiated by the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) to identify the differences between education needs of systems engineers in both the automotive industry and the DoD workforce, and to develop methods, processes, and tools to address the shortfalls in educating systems engineers in the DoD workforce.
7. The Systems Engineering Assessment and Workforce Development Plan project (completed 2012) created a prioritized set of competency modules to support workforce development within the U.S. Army's Research, Development, and Engineering Command (RDECOM). The team created an initial set of training objectives, training materials, an individual assessment tool, and a course assessment tool to create a systems engineering organization standard process. The material developed was disseminated to the RDECOM workforce four times throughout FY 2012. The effort established courseware that can now be used by all RDECs and selected universities offering systems engineering programs to continue to broaden the systems engineering talent.

3 DASD(SE) ASSESSMENTS OF MILITARY DEPARTMENTS

3.1 Assessment Overview

DASD(SE) requested that each Military Department (Army, Navy, and Air Force) submit a systems engineering self-assessment to be included in this year's Systems Engineering Annual Report to Congress. DASD(SE) requested that the Military Departments' self-assessments focus on describing a Military Department-level systems engineering strategy, including priorities, milestones, and measures of success. In addition, DASD(SE) asked the Military Departments to provide an update of their FY 2012 progress and FY 2013 plans in implementing the Weapon Systems Acquisition Reform Act requirements to improve their systems engineering capabilities, in accordance with the reporting requirements in Pub. L. 111-23, title I, Sec. 102(b), as amended by Pub. L. 111-383, Title VIII, Section 813(a):

> "The service acquisition executive of each military department and each Defense Agency with responsibility for a major defense acquisition program shall develop and implement plans to ensure the military department or Defense Agency concerned has provided appropriate resources for…
>
> (B) Development planning and systems engineering organizations with adequate numbers of trained personnel in order to—
>
> (i) support key requirements, acquisition, and budget decisions made for each major defense acquisition program prior to Milestone A approval and Milestone B approval through a rigorous systems analysis and systems engineering process;
>
> (ii) include a robust program for improving reliability, availability, maintainability, and sustainability as an integral part of design and development within the systems engineering master plan for each major defense acquisition program; and
>
> (iii) identify systems engineering requirements, including reliability, availability, maintainability, and lifecycle management and sustainability requirements, during the Joint Capabilities Integration Development System process, and incorporate such systems engineering requirements into contract requirements for each major defense acquisition program."

In addition to an update of their FY 2012 progress and FY 2013 plans in implementing the 10 U.S.C. 139(b) requirements, the Military Departments were asked to describe workforce development initiatives for their systems engineering workforce and a discussion of additional authorities or resources needed to attract, develop, retain, and reward systems engineers.

The Departments of the Army, Navy, and Air Force systems engineering self-assessments are provided in their entirety in Appendices A though C, respectively. DASD(SE) used the self-assessments and met with the systems engineering leadership of each Military Department to review their organizations and capabilities and to identify needed changes or improvements to such organizations' capabilities and policies in accordance with 10 U.S.C. 139(b).

3.2 Systems Engineering Strategy

Each Military Department has developed and reported on its strategy to improve its systems engineering capabilities, highlighting individual initiatives, priorities, and focus areas. Each department has reported on its organization, policy, and practice to implement that strategy.

3.2.1 Organization

Each Military Department has aligned its systems engineering organization to better support and oversee the systems engineering activities of its programs at all ACAT levels.

The Army reorganized and chartered its Office of the Chief Systems Engineer in FY 2011. The office is working to establish a standardized systems engineering model that consists of using systems engineering subject matter experts in the areas of planning, engineering, architecting, analyzing, and reviewing system capabilities across the Program Executive Office (PEO) community. Army OSCE is using collaborative forums such as the Army Systems Engineering Forum (ASEF) to identify and share best practices, and it is building a "bench" of system-of-systems engineers who can lend their expertise across the organization.

The Navy has aligned its systems engineering organization using a technical authority chain of command to delegate technical responsibility across the naval systems commands (SYSCOMs). The Deputy Assistant Secretary of the Navy for Research, Development, Test, and Evaluation (DASN(RDT&E)), on behalf of the Assistant Secretary of the Navy for Research, Development, and Acquisition (ASN(RDA)), establishes DON-wide systems engineering policy and tools to ensure consistency and rigor in the Navy's systems engineering activities. The SYSCOM commanders report to the Chief of Naval Operations and the Commandant of the Marine Corps, and they are responsible for the local implementation and execution of core policies and processes, including systems engineering. The DON has established SYSCOM integrating groups, namely the Naval Systems Engineering Stakeholder Group (SESG) and the Systems Engineering Competency Group (SECG), to address the overlap of systems engineering policy and execution.

The Air Force restructured and streamlined its systems engineering expertise by consolidating 12 Air Force Materiel Command centers into five. It consolidated center staff functions and reassigned many senior-level systems engineers to program offices. In addition, the Air Force reorganized the Office of the Deputy Assistant Secretary for Science, Technology and Engineering (SAF/AQR). SAF/AQR serves as the Air Force Senior Executive for Systems Engineering, and as Air Force technical lead for technology transition, systems engineering, and development planning. SAF/AQR provides technical advice to the Air Force Service Acquisition Executive in support of pre-acquisition investment decisions and conducts acquisition reviews of PEO programs to support Acquisition Strategy Panels, Air Force Review Boards, milestone reviews, portfolio reviews, and configuration steering boards.

The Department of Defense benefits from a stable, empowered systems engineering executive at the Military Department headquarters level. The Army, Navy, and Air Force have each established or reorganized their Military Department-level systems engineering leadership positions and have worked to delegate that technical expertise and accountability throughout their systems engineering

workforce. DASD(SE) commends the Military Departments' efforts to restructure and align their organizations to improve the authority and effectiveness of the systems engineering chain of command. It is important that they build upon and strengthen their respective systems engineering headquarters elements to reinforce systems engineering responsibilities and practices. It is also important that they monitor systems engineering competency and performance to fully implement systems engineering both within programs and to inform headquarters decision making.

3.2.2 Policy and Guidance

In order to implement a comprehensive systems engineering capability, each of the Military Departments is working to standardize its policy, processes, standards, tools, and training and to align them with DoD systems engineering policy and the DAG.

The Army is identifying common systems engineering tools, methodologies, and procedures and intends to develop a common sharable library to apply these consistently throughout the Army organization. In particular, the Army is standardizing its means to perform configuration management.

The Navy is revising the Naval Systems Engineering Guide (NSEG) and System Engineering Technical Review Handbook (SETRH). In addition, the Navy has drafted additional software assurance guidance for its Guidebook for Acquisition of Naval Software Reliant Systems. The Navy continues to use the Naval Systems Engineering Resource Center (NSERC) to share tools that support standard systems engineering processes across the organization.

The Air Force has streamlined its systems engineering policy by merging the Life Cycle Systems Engineering policy with its Integrated Life Cycle Management policy. In addition, the Air Force has developed and published 19 standardized systems engineering process guides, including tailored processes for lower-level ACAT programs. The Air Force also has instituted a standard process for attaining milestones called the Milestone Decision Process Execution Toolkit (PET).

All of the Military Departments are participating in Defense Standardization Council (DSC) authorized working groups to ensure the availability of adequate, contractually enforceable standards in the areas of Systems Engineering, Technical Reviews and Audits, and Configuration Management.

Each Military Department has made positive efforts to align its systems engineering policy and guidance to the Department's systems engineering policy and guidance while maintaining the flexibility to tailor the processes to meet the individual demands of each Military Department's mission. DASD(SE) recommends the Military Departments continue to increase the impact of systems engineering on weapon system development and decision making, through improved policy and guidance and an empowered systems engineering workforce.

3.3 Development Planning and Early Systems Engineering

The Military Departments have continued to make progress in addressing the challenges of performing early systems engineering and development planning, as required by DTM 10-017,

"Development Planning to Inform Materiel Development Decision Reviews and Inform Analyses of Alternatives."

The Army is developing several tools to enable successful development planning and early systems engineering efforts. The Office of the Chief Systems Engineer is initiating a development planning capability to support new program starts and major product upgrades. Furthermore, the office is establishing a methodology and identifying a common, tailorable set of tools and best practices for programs to use. Several individual Army programs have developed tools to assist in their early systems engineering activities. For example, the Ground Combat Vehicle (GCV) developed a "Whole System Trade Analysis" tool to provide a structured methodology for supporting requirements decisions. The Indirect Fire Protection Capability Increment 2-Intercept (IFPC Inc 2-I) was a pilot project for model-based systems engineering (MBSE), used to ensure model efforts remain in sync across the program's many technical planning documents.

To provide leadership and management direction to programs and their requirements (including interoperability), the Navy established the Marine Air-Ground Task Force (MAGTF) Integration War Room. The MAGTF War Room enables the systems engineering and requirements community to collaborate and trace warfighting operational functions to individual system capabilities. In addition, the Navy is developing policy, guidance, and tools to enable effective development planning and early systems engineering. For instance, the Navy plans to draft guidance and policy needed to execute a rigorous systems analysis approach for pre-Milestone A. The Navy also plans to develop products and processes to ensure development of a capability/mission-based technical baseline from MDD to Milestone A.

The Air Force implemented several initiatives to strengthen development planning and early systems engineering. The Air Force consolidated its systems engineering policy into its Integrated Life Cycle Management policy, requiring that a lead systems engineer be appointed at the same time as the program manager in order to initiate program technical planning as early as possible. The Air Force established Capability Collaboration Teams to identify potential materiel solutions and the S&T necessary to meet the Major Command (MAJCOM) capability needs. In addition, the Air Force plans to develop a common understanding of development planning across its organization through the use of cost and capability assessments to assist operational users in establishing affordable requirements by evaluating the cost of various increments of capability.

DASD(SE) recommends the Military Departments continue to strengthen development planning and early systems engineering processes and implementation activities in support of acquisition programs. DASD(SE) believes each Military Department will need to continue to apply proper governance and resources to initiate programs with a sound technical foundation that effectively and affordably meet operational needs.

3.4 Reliability and Maintainability

Since the release of Directive Type Memorandum (DTM) 11-003, "Reliability Analysis, Planning, Tracking, and Reporting," in March 2011, the Military Departments have all taken steps to reinvigorate the Reliability and Maintainability (R&M) engineering discipline. The DTM requires that each Military Department formulate a comprehensive R&M program for all Major Defense

Acquisition Programs (MDAPs), which includes mandatory engineering activities and key systems engineering planning for R&M. In FY 2012, the Military Departments, through acquisition policy, training, and workforce development activities, have shown progress in implementing the DTM and revitalizing R&M engineering.

The Army is finalizing Army Regulation (AR) 702-3, "Army Materiel Systems Reliability, Availability, and Maintainability," which is expected to be published by the end of CY 2013. The Center for Reliability Growth (CRG) conducted R&M training classes across the Army and DoD. The Army continued the Specialty Engineering Education and Training (SE2T) efforts from FY 2011, graduating its first participants and continuing the class through FY 2012. In addition to training the workforce, the Army has pursued consortiums with universities such as the University of Tennessee-Knoxville, Auburn University, and University of Alabama-Huntsville to recruit new R&M engineers.

The Navy has drafted a policy to incorporate DTM 11-003 into Navy programs with the intent to extend the scope to include all ACAT level programs, with tailoring. In developing the R&M workforce, the Navy SE Stakeholder Group (SESG) will identify standard skills, training, and experience required for an R&M practitioner and map each R&M engineer against the standardized set for gaps. The gaps will be compiled to prioritize the training necessary to maintain a capable R&M workforce. Additional efforts are underway in the NAVSEA Warfare Centers to develop and deploy R&M training.

The Air Force made efforts in FY 2011 to develop an R&M attachment to Air Force Instruction (AFI) 62-101, "System Engineering." Due to the reorganization within the Air Force in FY 2012, development of AFI 62-101 was cancelled and the Air Force Systems Engineering policy currently resides in AFI 63-101, "Acquisition and Sustainment Lifecycle Management." The Air Force developed two Air Force Institute of Technology (AFIT) courses related to R&M, "Introduction to Reliability and Reliability Growth," and "Reliability and Reliability Growth Foundations." These training courses have been provided to personnel at various Air Force bases and there are plans for Air Force Space Command to partner with AFIT to develop a space-focused R&M course in FY 2013.

The execution of effective R&M engineering relies on a sound workforce development strategy for recruiting, retaining, and training the R&M workforce. Similar to the FY 2011 self-assessments, all Military Departments emphasized the importance of the capacity and capability of the R&M engineering workforce. As part of the FY 2012 self-assessment, each Military Department submitted its workforce development processes. Although the activities differ, the basic premise of analyzing the capacity and capability of the R&M engineering workforce, identifying the resulting gaps, and developing strategies to close the gaps remain the same.

DASD(SE) recommends the Military Departments continue to develop and implement R&M policy within their respective Departments to ensure MDAPs focus on R&M early during development. In addition, DASD(SE) recommends the Military Departments continue to develop and deploy R&M-specific courseware in FY 2013. The identification of processes to assess the R&M workforce marks a major step for the Military Departments. DASD(SE) recommends the Military Departments continue to build on the progress made in FY 2012 to obtain a preliminary assessment of their R&M workforce capacity and capability and to develop an initial human capital strategy in FY 2013.

3.5 Systems Engineering in JCIDS and Contracting

Systems engineering must play a significant role in informing the development of affordable, achievable operational requirements and in translating those operational requirements into clear system requirements. Therefore, the development contracts that industry partners execute must reflect systems engineering processes and standards. The Military Departments have recognized the need to incorporate systems engineering into the DoD requirements development process governed by the JCIDS. They are developing and incorporating systems engineering processes, practices, and standards into system development contracts, often through the use of standardized contract language.

The Army reports that it has developed standard contract language to be inserted into system development contracts, citing numerous instances in which PEOs and PMs have included contract requirements covering metrics, technical reviews, configuration management baselines, requirements development, and RAM requirements within requests for proposals (RFPs), statements of work (SOWs), and system performance specifications.

The Navy is defining requirements from a mission-level perspective by developing and using mission threads and the DoD Architecture Framework (DoDAF). With this approach, the Navy seeks to ensure a broader perspective in developing operational requirements and system solutions so it can better account for the impact of how systems will interoperate as part of system development and acquisition. The Navy co-chairs the team developing the DoD Open Systems Architecture Contract Guidebook for Program Managers, and it has drafted human systems integration language to help with contracting and source selection.

The Air Force's Instruction AFI 10-601, Operational Capability Requirements, directs the Commanders of Air Force Materiel Command and Air Force Space Command and the Service Acquisition Executive to certify to the Secretary of the Air Force that space and non-space requirements (1) can be translated for evaluation in a source selection in a clear and unambiguous way, (2) are prioritized (if appropriate), and (3) are organized into feasible increments of capability. The Air Force High Performance Teams work across the systems engineering and requirements development communities, using gap analyses and affordability assessments to inform JCIDS documents, including ICDs and CDDs. Much of this work is expressed in the Air Force's Concept Characterization and Technical Descriptions as they are prepared for emerging MDAPs.

The Air Force Materiel Command has developed and published comprehensive guidance for incorporating engineering requirements into RFPs. In addition to publishing guidance, the Air Force has established Multifunctional Independent Review Teams and Air Force Red Teams to provide independent assessments of acquisition program plans, processes, and activities regarding RFPs and source selections to ensure that sound systems engineering principles and practices are infused into the source selection and resulting contracts.

All of the Military Departments have participated in OSD-level standards development working groups to promote military standards in focused areas of systems engineering.

Based on this and past Military Department systems engineering self-assessments, DASD(SE) recommends the Military Departments continue their efforts to include systems engineering in the

JCIDS, in requirements development processes unique to the Military Departments, and in RFPs, SOWs, and other contract documents. Including systems engineering in these documents will help inform and require contractors to perform the necessary systems engineering activities and to comply with Department standards. In addition, the participation of systems engineers in requirements development will inform the scope, dependencies, achievability, and affordability of those requirements, thereby permitting the Department to better identify and manage technical risk in the development of emerging acquisition systems.

3.6 Workforce Initiatives

The Army, Navy, and Air Force all continue to use the Defense Acquisition Workforce Development Fund (DAWDF) (10 U.S.C. 1705) to recruit, hire, develop, train, and retain the acquisition workforce. These funds continue to be a vital part of these workforce activities. In the area of training, the Military Departments' PEOs all use multiple methods to train new and mid-level engineers in an effort to build bench capability in support of systems engineering. These methods include a variety of resources offered by DoD, academia, industry, and industry associations.

3.6.1 Military Department Workforce Initiatives

The Army has continued to partner with the Naval Postgraduate School to develop and offer a master of science in systems engineering degree. The first class of 15 graduated in spring 2012, with a second class of 22 scheduled to graduate in spring 2013. The Army's Research, Development, and Engineering Command (RDECOM) completed a research task with the Systems Engineering Research Center to create a Systems Engineering Advanced course that was delivered to the workforce four times in FY 2012. The Army also established courseware that can be used by all RDECOMs to continue to broaden their systems engineering talent. RDECOM continued to focus on developing and applying program management skills, tools, and methods specific to systems planning and execution within systems engineering Integrated Product Teams across the Command. RDECOM established an online forum to share these and other systems engineering best practices throughout the systems engineering workforce.

In FY 2012, the Navy participated in the Navy Acquisition Intern Program and the Science, Mathematics, and Research for Transformation Program. Program candidates routinely transition to DON positions to provide systems engineering support for acquisition research, test, evaluation, and system management. For FY 2013, the DON will participate in the Pathways Program, a Presidential initiative to encourage recruiting and hiring students and recent graduates to work in the Federal Government. DON will continue targeted training by expanding into cyber engineering classes and will offer rotational assignments to current employees for career-broadening assignments.

In addition, a non-resident master's degree program with a systems development focus will be offered at Naval Postgraduate School's (NPS) Department of Systems Engineering in FY 2013. The DON integration and interoperability efforts have worked to develop the Mission Area System Engineer (MASE). The MASE is a senior systems engineer and supports the acquisition process by developing mission-level architectures for assigned mission areas; reviewing program-level architectures; establishing maintenance, operations, and configuration management processes for

mission-level integrated architectures; becoming a trusted partner in the development of operational concepts and alternative solutions to capability gaps; and evaluating the mission-thread performance for assigned mission areas through the Integrated Capability Framework Process.

Through its STEM Advisory Council, the Air Force investigated current and future STEM requirements for officers and civilians. Air Force functional managers revalidated STEM requirements, established academic listings of STEM degrees, and continued developing a model to monitor the health of the civilian and military STEM workforce. The Air Force also progressed in its effort to build a competency-based engineering workforce by identifying competencies for career development in areas leading to senior-level positions.

3.6.2 Implementation of Department Key Leadership Positions

A team of stakeholders from the DoD acquisition community is working to define requirements for Key Leadership Positions (KLPs). The program lead and chief systems engineer are identified as KLPs in a USD(AT&L) memorandum dated August 25, 2010. Section 824 of the FY 2013 National Defense Authorization Act (NDAA) identifies them as critical acquisition functions. KLPs require a significant level of authority commensurate with the responsibility and accountability for acquisition program success. The selection of qualified personnel to fill KLPs is essential for both the organization and the individuals filling these demanding positions. To aid in evaluating and selecting the best qualified KLP candidates, the team has identified five factors to assist supervisors in selecting personnel to fill KLP vacancies: education, experience, cross-functional competencies, tenure, and currency.

3.6.3 Additional Authorities and Resources Required

Although systems engineering is always an essential function, it becomes even more critical in a fiscally constrained environment. Maintaining the systems engineering workforce requires adequate authorities and resources, flexibility in hiring processes and compensation, and a commitment from congressional and defense leadership to provide adequate funding to preserve the recent rejuvenation of the workforce.

On September 11, 2012, the USD(AT&L) issued an updated memorandum, "Guidance for the Continuation of Defense Acquisition Workforce Improvement Initiative." In the memo, USD(AT&L) requests the Department take a strategic view in workforce decisions to protect recent rebuilding investments, especially in light of ongoing contractor support reductions. The Military Departments must adopt a mind-set of continuous workforce improvement that includes sustaining and deliberately developing the workforce. The continuation of the DAWDF must target the remaining gaps in critical skills and will be essential to the Department's efforts to develop and improve the systems engineering workforce.

In addition, USD(AT&L) directed the Assistant Secretary of Defense for Acquisition to establish a pilot project for advance replenishment hiring in partnership with the Office of the Under Secretary of Defense for Personnel and Readiness. Limited advance replenishment hiring is intended to mitigate experience shortfalls by enabling a "jump start" on training and on-the-job experience. This strategy will ensure continuity for critical positions.

3.6.4 DoD Systems Engineering Workforce and the Impact of Budget Cuts

Table 3-1 shows workforce data for each Military Department and DASD(SE), including the total number of Government (civilian and military) acquisition-coded personnel in the SPRDE-SE/PSE career paths for FY 2005 through FY 2012, the planned growth of the personnel from FY 2012 through FY 2017, and the FY 2018 planned end-state. The total number of SPRDE-SE/PSE personnel is projected to be 38,463 by the end of FY 2018, a growth of 504 since the end of FY 2012.

Maintaining a capable, competent, and adequately resourced systems engineering workforce is critical to ensuring the successful execution of the Department's acquisition programs. DASD(SE) has sustained a workforce capable of fulfilling its mission since its establishment in 2009. Although the impacts of the FY 2013 budget on the Department's systems engineering workforce cannot be known until the a final budget and appropriations are passed by the Congress and signed by the President, DASD(SE) will remain attentive to the impacts of the final budget. DASD(SE) will continue to work closely with the Military Departments to guide, oversee, and advocate for a systems engineering workforce that is capable of executing the WSARA mission.

Table 3-1. Systems Engineering Workforce in the DoD Reported by Military Department Systems Engineers and DASD(SE)

Total Number of Civilian and Military Acquisition-SPRDE-SE/PSE Personnel												
Fiscal Year	Year Ending	US Army			US Navy			US Air Force*			DASD(SE)	
FY05	30-Sep-05	11,138			16,886			6,505			13	
FY06	30-Sep-06	11,964			16,688			6,237			14	
FY07	30-Sep-07	11,050			16,804			6,162			13	
FY08	30-Sep-08	10,769			16,576			6,429			14	
FY09	30-Sep-09	10,208			18,085			7,197			13	
FY10	30-Sep-10	10,647			19,270			7,625			14	
FY11	30-Sep-11	10,071			19,325			8,514			23	
FY12	30-Sep-12	9,812			19,498			8,649			23	
Planned Growth in Civilian and Military Acquisition-Coded SPRDE SE & PSE												
Fiscal Year	Year Ending	US Army			US Navy			US Air Force**			DASD(SE)	
As Reported In****:		FY 10	FY 11	FY 12	FY 10	FY 11	FY 12	FY 10	FY 11	FY 12	FY 10	FY 11	FY 12
FY13	30-Sep-13	208	11	17	225	160	329	86	-86	-435***	0	0	-1
FY14	30-Sep-14	220	11	11	88	94	60	170	160	77	0	0	0
FY15	30-Sep-15	125	0	4	164	79	158	-4	-6	-18	0	0	0
FY16	30-Sep-16		0	0		35	98		-9	-33		0	0
FY17	30-Sep-17			0			66			-13			0
FY18	30-Sep-18			0			8			-10			0
Planned End-State Total Number of Civilian and Military Acquisition-Coded SPRDE SE & PSE												
Fiscal Year	Year Ending	US Army			US Navy			US Air Force**			DASD(SE)	
FY16	30-Sep-16	9.844			20,703			8,240			22	
FY17	30-Sep-17	9,844			20,393			8,227			22	
FY18	30-Sep-18	9,844			20,402			8,217			22	

*Source: USD AT&L DataMart Q4 FY12
**Data based on FY14 PB 23 as of 31 Dec 2012
***Overhires play a significant role in the delta between FY12 personnel and FY13 positions. As of 30 Sept 12, there were 193 SPRD&E-SE/PSE overhires on board funded by DAWDF alone. Additionally, there was a minor difference of 12 between USD AT&L DataMart and AF DoDI 5000.55 end of FY12 personnel count
**** "As Reported In" includes the SPRDE-SE workforce growth projections as they have been reported in each of the 2 previous WSARA reports, displaying the change in projected SPRDE-SE workforce growth each consecutive year.

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4 DASD(SE) PROGRAM ASSESSMENTS

The following sections include detailed assessments of 46 Major Defense Acquisition Programs (MDAPs), Major Automated Information Systems (MAISs), and special interest programs that involved significant systems engineering activity in FY 2012. Assessments are as of the end of FY 2012 (September 30, 2012); however, some assessments may include information on program status through the 1st quarter FY 2013 (December 31, 2012).

The assessments are organized by Military Department (Army, Navy, and Air Force), followed by DoD (joint) programs.

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4.1 DASD(SE) Assessments of Army Programs

Assessments are as of the end of FY 2012 (September 30, 2012); however, some assessments may include information on program status through the 1st quarter FY 2013 (December 31, 2012). This section includes summaries on the following nine programs:

- Apache Block III (AB3)
- Army Integrated Air and Missile Defense (AIAMD)
- Distributed Common Ground System–Army (DCGS-A)
- Excalibur Precision 155mm Projectiles
- Ground Combat Vehicle (GCV)
- Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)
- MQ-1C Gray Eagle Unmanned Aircraft System (UAS)
- Paladin Integrated Management (PIM)
- Warfighter Information Network–Tactical, Increment 2 (WIN-T Inc 2)

Apache Block III (AB3)

Prime Contractor: Boeing Integrated Defense Systems

Executive Summary: The Apache Block III (AB3) is the Army's heavy attack helicopter of the current and future force. The program is structured into three phases with depot-level upgrades completed in Phase 1. Phases 2 and 3 are preplanned evolutions consisting primarily of software upgrades that will be field retrofitted. The program entered LRIP in FY 2010 and has delivered 24 aircraft. The program had its FRP decision on August 16, 2012. The AB3 program was selected to receive the 2012 DoD Systems Engineering Top 5 Program Award, recognizing the program's systems engineering achievement.

Mission Description: The AB3 will provide the capability to simultaneously conduct (or quickly transition among) close combat, mobile strike, armed reconnaissance, security, and vertical maneuver missions across the full spectrum of warfare from stability and support operations to major combat operations. It is capable of being employed day or night in adverse weather and obscurants and can effectively engage and destroy advanced threat weapon systems.

System Description: The Apache helicopter is a twin-engine, four-bladed, tandem-seat attack helicopter with 30-millimeter cannon, 2.75-inch rockets, and Hellfire missiles. The AB3 is a preplanned upgrade program of the Block II AH-64D Longbow Apaches with increased performance and improved lethality, survivability, interoperability, and sustainability.

Schedule: The program is in the Production and Deployment phase. MS C was held in 2010, and an FRP decision was held on August 16, 2012. DASD(SE) conducted a PSR in June 2012 to inform the FRP decision.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP on August 31, 2010, to support the MS C decision. The SEP detailed all program activity beyond MS C and FRP. The objectives of the SEP are being met without waivers or deviations.
- **Requirements** – The JROC approved the AB3 CPD on June 1, 2010. The program adequately demonstrated all five KPPs before the August 2012 FRP decision.
- **Program Protection Plan (PPP)** – The program updated the PPP before the FRP decision to address Anti-Tamper and to support Foreign Military Sales. DASD(SE) worked closely with the program, the office of the Program Executive Officer–Aviation, the Army, the Anti-Tamper Executive Agency, and other OSD offices to update the PPP. The PPP was approved on August 27, 2012.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – Design efforts have emphasized improved reliability and maintainability over the Apache Block II. The contractor's logistics support plan includes performance-based logistics (PBL) that will be fully implemented in October 2014. This effort has resulted in cost avoidance and should result in a reduced logistics footprint in October 2014. The program projects that the PBL and Lean manufacturing efforts have resulted in a 24 percent decrease in total ownership cost.

- **Program Risk Assessment** – The program has an active risk management process that is integrated between the Government and the contractor. Key risks identified at the PSR were Main Gearbox manufacturing capacity and Link 16 integration. Mitigation plans are in place and on track for closure.

FY 2012 Systems Engineering Assessments

- Key FY 2012 program events included an engineering design review for the Phase 2 insertions, four Working Integrated Product Teams, a PSR, an Integrating Integrated Product Team, and an OIPT, which led to the August FRP decision.
- DASD(SE) conducted a PSR in June 2012 to support the FRP decision. The PSR team found the program to be well managed and proactive, with strong Government/contractor synergy. All risks identified by the PSR team were being addressed at that time and were mitigated before the FRP decision.
- In FY 2013 DASD(SE) will continue to monitor production performance and the development and integration of the Phase 2 and 3 insertions.

Measurable Performance Criteria

- **Reliability –** From its inception, the AB3 program has focused on improving reliability. Data from operational and developmental testing show AB3 has improved the system materiel availability by 10 percent and reliability by 30 percent over the Block II. During Initial Operational Test and Evaluation (IOT&E) the system failed to meet one technical performance measure: the demonstrated mean time to repair. The root causes were identified as insufficient maintainer training and the introduction of draft electronic maintenance manuals, resulting in overly cautious and unnecessary maintenance efforts. DASD(SE) reviewed this issue during the PSR and concurred with the program's assessment and planned corrective actions.
- **Software –** Software development and integration have been performing to plan. DASD(SE) parametric analysis of the program software effort showed the program's software production is better than industry standards and is at low risk for meeting delivery schedules.
- **Manufacturing** – Boeing continues to exploit Lean manufacturing methods and has transitioned one of two Block II manufacturing lines for AB3 LRIP production. All Lean manufacturing goals established in 2011 have been met or exceeded and are being incorporated into the new line. Boeing is currently assessing the best use of the second Block II line, potentially increasing the AB3 production capacity. Boeing experienced a disruption to its LRIP production with the bankruptcy of its Main Gearbox supplier. Boeing and the program office aggressively worked to mitigate the associated risks and developed a recovery plan.
- **Integration** – The lack of a Joint Tactical Radio System (JTRS) radio to support Lot 4 requirements necessitated the implementation of an alternative Link 16 system. This effort effectively mitigates the risks for the Lot 4 fielding and will meet the Lot 4 specific requirements, providing capability in June 2014. The program continues to work with the JTRS program office to field a JTRS Link 16 solution in Lot 6 production, scheduled for November 2015.

Conclusion: The AB3 program is on track. The program has been well managed and is at low risk for producing a system capable of providing a significant combat improvement to the warfighter.

Army Integrated Air and Missile Defense (AIAMD)

Prime Contractor: Northrop Grumman Information Systems

Executive Summary: Army IAMD (AIAMD) is an integrated fire control system that networks distributed sensors and shooters and provides common situational awareness. The program is currently in the Engineering and Manufacturing Development (EMD) phase. DASD(SE) worked with the AIAMD program office to maintain technical rigor through the conduct of the May 2012 program CDR and follow-up actions.

Mission Description: AIAMD provides a network-centric system-of-systems capability that integrates Army air and missile defense (AMD) sensors, weapons, and battle management, command, control, communications, computers, and intelligence (BMC4I), functioning interdependently to provide total operational capabilities not achievable by the individual element systems. This future architecture will enable the distributed support of engagements with available sensor assets not limited to system-centric organic sensors.

System Description: AIAMD major end items include an IAMD Battle Command System (IBCS) Engagement Operations Center (EOC) that provides the common BMC4I capability, the integrated fire control network (IFCN) capability to provide fire control connectivity and enabling distributed operations, and the IBCS common plug and fight (P&F) kits that will network-enable multiple sensor and weapon components.

Schedule: The program is in the EMD phase. MS B was held in December 2010, and MS C is planned for FY 2015. The program conducted the system CDR in May 2012. Key FY 2012 DASD(SE) activities included participation in the CDR, preparing an assessment of the CDR, supporting the Army Acquisition Executive to review the systems engineering and analysis tools used to assess system performance and return on investment, and PPP development.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the MS B SEP in April 2010. There are no approved waivers or deviations from the SEP. The objectives of the SEP are being met. The CDR demonstrated the effectiveness of the technical performance measure (TPM) processes to identify potential performance issues, evaluate alternatives, and manage the technical baseline.
- **Requirements** – The JROC validated the CDD in 2010. The AIAMD program has five KPPs. All are on track to be demonstrated by FY 2016. Program performance requirements are stable and reasonable, although the Army continues to develop its AMD portfolio, which drives changes to the number of planned IAMD systems. The reduction or elimination of the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) and Surface-Launched Advanced Medium-Range Air-to-Air Missile (SLAMRAAM) is counterbalanced by the Army's decision to use IBCS as the single common AMD command and control (C2) system. IAMD will replace seven separate systems, which will result in more IAMD units and a decreased per-unit cost.
- **Program Protection Plan (PPP)** – DASD(SE) coordinated with the program to ensure current PPP guidance was implemented for the CDR, documenting how the system design will protect

critical program information and mitigate supply chain risks. The program will provide an updated PPP leading to MS C in 2015.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The AIAMD program will be supported by organic and contractor-provided resources through a performance-based life cycle Product Support Strategy (PSS). The program will conduct a business case analysis to determine the support alternatives that provide the best value and operational availability.
- **Program Risk Assessment** – The program follows the risk management process described in the approved SEP. Using the risk process, the CDR review team identified key program risks during the CDR, including track management implementation, IFCN performance, radar interface unit development, and implementation of the P&F kit interface. The program has implemented effective risk-mitigation plans.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted four quarterly performance and production assessments in FY 2012 to provide reviews for the Defense Acquisition Executive Summary report.
- DASD(SE) conducted one assessment in FY 2012 on the system CDR. DASD(SE) participated in the subsystem CDRs that supported the system CDR.
- In the CDR assessment, DASD(SE) found that the CDR was not complete. The program had not yet conducted a subsystem CDR for the Launcher Interface Network Kit (LINK) to complete the initial product baseline. LINK interfaces the PATRIOT launchers to the IFCN. The program identified the need for the LINK during post-PDR analysis, leading to a relatively late contract award for the LINK development and the subsequent delay in completing the subsystem CDR. Some CDR artifacts were also incomplete, presenting medium risk. The LINK CDR and medium-risk open items are scheduled to be completed by November 2012. In other areas the program demonstrated CDR-level maturity.

Measurable Performance Criteria

- **Reliability** – The program office has allocated reliability and maintainability requirements to the key system components. The program has established a reliability growth program to track mean time between system abort for a reference task force configuration and is on track to meet the requirement.
- **Software** – The program has software requirements and estimates for each of the three major software builds with metrics in place to manage the 3.9 million software lines of code. The software architecture is stable. Two of three major software builds have been delivered, although with less overall capability than expected. The overall software effort is behind schedule; however, the current plan maintains the program APB objective milestone dates.
- **Manufacturing** – The AIAMD program provided details on qualification and manufacturing planning at the system CDR and subsystem CDRs. The program has completed prototypes of key components including the EOC and network equipment.
- **Integration** – The AIAMD program integrates multiple programs of record into a single fire control network. The program has established an Interface Control Working Group to manage technical and programmatic interfaces. Interface control documents define both internal and external interfaces. The program uses integration laboratories and demonstrations to evaluate technical maturity of interfaces.

Conclusion: The program is on track and is executing an effective systems engineering process.

Distributed Common Ground System–Army (DCGS-A)

Prime Contractors: Lockheed Martin, MANTECH, CACI, Booz Allen Hamilton, and General Dynamics

Executive Summary: DCGS-A will provide the future Army intelligence, surveillance, and reconnaissance (ISR) framework and foundation for all intelligence operations at the Joint Task Force and below. The program conducted Initial Operational Test and Evaluation (IOT&E) in June 2012 and has initiated plans to address suitability and survivability shortfalls. DASD(SE) conducted a review focusing on software development and security engineering.

Mission Description: DCGS-A provides timely, multi-intelligence battle management and targeting information to field commanders at all echelons. DCGS-A provides an integrated ISR ground processing capability, operating in a secure, distributed, and collaborative environment enabled by networks. DCGS-A enables users to collaboratively access, plan, task, collect, post, process, exploit, use, and employ threat, non-combatant, terrain, and weather information.

System Description: DCGS-A is a software-intensive program integrating commercial off-the-shelf (COTS) and Government off-the-shelf (GOTS) hardware and software. The DCGS-A Software Baseline (DSB) includes three follow-on increments (DSB 1.0–1.3). Each incremental software release will integrate ISR capabilities that satisfy prioritized capability gaps and sensor capabilities.

Schedule: The program is in the Production and Deployment phase following a MS C in February 2012. The acquisition strategy provides for incremental releases every 12 to 24 months and the PMO is planning a Full Deployment Decision (FDD) in 1st quarter FY 2013. DASD(SE) assessed the program's systems engineering processes and provided recommendations in support of the FDD.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the DCGS-A SEP on December 5, 2011, which supported MS C. The program is updating the SEP to include references to the DASD(SE) recommended Software Quality Assurance Plan (SQAP) and Software Development Plan (SDP), updates to the staffing profile, and a new Systems Engineering Standard Operation Procedures (SE SOP) annex. The program is fulfilling the SEP objectives with no waivers or deviations.
- **Requirements** – The JROC approved the DCGS-A Increment 1 CPD in February 2012. Two KPPs were validated: net-ready and fusion.
- **Program Protection Plan (PPP)** – The program received a MS C PPP waiver and was directed to submit a PPP for approval to support the FDD. DASD(SE) has reviewed the PPP, and the program is preparing to submit the document for staffing to support USD(AT&L) approval.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program conducted sustainability analyses during the Engineering and Manufacturing Development phase, including a Level of Repair Analysis to support planning for maintenance item availability and modeling to determine the initial sparing approach. During IOT&E, DSB 1.0 achieved both

partial and full mission-capable availability requirements (i.e., > 90% partial mission capable and > 10% fully mission capable).

- **Program Risk Assessment** – The program accepted DASD(SE) recommendations to reduce risk. To reduce schedule risk, the program will include detailed schedule dependencies for all key program events. The maturation of the program's systems/software engineering practices will reduce follow-on development risk. Also, the program is seeking to improve risk-identification activities to bolster its overall risk management process.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted two assessments in FY 2012.
  - DASD(SE) conducted a DSB 1.0 program review to support the MS C decision. During this review, DASD(SE) assessed the program as having inadequate security engineering, poor systems engineering process documentation, and insufficient software reliability tracking processes. Effects of the new DoD agile acquisition approach were not accounted for in systems engineering processes.
  - DASD(SE) conducted a second program review to support the FDD**.** Many of the same issues identified in the first review remained. DASD(SE) assessed the program as having weak software-reliability tracking measures, insufficient requirements management, and unmanaged Cloud integration. However, the systems engineering review team assessed the security engineering and program protection documentation as slowly improving. Also, the program submitted an SDP and SE SOP, in July 2012, and the program had made substantial efforts to document software quality assurance procedures.
- There are no systems engineering–related assessments anticipated or scheduled for FY 2013, except for quarterly Defense Acquisition Executive Summary assessments.

Measurable Performance Criteria

- **Reliability** – Corrective action is ongoing to address reliability deficiencies: numerous computer system restarts occurred during IOT&E. The plan of action is to increase computer processor memory and solid state storage in order to improve computer system performance and stability.
- **Software –** DCGS-A's DSB evolutionary approach is deferring some capability to the next release while also growing capability over time through a series of future software releases synchronized with Army interoperability and information assurance standards. To grow system capability, the DSB SDP must mature with increased use of technical performance measures to allow assessment of progress and need for corrective action.
- **Manufacturing** – DCGS-A will leverage COTS/GOTS hardware. A Diminishing Manufacturing Sources and Material Shortages program is in place to address supplier issues. Consequently, manufacturing concerns are minimal.
- **Integration** – The program is working to integrate capabilities provided by other DoD programs, (e.g., other Service DCGS programs). DCGS-A supported an effort toward joint integration and testing by participating in the FY 2012 Enterprise Challenge Exercise to promote intelligence interoperability and integration with new technology.

Conclusion: During FY 2012, DCGS-A improved core systems engineering planning and procedures (e.g., SEP, SDP, SQAP, and SE SOP) to support future increments. The program is taking action to remedy IOT&E deficiencies and is updating software quality assurance procedures and security engineering documentation. The program is working to formalize its software processes and codify the ongoing integration of new technologies to meet user requirements and emerging requirements.

Excalibur Precision 155mm Projectiles

Prime Contractor: Raytheon Missile Systems

Executive Summary: The Excalibur, an ACAT IC (Army) program, is a 155 millimeter cannon-delivered precision artillery projectile with Increment (Inc) Ia in production and Inc Ib in the Engineering and Manufacturing Development (EMD) phase. DASD(SE) prepared a CDR assessment for the Inc Ib program. Excalibur is a cooperative development program with the Kingdom of Sweden (KoS).

Mission Description: The Excalibur artillery projectile is fired by U.S. forces using the M777A2 Lightweight 155mm howitzer (LW155) and the M109A6 (Paladin) howitzer. Excalibur provides improved fire support through greatly increased accuracy. It has a requirement for 10-meter accuracy at all ranges and offers significant reduction in collateral damage over conventional projectiles. It also increases the range over current rocket-assisted projectiles from 32 kilometers to more than 35 kilometers.

System Description: Excalibur is a cannon-delivered, precision-engagement, extended-range family of indirect fire artillery projectiles that is self-guided to a programmed aim point. Excalibur is a versatile unitary munition with a high-explosive fragmenting and penetrating warhead. It includes an integral fuze capable of air, point, or delayed detonating fuze options. The Excalibur projectile is composed of three major subsystems: base, warhead, and guidance section. Inc Ia, in production, has been successfully employed in operational theaters. The Army is developing Inc Ib to improve system reliability and decrease cost. Inc Ib represents the final 46 percent of projectiles required to meet the Army Acquisition Objective.

Schedule: The Inc Ia-2 entered FRP in March 2011. Inc Ib is in the EMD phase, with its MS C planned for December 2012. The Inc Ib program conducted Projectile and System Detailed Design reviews in FY 2012.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The Army approved the Excalibur SEP in FY 2007 to support Inc Ia MS C. There are no approved waivers or deviations from the SEP. The program is meeting the objectives of the Inc Ia SEP. The Army is staffing the Inc Ib SEP to support the December 2012 MS C.
- **Requirements** – The Army approved the Inc Ia-2 CPD in October 2007. The JROC was reviewing the MS C Inc Ib CPD as of September 2012 to support MS C. The Excalibur Inc Ib program has five KPPs. The Inc Ib program is projected to meet its KPPs by Initial Operational Test and Evaluation (IOT&E) in 3rd quarter FY 2013, with moderate risk to meeting its reliability requirement by that event, although there remains sufficient growth potential to achieve the requirement. Program requirements are stable and reasonable. The Marines procured Inc Ia rounds based upon urgent operational needs. The Inc Ib is projected to increase range compared with Inc Ia-2 and could meet the KoS 50-kilometer range requirement using the Swedish Archer howitzer in prime conditions.

- **Program Protection Plan (PPP)** – The PPP update for Inc Ib was under Army review for approval by the Army Acquisition Executive as of September 2012, in support of MS C.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program continued its Inc Ib design-for-reliability activities to improve reliability performance.
- **Program Risk Assessment –** Detailed design of the base assembly was not complete at the April 2011 system CDR. Subsequent to the system CDR, the program office identified safety and reliability risks attributed to the Inc Ib warhead. The program reverted to the Inc Ia-2 base and warhead design in February 2012, reducing its design, schedule, and safety risk. The reliability risk noted above was due to integration of the Inc Ia-2 components post-CDR and the limited schedule allocated to growing reliability during the remainder of FY 2012. The program office has mitigation plans in place, including its reliability growth program.

FY 2012 Systems Engineering Assessments

- DASD(SE) concluded its assessment of the Inc Ib system CDR and participated in two follow-on subsystem design reviews, which finalized the Inc Ib design.
- The Inc Ib CDR assessment noted that the detailed design and associated product baseline were not mature when the system-level CDR was conducted in 2011. As a result, significant follow-on subsystem design-level activities were required. The CDR assessment noted significant actions completed since the CDR related to key subassembly design maturity and robustness. The assessment also noted significant actions were still in progress related to base and warhead design maturity and safety, fuze safety certification, and meeting the reliability KPP. The program office's decision to revert to the Inc Ia-2 base and warhead design in February enabled the program to finalize the detailed design later in 2012.
- DASD(SE) participated in the Projectile Detailed Design Review (PDDR) and the System Detailed Design Review (SDDR) after the program decision in February to revert to the Inc Ia-2 base and warhead design. The program office conducted the PDDR to finalize the design for the base and warhead assemblies and conducted the SDDR to finalize the design for the guidance subassembly, associated software, and the system as a whole. The program established the Inc Ib product baseline with the conclusion of the SDDR.

Measurable Performance Criteria

- **Reliability** – The Inc Ib reliability threshold requirement is 90 percent, compared with 85 percent for the Inc Ia-2. By the end of September 2012 the program had achieved a reliability growth point estimate of 80 percent, short of the growth expectation of 84 percent. There remains sufficient growth potential to achieve 90 percent with an effective reliability growth effort in 2013.
- **Software** – The Inc Ib CDR risk assessment of the software design was low risk. Requirements volatility is low, and the software baseline is mature.
- **Manufacturing** – The Inc Ia program successfully managed a counterfeit part issue in one of its subassembly components by pulling the parts from non-assembled projectiles and investigating the impact on performance. The investigation suggested a potential impact to long-term reliability, and the program office provided guidance to the field to fire these rounds first. The program's production capacity is on track to meet its Inc Ib production requirements.
- **Integration** – The Excalibur round has external interfaces with the howitzer, the propellant, the fuze setter, fire control software, and Global Positioning System. Integration efforts for Inc Ib are on track.

Conclusion: Excalibur Inc Ia is fielded and meets all program KPPs. Inc 1b is on track to meet its planned MS C, with the program managing moderate risk to meeting increased reliability requirements over the prior Increments.

Ground Combat Vehicle (GCV)

Technology Development (TD) Phase Competitive Prototyping Contractors: General Dynamics Land Systems and BAE Systems

Executive Summary: The GCV program is using an incremental approach to acquiring modern combat vehicle capabilities. The first increment focuses on acquiring an Infantry Fighting Vehicle (IFV) intended to replace the Bradley IFV. The GCV IFV program is in the Technology Development (TD) phase. DASD(SE) FY 2012 activities included participation in: updates to the Analysis of Alternatives (AoA); Systems Engineering Working Integrated Product Team (WIPT) meetings; knowledge point reviews; and technical reviews. DASD(SE) has identified significant schedule risk in the program due to potential requirements changes that may result in additional preliminary design effort.

Mission Description: The GCV IFV is the Army's future IFV in support of joint forces across the full range of military operations in a wide range of terrain and environments. The GCV replaces the Bradley M2A3 IFV in the Armored Brigade Combat Team. It will provide mobile reconfigurable armored protection in a variety of terrain and weather against a variety of hybrid threats. GCV IFV provides a growth potential for enhanced survivability and lethality to meet future threats.

System Description: GCV IFV provides the infantry squad with highly mobile and protected transport to decisive locations on the battlefield. It provides both destructive fires against threat armored vehicles and direct fire support for the squad during dismounted assaults.

Schedule: The program entered the TD phase with a MS A decision in July 2011. MS B is planned for 1st quarter FY 2014. The first production IFV is expected approximately 7 years from MS A.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The DASD(SE) approved the SEP on March 8, 2011, to support MS A. There are no approved waivers of the SEP. The Acquisition Decision Memorandum (ADM) for MS A directed the program to conduct a formal update to the AoA and conduct assessments of Non-Developmental Vehicle (NDV) alternatives in addition to the contractor competitive efforts. DASD(SE) has been working with the program to ensure the AoA, NDV, and competitive contractor efforts inform a well-thought-out and documented technical foundation for the program at MS B.
- **Requirements** – The JROC approved the GCV ICD in December 2009. At contract award, the GCV IFV draft CDD had 9 KPPs (7 core, 2 IFV) and 40 KSAs (28 core, 12 IFV). Inputs from an NDV Assessment, the AoA update, and the TD phase contractors have informed program trade space for capabilities versus affordability through a knowledge-based acquisition approach. The Army is reviewing an updated CDD that reflects a balanced approach for affordability.
- **Program Protection Plan (PPP)** – The program does not have an approved PPP. The PPP is in development for MS B. The Critical Function Analysis completed to date identified no Critical Program Information. DASD(SE) provided PPP training to the program office in February 2012

to help the program adequately protect its technology, components, and information throughout the acquisition process during design, development, delivery, and sustainment.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The GCV program does not have an approved Life Cycle Sustainment Plan (LCSP). The LCSP is in development for MS B. TD phase activities include sustainability assessments of contractor designs and maturing the GCV Supportability Strategy. The draft CDD has a sustainment KPP.
- **Program Risk Assessment** – The draft CDD requirements have matured through trade-off analyses. The program may modify its performance specification prior to the PDR after having established its functional baseline. These changes, combined with software and integration risks, create a significant schedule risk for the program. DASD(SE) has recommended the program reexamine its current strategy for achieving a 7-year schedule.

FY 2012 Systems Engineering Assessments

- The program conducted a System Requirements Review and System Functional Review with each of the two competing contractors in FY 2012. The program conducted two knowledge point reviews in FY 2012 that provided updates to the draft CDD based on knowledge gained about trade space. DASD(SE) assesses the program as proceeding with significant schedule risk while acceptably managing technical risks. The program's requirements are not yet stable, which could cause revisions to contractor preliminary designs.
- DASD(SE) focus areas in FY 2012 included requirements development and the capabilities trade process as the program reviewed its competing designs and conducted knowledge-based acquisition efforts in the TD phase.

Measurable Performance Criteria

- **Reliability** – The program lowered its requirement for mean time between system abort to 220 hours after comparative analysis of existing Bradley IFV performance in the field. DASD(SE) is continuing to assess reliability growth planning and impacts on operations and sustainment resourcing to support MS B.
- **Software** – The program identified potential technical and management software development metrics in the SEP to be assessed throughout the software life cycle. Both competing contractors are reporting source lines of code (SLOC) developed during the TD phase and associated problem reports. DASD(SE) identified limited visibility of software schedule details in the Integrated Master Schedule, which the program corrected in July 2012.
- **Manufacturing** – The competing contractors provided self-assessments of their manufacturing readiness during FY 2012. Both predict they will achieve the required manufacturing readiness level by MS B. The program office is conducting additional site visits to confirm the assessments and will complete a follow-on assessment to inform the PDR in FY 2013.
- **Integration** – The SEP identifies system integration metrics. The TD phase contractors have developed initial system-level integration plans and Interface Control Documents in preparation for the integration, assembly, test, and checkout of the system prototypes in the EMD phase. The GCV program is managing external dependencies on other programs.

Conclusion: The GCV program is executing a three-pronged strategy of NDV Assessments, an AoA update, and technology development with two competing contractors. Periodic knowledge points and reports to the Defense Acquisition Executive in FY 2012 have provided insight into continued program execution and further refinement of requirements. The program is meeting its objectives for the TD phase; however, it faces significant schedule risk for meeting its 7-year goal to deliver the first production vehicle.

Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)

Prime Contractor: General Dynamics C4 Systems

Executive Summary: JTRS HMS provides a family of tactical radios for mounted, dismounted, and specialized use. The program is post MS C and is in LRIP for Rifleman and Manpack Radios. DASD(SE) provided technical analysis and recommendations for the LRIP decision and follow-on activities in FY 2012.

Mission Description: The JTRS HMS program provides software-reprogrammable, networkable, multi-mode, system-of-systems radios capable of simultaneous voice, data, and video communications to satisfy joint Service requirements.

System Description: The JTRS HMS radios are Software Communications Architecture (SCA)-compliant hardware systems hosting SCA-compliant software waveforms as applications. The radios provide two main variants, a handheld radio (Rifleman Radio) and a Manpack Radio. The threshold Rifleman Radio waveform is the Soldier Radio Waveform (SRW). The threshold waveforms for the Manpack Radio are SRW; Ultra High Frequency Satellite Communications (UHF SATCOM 181B, 182A, and 183A); and Satellite Communications and Single Channel Ground to Air Radio System (SINCGARS). The program is also responsible for developing Small Form Fit (SFF) radios (B and D) for use in various platforms.

Schedule: The program entered the Production and Deployment phase at MS C in June 2011 with LRIP authorization for up to 6,250 Rifleman and 100 Manpack Radios. The June 17, 2012, Acquisition Decision Memorandum (ADM) authorized an additional LRIP for Rifleman Radio of 13,077, deferring an FRP decision. An additional LRIP decision for Manpack Radio was deferred pending performance improvements related to reliability, sustainability, and two-channel simultaneous operations. An FRP decision for Manpack Radios is also planned for after completion of additional developmental and operational testing.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The DASD(SE) approved the SEP in May 2011 to support MS C and to document the program's technical planning for the full line of HMS products. The program is meeting SEP objectives for the Rifleman Radio but is experiencing difficulty meeting SEP requirements for the Manpack Radio. No SEP waivers or deviations are approved.
- **Requirements** – The JROC approved CPDs for both the Rifleman (April 2011) and Manpack (May 2012) Radios. The Rifleman Radio has three KPPs and three KSAs and has met these requirements. The Manpack Radio has four KPPs and three KSAs. Two Manpack Radio KPPs, Sustainability and Multichannel Operations and Route and Retransmission capabilities, were not met during its Multiservice Operational Test and Evaluation (MOT&E) in May 2012. Two Manpack KSAs, ownership cost and reliability, also were not met in FY 2012.
- **Program Protection Plan (PPP)** – The Rifleman PPP was approved in August 2012. The JTRS HMS is developing the Manpack PPP. DASD(SE) provided technical assistance to the program office to document the PPP approach to ensure the systems' designs protect critical program information and that supply chain risks are mitigated.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The JTRS HMS does not have an approved sustainment strategy. The program is developing a sustainment strategy to clarify the disposability determination for the Rifleman Radio as well as levels of support for its products.
- **Program Risk Assessment –** The major risks for JTRS HMS are the Manpack Radio's failure to meet its reliability requirements and ability to operate as required with all threshold waveforms.

FY 2012 Systems Engineering Assessments

- DASD(SE) assessed the Rifleman Radio's technical readiness to begin FRP prior to the subsequent additional LRIP decision. The assessment and subsequent recommendation for FRP was based on the Rifleman Radio meeting the KPPs and KSAs in its IOT&E, Government testing, and production readiness reviews. FRP was deferred to further mature the Rifleman Radio procurement plan and sustainment strategy.
- DASD(SE) assessed that the Manpack Radio showed a lack of reliability growth and did not meet several technical performance measures. DASD(SE) recommended more emphasis on effective execution of the reliability growth program, extension of corrective action periods, and adoption of an event-driven schedule, which should result in better technical development and a more effective and suitable product.

Measurable Performance Criteria

- **Reliability** – The JTRS HMS products have an availability requirement of 96 percent and a mean time between failure requirement of 477 hours. The Rifleman Radio met its KPPs and KSAs, with the exception of reliability, during the IOT&E. Subsequent Government testing validated the Rifleman Radio reliability at 1,168 hours. Despite an aggressive reliability growth program, the Manpack Radio has not experienced the expected growth. The current estimate for Manpack Radio's reliability is 293 hours mean time between effective functional failure, which is below the CPD requirement of 477 hours.
- **Software** – The software development effort for the Rifleman Radio is in sustainment. During the MOT&E the Manpack experienced a high frequency of reboots related to the Operating Environment software. The Mobile User Objective System waveform software development for the Manpack Radio is behind schedule as a high number of problem correction reports outpaced fault resolution. The final version is expected to complete Final Qualification Testing in 1st quarter FY 2013.
- **Manufacturing** – As Rifleman Radio quantities ramped up from 160 radios a week in July to 250 radios per week by September 2012, the program experienced a 1-month delay in meeting the internal delivery schedule, revealing a supply chain risk. There is a component end-of-life issue for the Manpack Radio. The program's mitigation strategy is either to do a life-time-buy or redesign the affected component.
- **Integration** – Manpack waveform integration and environmental issues have led to performance shortfalls. Additional development and testing are planned to address these issues.

Conclusion: DASD(SE) recommended Manpack Radio program revisions to incorporate adequate time for resolving faults and implementing corrective actions. The Army is outlining a strategy to achieve a successful FRP decision, including resolution of previous issues, demonstration of continued reliability growth, testing of remaining threshold capabilities, and support for the program's competition strategy.

MQ-1C Gray Eagle Unmanned Aircraft System (UAS)

Prime Contractor: General Atomics Aeronautical Systems Incorporated (GA-ASI)

Executive Summary: The Gray Eagle program is in the Production and Deployment (P&D) phase and is simultaneously integrating new sensor capabilities and supporting deployed operations. DASD(SE) conducted reviews to assess and improve reliability engineering and software (SW) development. A reliability improvement program is ongoing; DASD(SE) is engaged in program SW process improvements.

Mission Description: The Gray Eagle is a medium-altitude, long-endurance UAS providing multiple sensor and weapons capabilities. The system executes reconnaissance, surveillance, security, targeting, attack, and command and control missions to provide dedicated mission-configured UAS support to Army and Joint Force units based upon the Division Commander's mission priorities.

System Description: The Gray Eagle consists of weapons-capable unmanned aircraft equipped with Synthetic Aperture Radar (SAR) and Electro-Optical/Infrared/Target Designation payloads, Ground Control Stations (GCS), Tactical Common Data Links (TCDL), satellite communications, and other support equipment. One full company of the Block 1 configuration and one Quick Reaction Capability (QRC) are currently deployed conducting operational missions in theater.

Schedule: USD(AT&L) held an LRIP III DAB in May 2012, authorizing the procurement of 29 additional aircraft. DASD(SE) conducted technical working groups to assess the program's progress in reliability improvements and SW development. The program completed Initial Operational Test and Evaluation (IOT&E) in August, and the system was found effective and suitable. The results of IOT&E will inform the FRP decision in May 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP) –** DASD(SE) approved the SEP in May 2010 to support MS C. An update to support FRP is under way and will be completed in early FY 2013. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC approved the CPD on March 24, 2009. The program has seven KPPs, of which six are on track to be demonstrated by FRP. The net-ready KPP will not be met due to a delay in Link 16 integration related to the Army communications infrastructure. A waiver was granted for Link 16 prior to FRP. OSD and the Army have reviewed the system reliability requirements to determine if they support operational availability (Ao) requirements and are achievable. Analysis of IOT&E results is ongoing and will inform potential requirements changes.
- **Program Protection Plan (PPP)** – DASD(SE) led a PPP working group with the program and OSD/DoD stakeholders to identify and develop protection measures for critical program information and to assess and mitigate supply chain vulnerabilities. The PPP is in formal coordination for approval to support the FRP DAB.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The Gray Eagle program uses flight test and deployment lessons learned to improve on the baseline support approach. The program is moving to a soldier/field service representative maintenance structure using performance-based logistics.
- **Program Risk Assessment** – The Gray Eagle program has an adequate risk management process and allocates resources based on risks. Risks include immature SW processes and reliability shortfalls that may affect Ao. DASD(SE) is engaged in program reliability growth efforts and will conduct a SW focused review (SFR) in FY 2013 to assist the program in improving software development processes.

FY 2012 Systems Engineering Assessments

- DASD(SE) led five technical working groups to assess and improve system reliability and SW development planning. DASD(SE) elevated configuration instability, reactive SW processes, and reliability performance as issues for consideration at the OIPT and LRIP III DAB.
- DASD(SE) provided subject matter expertise to an OSD-directed assessment of system reliability requirements and growth planning to inform the LRIP III decision in FY 2012.

Measurable Performance Criteria

- **Reliability –** The program has mean time between system abort (MTBSA) reliability requirements of 150, 100, and 500 hours for the GCS, aircraft, and payloads (SAR and Common Sensor Payload (CSP)) respectively. Gray Eagle achieved an Ao of 81 percent at IOT&E, exceeding the sustainment KPP requirement of 80 percent despite subsystem MTBSA shortfalls. The subsystem MTBSAs at IOT&E were 44, 55, 97, and 218 hours for the GCS, aircraft, SAR, and CSP. DASD(SE) advised an OSD and Army joint study to clarify the relationship between subsystem reliability and system Ao. The Army deferred the reliability requirements in August and is analyzing the IOT&E results to determine what levels of reliability are needed to support the system's operational requirements.
- **Software (SW) –** Unstable requirements, concurrent development, and fixes to problems identified in testing led to six unplanned SW revisions prior to the recent IOT&E. DASD(SE) recommended process improvements including eliminating concurrent SW builds by moving to a single active thread per release, performing formalized requirements reviews with user participation, and formal qualification testing for each release. The program agreed to stabilize the SW configurations and migrate to a less concurrent SW development process and schedule.
- **Manufacturing** – GA-ASI has demonstrated satisfactory production rates (up to 24 aircraft per year) and quality control processes and has been delivering aircraft in accordance with the program's schedule. Capacity is three aircraft per month with a surge capability of five per month. Production is currently climbing to the peak rate of 29 per year for LRIP II and LRIP III. An FRP decision is planned for May 2013 and will result in a rate decrease to 15 aircraft per year.
- **Integration** – Developmental testing (DT) of the CSP began in April 2011 and continued into 3rd quarter FY 2012. DT of the STARLite SAR began in 2nd quarter FY 2012. Testing revealed integration issues that were partially addressed through hardware and SW improvements prior to IOT&E. The Army's Link 16 infrastructure is incomplete. Gray Eagle can transmit a partial message set; full capability will be incrementally developed. Integration efforts are planned for FY 2013.

Conclusion: The Gray Eagle program continues to make progress toward fielding the Block 1 configuration but needs to mature and stabilize SW development processes and continue to improve reliability as the system matures.

Paladin Integrated Management (PIM)

Prime Contractor: BAE Systems

Executive Summary: The PIM program upgrades the current Self-Propelled Howitzer (SPH) and Carrier Ammunition Tracked (CAT) to address system platform limitations, sustainment challenges, and obsolescence issues. PIM provides increased force protection, survivability, mobility, growth margin, and commonality. PIM is in the Engineering and Manufacturing Development (EMD) phase. DASD(SE) FY 2012 activities included initiation of a PSR and participation in the program CDR.

Mission Description: The mission of the PIM SPH is to destroy, neutralize, or suppress the enemy by indirect fire. PIM will enable Army armored brigade combat teams and fires battalions to accomplish their relevant tasks in support of the command and control, force application, battle space awareness, protection, and net-centric environment joint warfighting capabilities.

System Description: The SPH is an aluminum-armored, full-tracked 155-millimeter self-propelled howitzer operated by a crew of four, including the driver. It provides tactical and operational fires during offensive and defensive operations and includes a roof-mounted .50-caliber M2 machine gun or 40-millimeter MK19 grenade machine gun. The CAT, a companion vehicle, supplies the SPH with ammunition. The CAT is a self-propelled vehicle and will replace the M992A2 ammunition support vehicle. PIM shares some common components with the Bradley Fighting Vehicle.

Schedule: The Defense Acquisition Executive designated PIM an ACAT ID EMD phase program in June 2011. The program conducted a CDR in April 2012. MS C is planned for June 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP in August 2012 to support the program's technical planning for EMD phase systems engineering activities. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC approved the PIM CPD in December 2011. The CPD contains 10 KPPs (6 for SPH, 2 for CAT, 2 for both) and 11 KSAs (3 for SPH, 1 for CAT, 4 for both, and 3 for the SPH trainer). The CPD requirements are reasonable and stable. The program is projected to meet its KPPs by Initial Operational Test and Evaluation in 4th quarter FY 2016. The DAE directed the program to design, develop, and test an add-on underbelly kit that achieves the objective requirement for underbody force protection by the planned January 2017 FRP decision.
- **Program Protection Plan (PPP)** – DASD(SE) reviewed and provided comments on the initial draft MS C PPP and critical functionality analysis.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program is executing a design-for-reliability program. The program conducted a logistics demonstration, which helped identify and address sustainment-related risks. The program is implementing a performance-based logistics strategy to achieve PIM materiel and operational availability objectives and maintenance ratio objectives.

- **Program Risk Assessment** – The top (moderate) risk is availability of the Cummins engine. Other moderate risks identified at the delta CDR and the PSR include meeting reliability threshold requirements, Phase III software qualification testing (schedule), incorporation of engineering change proposals (ECPs) after MS C (cost, schedule), location of the production final assembly facility (cost, schedule, performance), and program office acceptance of ICDs (schedule, performance). The program office has mitigation plans and is managing these risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) initiated a PSR and a CDR assessment in FY 2012 to support MS C.
- FY 2012 PSR activities focused on resources, management, and technical processes and will be completed in 2013 to inform MS C. Initial PSR observations: the program office significantly increased its staff with qualified personnel after its ACAT ID designation; the program office quickly optimized the schedule when the contractor identified 5 months of production lead time slack; and the statement of work includes incentives to improve reliability. The program is increasing management control of planned post-MS C changes to the system to reduce performance risk. The program office was receptive to DASD(SE) PSR recommendations.
- CDR observations: PIM is on track to meet all threshold KPPs in the CPD with moderate risk. The program office requested the contractor make refinements to the product baseline, which should be completed prior to the Production Readiness Review (PRR) in January 2013. The program is managing several moderate risks (Program Risk Assessment above).
- DASD(SE) submitted performance and production assessments for the PIM program's first Defense Acquisition Executive Summary assessment in July.

Measurable Performance Criteria

- **Reliability** – SPH conducted two rounds of reliability testing. The first round score of 45 hours mean time between system abort (MTBSA) was on the planned reliability growth curve (RGC) estimate. After a corrective action period, the program completed the second round of reliability growth testing, demonstrating a reliability of 45 hours MTBSA versus the 60 hours projected on the RGC. Despite not meeting the predicted reliability, PIM essential function failures significantly decreased in this round of reliability testing. CAT scored 53 MTBSA in its initial round of reliability testing, corresponding to 71 percent reliability; the threshold requirement is 84 percent. The program will verify modifications to address failure modes in early FY 2013. The contractor is satisfactorily executing the design-for-reliability program.
- **Software** – The current software is on schedule and meeting performance requirements. Capacity and margin for processor, disk, and memory are assessed at greater than 60 percent spare, except for the generator inverter and the bidirectional converter, which are currently at less than 50 percent processor reserve. The production phase software effort, initiated in May, is progressing at low to moderate risk for successful qualification testing in FY 2015.
- **Manufacturing** – Manufacturing planning for LRIP is progressing to plan. The program office is working to reduce risk of the engine not being available for production. Several engineering changes are planned for the PIM subassemblies, which will not be fully tested until after the MS C decision and may cause cost, schedule, or performance risk.
- **Integration** – The program office rejected the contractor's initial draft ICDs submitted at CDR and directed the contractor to make revisions, which were still in progress at the end of FY 2012.

Conclusion: The PIM program is on track for MS C while managing several moderate risks. Implementation and verification of the post-MS C ECPs will inform readiness for operational testing and FRP.

Warfighter Information Network-Tactical, Increment 2 (WIN-T Inc 2)

Prime Contractor: General Dynamics C4 Systems

Executive Summary: WIN-T is the Army's high-speed and high-capacity backbone communications network. The WIN-T Inc 2 program is the second of four planned WIN-T increments. WIN-T Inc 2 provides an initial on-the-move communications capability. A WIN-T Inc 2 Lot 3 LRIP was approved in September 2012, reaching 53 percent of the total procurement DASD(SE) provided technical analysis and recommendations for the LRIP decision and follow-on activities in FY 2012.

Source: PM WIN-T Increment 2.

Mission Description: WIN-T Inc 2 provides mobile tactical network communications from maneuver Companies, Battalions, Brigade Combat Teams, and Divisions to the strategic portion of the Global Information Grid. WIN-T Inc 2 provides the warfighter with an initial on-the-move communications capability including both commercial and military band satellite communications and terrestrial communications. It supports limited collaboration and mission planning and enables distribution of information via voice, data, and real-time video from ground-to-ground and ground-to-satellite communications.

System Description: WIN-T Inc 2 is a high-capacity Everything-Over-Internet Protocol (EOIP) secure tactical network system. It capitalizes on commercial off-the-shelf/Government off-the-shelf mature technologies. WIN-T Inc 2 operates at the Secret level by extending the Secure Internet Protocol Router Network (SIPRNet) and at the unclassified level by extending the Unclassified but Sensitive Internet Protocol Router Network (NIPRNet) into the tactical domain. WIN-T Inc 2 includes several configuration items (CIs) including Tactical Communication Nodes, Points of Presence, Vehicle Wireless Packages, and Soldier Network Extensions (SNEs).

Schedule: WIN-T Inc 2 MS C ADM was issued in March 2010. The program was authorized to procure two LRIP lots leading to a Production Readiness Review. Performance and continued reliability issues were documented in the Army and DOT&E reports. An FRP decision planned for September 2012 was deferred, leading to authorization for procurement of a third LRIP Lot. An FRP decision is planned subsequent to Follow-on Test and Evaluation in September 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the WIN-T Inc 2 SEP in August 2009 to support MS C. The program is delayed in meeting some program objectives outlined in the SEP, particularly related to reliability and maintainability. No waivers or deviations were requested.
- **Requirements** – The JROC approved the WIN-T Inc 2 CPD in November 2008. The CPD has undergone revision, and the latest approved CPD is Version 5.1, February 2012.
  - The WIN-T Inc 2 program has five KPPs: net-ready, network management, information dissemination, force protection, and mobile throughput. All of the KPPs were demonstrated

in IOT&E. Requirements and performance of specific attributes of the SNE and Highband Networking Waveform will be further evaluated before the FRP decision.
    - WIN-T Inc 2 has four KSAs. The KSAs for availability and reliability/maintainability were not met. DASD(SE) is assessing the WIN-T Inc 2 reliability growth program in FY 2013.
- **Program Protection Plan (PPP)** – DASD(SE) led a PPP working group with the program and OSD/DoD stakeholders to identify and develop protection measures for critical program information and to assess and mitigate supply chain vulnerabilities. The WIN-T PPP was approved on October 26, 2012.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – WIN-T Inc 2 has a Life Cycle Sustainment Plan (LCSP) dated September 2011 that adequately addresses configuration management, sustainability, and cost. The WIN-T Inc 2 program has not met requirements for mean time between essential function failure for 6 out of 7 CIs, nor any of the maintainability requirements for any of those CIs. These shortfalls may require some adjustments to the LCSP if planned performance growth does not meet these requirements.
- **Program Risk Assessment** – The main risk for the WIN-T Inc 2 program is meeting reliability requirements. The Defense Acquisition Executive directed DASD(SE) to assess and validate updated reliability growth plans. Although the plans are technically adequate, operational testers assessed shortfalls concerning SNE performance that may drive changes to this CI within the program. Shortfalls in training and user documentation, which represent a key part of the failure mode correction plan, could have an impact on various aspects of effectiveness and suitability.

FY 2012 Systems Engineering Assessments

- Throughout the year, DASD(SE) participated in Working Integrated Product Teams (WIPTs), completed four Defense Acquisition Executive Summary assessments, and contributed to IPTs leading to the DAB in September 2012.
- Through a combination of DASD(SE) technical exchanges with the program office and prime contractor, including reviews of contract deliverables, DASD(SE) assessed no significant manufacturing risks for production.
- DASD(SE) noted the risk of achieving reliability requirements and was subsequently assigned to continue to assist the program with reliability issues and validate a revised reliability growth plan.

Measurable Performance Criteria

- **Reliability** – WIN-T Inc 2 was unable to meet the KSA reliability requirements for its major CIs. DASD(SE) is tasked to assess an updated WIN-T Inc 2 reliability growth program in FY 2013.
- **Software** – WIN-T Inc 2 software development is stable at about 1.3 million lines of code, with no significant deficiencies, for the past 12 months.
- **Manufacturing** – Manufacturing processes are stable with no significant risks. FRP rates were achieved during LRIP.
- **Integration** – WIN-T Inc 2 demonstrated integration with current radios, select platforms, the Global Information Grid, and other communications networking equipment. User integration has presented a challenge. The Army manages integration risks through Network Integration Evaluations conducted twice a year.

Conclusion: The WIN-T Inc 2 program office is focusing on corrective actions for reliability shortfalls through revised reliability growth planning and verification.

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4.2 DASD(SE) Assessments of Navy Programs

Assessments are as of the end of FY 2012 (September 30, 2012); however, some assessments may include information on program status through the 1st quarter FY 2013 (December 31, 2012). This section includes summaries on the following 17 programs:

- AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)
- Air and Missile Defense Radar (AMDR)
- Amphibious Combat Vehicle (ACV)
- CH-53K Heavy Lift Replacement Helicopter
- Consolidated Afloat Network Enterprise Services (CANES)
- E-2D Advanced Hawkeye Aircraft (E-2D AHE)
- Littoral Combat Ship Mission Modules (LCS MM)
- Littoral Combat Ship (LCS) Seaframes
- MQ-4C Triton Unmanned Aircraft System (UAS)
- Next Generation Jammer (NGJ)
- OHIO Class Submarine Replacement
- P-8A Poseidon Multi-Mission Maritime Aircraft
- Presidential Helicopter Fleet Replacement (VXX)
- Remote Minehunting System (RMS)
- Ship-to-Shore Connector Amphibious Craft (SSC)
- SSN 774 VIRGINIA Class Submarine (VCS)
- T-AO(X) Fleet Replenishment Oiler

AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)

AARGM

Prime Contractor: Alliant Techsystems (ATK)

Executive Summary: The AARGM provides a major technological upgrade to the AGM-88 high-speed antiradiation missile (HARM) inventory. The AARGM is integrated with the F/A-18C/D and is planned to be compatible with the F/A-18E/F, EA-18G, and Italian Tornado ECR aircraft. The program, an ACAT IC system developed in cooperation with the Italian Air Force, was approved for FRP in August 2012 and is executing to cost and schedule. In FY 2012, DASD(SE) engaged with the program on resolution of the platform's reliability challenges and readiness for FRP.

Mission Description: The AARGM provides capability in the offensive counter air/destruction of enemy air defenses mission area in direct support of strike warfare, amphibious warfare, antisurface ship warfare, command and control warfare, and information warfare. The AARGM provides a rapid, organic response to air defense threats in operations ranging from small-scale contingencies to major theater war. This upgrade overcomes identified HARM capability gaps and, along with HARM, will be used against appropriate threats. AARGM will be employed by naval aircraft operating from both sea and land bases.

System Description: The AARGM system provides a new multimode Guidance Section (GS) and modified Control Section (CS) mated with existing HARM propulsion and warhead sections. The new GS has a passive antiradiation homing receiver and associated antennae, a Global Positioning System/Inertial Navigation System, and a millimeter-wave radar for active terminal guidance. The AARGM adds a capability to transmit pre-impact data to national satellites via a weapon-impact-assessment transmitter. A provision to receive off-board targeting information via the Integrated Broadcast System also will be incorporated in future missiles.

Schedule: The program is in LRIP Lot 3 within the Production and Deployment phase. The Assistant Secretary of the Navy for Research, Development, and Acquisition (ASN(RDA)) approved FRP in August 2012.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan** – The ASN(RDA) approved the AARGM SEP prior to WSARA in October 2008 leading to the MS C/LRIP decision. A SEP update was not required to support the FRP decision, and further updates are not required. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC validated the CPD in July 2008. The program has demonstrated four of five KPPs, and all five KSAs meet required thresholds. The Chief of Naval Operations deferred the fifth KPP until Follow-On Operational Test and Evaluation (FOT&E) of Block 1 in FY 2014. Block 1 will also address limitations noted in the initial capability release. The program requirements are stable and reasonable.
- **Program Protection Plan (PPP)** – ASN(RDA) approved the PPP in June 2012. The PPP will guide the protection of critical technology, components, and information through production and sustainment. There are no unique program protection issues, and no PPP updates are planned.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The ASN(RDA) approved the AARGM Life Cycle Support Plan (LCSP) in May 2012. No LCSP

updates are planned. The program is meeting both the materiel availability KPP and the materiel reliability KSA, and data will continue to be gathered on both metrics. The AARGM program will not use performance-based logistics but will use the existing three-level maintenance concept employed by HARM, with designated overhaul points used for component repair.

- **Program Risk Assessment –** The AARGM program has established an acceptable risk management program to include active risk identification, mitigation, and tracking. Analysis and test identified shortfalls requiring additional development, with validation deferred to Block 1. These deferred performance requirements will continue to be tracked through FOT&E.

FY 2012 Systems Engineering Assessments

- DASD(SE) participated in two Production Readiness Reviews and identified risk associated with minor subvendor changes and with the re-spin of circuit-board assemblies late in development. These risks have been mitigated and will be proven out in production.
- DASD(SE) conducted four quarterly Defense Acquisition Executive Summary assessments and one DAES review of AARGM in FY 2012.
- No systems engineering assessments are scheduled for FY 2013.

Measurable Performance Criteria

- **Reliability** – The program has demonstrated it will meet or exceed the 28-hour mean time between operational mission failures KSA threshold by achieving 83 hours through verification of correction of deficiencies (VCD) testing. Root-cause analysis of reliability issues experienced by LRIP Lot I units identified four dominant contributors. Design and process changes resolved three of the issues, while a re-spin of circuit-board assemblies is expected to resolve the remaining issue for the first FRP lot. The program determined only a minor software correction was needed to resolve communications faults between the missile guidance and control sections identified during Initial Operational Test and Evaluation (IOT&E). Subsequent VCD testing indicated the fix was effective as the missile experienced no discrepancies in over 70 hours of flight testing.
- **Software** – The AARGM software has been stable since November 2010 with the release of software version V2B5 0.5C. The recent release of version 0.5D for VCD testing, addressing discrepancies discovered in IOT&E, involved approximately 10 source lines of code.
- **Manufacturing** – The AARGM program successfully completed the FRP review and will ramp up to full rate in FY 2013. The program experienced challenges to production rate and quality in FY 2011 during early LRIP but has incorporated re-spins of circuit card assemblies along with improvements to manufacturing and production processes, process control and metrics, document configuration management, and supplier management.
- **Integration** – The AARGM program resolved all known integration issues with the F/A-18C/D aircraft through the development program. Objective aircraft include the F/A-18E/F, EA-18G, and Italian Tornado ECR aircraft. VCD testing included the F/A-18E/F and the EA-18G with no integration issues experienced. As mentioned, the AARGM program successfully integrated a new GS and a modified CS with the existing HARM warhead and rocket motor. In addition, software release 0.5D resolved an identified communication issue between the CS and GS as well as a second classified issue identified during FY 2012 VCD testing.

Conclusion: The AARGM program is on track for a successful ramp-up to FRP. LRIP Lot 3 is expected to validate improvements made to design, processes, process control, and supplier management.

Air and Missile Defense Radar (AMDR)

Prime Contractor: Engineering and Manufacturing Development (EMD)/LRIP RFP released; responses are under evaluation. Technology Development (TD) phase contractors were Lockheed Martin, Raytheon, and Northrop Grumman

Executive Summary: AMDR is the Navy's next-generation radar system addressing ballistic missile defense (BMD) and air defense (AD) capability gaps identified in the Maritime Air and Missile Defense of Joint Forces (MAMDJF) Initial Capabilities Document (ICD). The program is completing competitive prototyping and preparing for MS B. DASD(SE) participated in the contractor PDRs and conducted a PSR.

Mission Description: AMDR will provide simultaneous sensor support of BMD and AD missions with ancillary support of surface warfare and antisubmarine warfare missions. AMDR will provide battlespace awareness to surface combatants supporting joint forces ashore and afloat. It will provide defense capability to counter current and future threats.

System Description: The AMDR suite consists of S-band radar (AMDR-S), X-band radar, and a radar suite controller (RSC). AMDR-S is a new development-phased array radar providing sensitivity for long-range detection and engagement of advanced threats. The-X band radar is horizon-search radar based on existing technology. Initial ship sets will use the AN/SPQ-9B X-band radar currently in production. The RSC provides S and X-band radar resource management and interface to the combat system. The radar will be scalable and adaptable to changes in operational requirements in support of multiple ship classes. The Navy plans to deploy AMDR-S on the DDG 51 Flight III with a 16-foot array structure populated to an approximate 14-foot active aperture, capable of meeting the CDD threshold of AN/SPY-1 Radar +15dB sensitivity.

Schedule: AMDR is completing the TD phase. The program conducted PDRs with each of the three contractors. MS B is planned for 2013 with the Engineering and Manufacturing Development (EMD) phase to begin with a delta PDR for the selected contactor's updated design.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the AMDR SEP in August 2010 to support MS A. The program is fulfilling the objectives of the SEP without waivers or deviations. DASD(SE) has worked with the program to update the SEP to support the EMD phase. It will be approved prior to MS B.
- **Requirements –** The MAMDJF ICD identified sensor related capability gaps that established the initial requirements for AMDR. The Navy used these requirements to develop the AMDR CDD to support MS B in coordination with the DDG 51 Flight III CDD, which will subsequently inform detailed combat system requirements development. The design and performance analysis presented by each contractor during the PDR indicated that the six draft KPPs and nine draft KSAs related to AMDR-S/RSC will be achieved.

- **Program Protection Plan (PPP) –** DASD(SE) worked with the program to develop a system design and a draft PPP that reflect protection for critical program information and mitigate supply chain risk. A final PPP will be approved prior to the MS B.
- **Systems Engineering Support of Life Cycle Management and Sustainability –** The program has a draft Life Cycle Sustainment Plan. AMDR will be supported by the same Navy logistics infrastructure network that provides product support to current Fleet radars and DDG 51 class ships. Life cycle sustainment planning for AMDR incorporates those features of the system design, as well as those support processes and mechanisms needed to ensure that required performance will be sustained at the lowest total ownership cost.
- **Program Risk Assessment –** The program has focused attention on risk in the draft SEP and in the EMD RFP. The PSR documented risk findings in the areas of integration, scheduling/ planning tools, and evaluation assets.

FY 2012 System Engineering Assessments

- DASD(SE) conducted a PSR in August 2012 to assess the program's readiness to proceed to the EMD phase and to provide recommendations to reduce EMD risk. PSR findings indicate the program has executed an effective and comprehensive TD phase, demonstrating the critical technologies needed to ground the future scalable multi-mission active array radar. The program is currently assessing DASD(SE) findings and recommendations to reduce risk in the areas of integration, planning and scheduling tools, and verification assets.

Measurable Performance Criteria

- **Reliability** – Reliability requirements will be based on the AMDR CDD when approved. The Reliability, Availability, Maintainability, and Cost (RAM-C) Report provides mission justification for the reliability and availability requirements. TD phase reliability demonstrations showed preliminary support for draft requirements. The program is using reliability growth curves to track software end items and mean time between failure of line-replaceable units.
- **Software** – The program has determined high-level functionality for the system. The TD contractors have provided preliminary software architectures and software development plans. Specific software implementation details depend on final contractor selection and system design.
- **Manufacturing** – The program has determined that the U.S. technology and industrial base is adequate to develop, produce, maintain, and support AMDR. The program has established a Manufacturing Working Group to ensure the AMDR equipment is producible, best manufacturing process are implemented, and appropriate quality assurance is applied. The program will use LRIP to prove the manufacturing processes prior to approval of FRP.
- **Integration** – DASD(SE) previously identified risk in the integration of the AMDR, ship, and combat system (CS). During the TD phase, the program began to address the integration issue by developing detailed technical review criteria, adopting the Navy's open architecture guidance, ensuring close coordination and planning with associated program offices, and leading CS Interface and Radar Ship Integration Working Groups. The program is developing a draft Interface Functional Document for coordination with the CS and a draft Interface Requirements Document for coordination with ship systems. The programs have planned a series of Interim Program Reviews to review and validate the AMDR-CS architecture and external logical interface requirements prior to each AMDR technical review.

Conclusion: The AMDR program is on track to enter the EMD phase of development. The program is considering DASD(SE) recommendations in the areas of integration, planning/scheduling, and verification assets.

Amphibious Combat Vehicle (ACV)

Prime Contractor: To be determined

Executive Summary: The ACV program will field a successor to the Marine Corps's Assault Amphibious Vehicle Model 7A1 (AAV7A1). The program entered the Materiel Solution Analysis (MSA) phase after Materiel Development Decision (MDD) in December 2011. In FY 2012 DASD(SE) supported the MDD, participated in the ongoing Analysis of Alternatives (AoA) Senior Advisory Groups (SAGs), and began a PSR.

Mission Description: The ACV will provide the principal means of tactical surface mobility for the Marine Air-Ground Task Force during both ship-to-objective maneuver and sustained combat operations ashore. Tactical employment of the ACV permits the embarked Marine infantry to dismount close to the objective under the supporting fires of the ACV's organic weapons.

System Description: The ACV is a fully amphibious, self-deploying armored personnel carrier capable of transporting up to 17 Marines from Navy ships located beyond the visual horizon to inland objectives.

Schedule: The ACV program received an MDD in December 2011, which authorized its entry into the MSA phase. The Marine Corps conducted AoA activities and plans to enter the next phase of the acquisition during FY 2013. DASD(SE) supported the MDD, participated in three AoA SAGs, supported four CDD requirements reviews, participated in three Systems Engineering Working Integrated Product Teams (SE WIPTS), assisted in developing performance specifications, and conducted a PSR.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The ACV program does not have an approved SEP. DASD(SE) provided SEP training to the ACV program office in April 2012. The ACV program held SE WIPTS to develop the technical management strategy and began to document the program strategy within the draft SEP. DASD(SE) reviewed a draft SEP in July 2012. The ACV program office is continuing to refine the draft SEP to align with the emerging acquisition strategy.
- **Requirements** – The JROC approved the ACV ICD in October 2011. DASD(SE) actively participates in the program's ongoing Knowledge Point Review process, which supports requirements development. These knowledge points are the culmination of studies and analyses that inform CDD requirements development. The program completed Knowledge Point Three, establishing several key requirements thresholds. The program plans seven knowledge points to complete requirements development.
- **Program Protection Plan (PPP)** – The ACV program does not have an approved PPP. DASD(SE) provided PPP training to the program office in February 2012 to help the program adequately protect its technology, components, and information throughout the acquisition process during design, development, delivery, and sustainment.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The ACV program does not have an approved Life Cycle Sustainment Plan (LCSP). DASD(SE) conducted two logistics-focused PSR site visits at the ACV program office in Woodbridge, Virginia, in June and July 2012. During the PSR site visits, the team met with key subject matter experts to develop criteria for the LCSP and discuss the program's plans to implement performance-based logistic strategies that optimize total system availability while minimizing the cost and logistics footprint.
- **Program Risk Assessment –** The ACV PSR identified two primary risk areas, program planning and affordability. As it moves forward, the program should apply lessons learned from existing programs and the prior Expeditionary Fighting Vehicle (EFV) program to reduce risks in its acquisition strategy and program plans. The Marine Corps faces challenges establishing an affordable threshold capability set to meet its capability gap.

FY 2012 Systems Engineering Assessments

- DASD(SE) began a PSR during FY 2012. The ACV PSR identified two primary risk areas, program planning and affordability. This PSR is ongoing due to evolving requirements and draft acquisition strategy.
- In the PSR findings, DASD(SE) identified the program's Systems Engineering Operation Planning Team (SE OPT) activities as a systems engineering best practice. Through market research, engineering analysis, and requirements trades, the SE OPT informed the trade space for the AoA alternatives.
- DASD(SE) activities supporting requirements development, specification development, and development of key program strategy and planning documents will continue through FY 2013. These efforts will help the program establish achievable CDD requirements with traceability to the performance specification and statement of work to reduce acquisition risks.

Measurable Performance Criteria

- **Reliability** – The ACV program established draft reliability requirements and developed draft metrics that will track reliability program progress. The program also has identified the design-for-reliability activities that will be included in the draft RFP. The ACV program has not developed a Reliability, Availability, Maintainability, and Cost (RAM-C) Report. This concern was documented in the draft SEP review comments and PSR findings. The ACV program office has developed a plan to complete the RAM-C Report in support of MS B in FY 2013.
- **Software** – The ACV program plans to provide software management metrics within the SEP. The ACV program may provide Government-developed vehicle-level software developed under the EFV program to the preliminary design contract awardees in an effort to encourage reuse of existing software code.
- **Manufacturing** – Draft ACV program plans indicate the intent to evaluate manufacturing feasibility at PDR and CDR in accordance with the Defense Acquisition Guidebook criteria.
- **Integration** – The ACV program is leveraging technology, mature designs, existing processes, and lessons learned from the EFV and AAV programs to mitigate integration risk. The ACV draft SEP and draft program plans identify design-for-reliability requirements including fault tree analysis; block diagrams; and failure mode, effects, and criticality analysis.

Conclusion: DASD(SE) will continue to evaluate the risks and recommend mitigations through continuous engagement with the program and OSD leadership.

CH-53K Heavy Lift Replacement Helicopter

Prime Contractor: Sikorsky Aircraft Corporation

Executive Summary: The CH-53K Heavy Lift Replacement Helicopter will provide an improved U.S. Marine Corps heavy-lift capability. The program is in the System Development and Demonstration (SDD) phase. DASD(SE) maintains regular engagement via bimonthly Systems Engineering Working Integrated Product Teams (WIPTs) and by assisting the program in the development of a reliability program description and position paper in response to OSD concerns.

Mission Description: CH-53K will meet Marine Air-Ground Task Force vertical heavy-lift requirements beyond 2025. The aircraft will internally transport passengers, litters, cargo, and vehicles, and includes provisions for weaponry. For external lift of cargo, the CH-53K has three independent cargo hooks and is capable of lifting three times the capacity of the CH-53E under high/hot conditions.

System Description: The aircraft is a build-new, evolutionary update of the CH-53E design. It is a dual-piloted, multi-engine helicopter, incorporating the latest vertical lift, survivability, reliability, maintainability, and avionics technologies. The CH-53K will be equipped with a seven-blade main rotor system and a four-blade canted tail rotor designed by Sikorsky Aircraft Corporation. Main engine power is supplied by three GE38-1B turboshaft engines.

Schedule: The program is in the SDD phase. MS B was held in 2005, a revised Acquisition Strategy (AS) has been approved, a revised Acquisition Program Baseline (APB) is currently in formal staffing with the service, and MS C is planned for FY 2015. DASD(SE) participated in program reviews and an OIPT to support the AS revision.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – A SEP revision was approved in December 2011 to document technical plans for the manufacturing, assembly, system qualification, and test phases of the program. An update is planned in FY 2015 to support MS C. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The program has an Operational Requirements Document approved in 2005 that will be updated to a CPD to support MS C. The program has seven KPPs. All are predicted to be met within the restructured schedule. The program has taken positive steps to prevent requirements growth. The Capabilities Integrated Product Team serves as a configuration steering board to identify and resolve aircraft mission-related issues and program requirements.
- **Program Protection Plan (PPP)** – DASD(SE) worked with the program to develop a PPP via four Program Protection Working Group (PPWG) meetings in FY 2012. Focus areas included criticality analysis, software assurance, and countermeasure selection. In FY 2013 DASD(SE) will assist the program in the final stages of PPP development and approval.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – Design efforts have included an emphasis on design for maintainability and design for reliability. Three of the seven KPPs (reliability, logistics footprint, and sortie generation rate) are logistics based.

- **Program Risk Assessments** – The program maintains a robust risk and opportunity management process that is openly accessible to DASD(SE). The program is working to mitigate risks associated with manufacturing process maturity and associated impacts to parts delivery necessary to support test article production. All identified risks are manageable and have executable mitigation strategies in place.

FY 2012 Systems Engineering Assessments

DASD(SE) participated in software and reliability focused reviews; an IIPT; an OIPT; three SE WIPTs; Reliability, Availability, and Maintainability (RAM) WIPTs; and an OSD program (Defense Acquisition Executive Summary (DAES)) review.

- An OIPT was conducted December 2011 to garner support for updates to the AS, APB, and streamlining of the approval process for System Demonstration Test Articles RFP. The OIPT recommended streamlining the RFP approval process and approval of AS and APB (once Service cost position is established). The subsequent DAES review in June 2012 closed open reliability actions and confirmed the program strategy.
- DASD(SE) maintains close and integrated engagement with the program, conducting SE WIPTs bimonthly to evaluate technical progress and risk. All seven KPPs and 23 of 24 technical performance measures are at or above required performance levels, indicating that the program is on track to meet requirements by FRP.
- In FY 2013 DASD(SE) will continue to assess subsystem qualification, engineering development model (EDM) assembly, subcontractor technical performance, and software release and verification activities including Ground Test Vehicle (GTV) light off.

Measurable Performance Criteria

- **Reliability** – System reliability is projected to meet system requirements, and the program has developed a robust reliability growth plan. Reliability of the system is measured through mean flight hours between operational mission failures-design controllable ($MFHBOMF_{DC}$) and mean flight hours between failures-design controllable ($MFHBF_{DC}$). Both are estimated to favorably exceed threshold requirements.
- **Software** – There are 7 million lines of code, including more than 2 million of new development. Release plans include three major builds, one of which is currently in test. There have been seven engineering and two formal software build deliveries to the contractor's software integration lab (SIL). Software coding and qualification is on track for GTV light off (FY 2013) and first flight (FY 2014) with all planned functionality.
- **Manufacturing** – The program has a strong focus on producibility, Lean manufacturing, modularization, and utilizing smart design guidelines for machined parts and tolerances. The emphasis on ergonomics, safety, foreign object debris prevention, and mistake proofing is proving beneficial. At Sikorsky's West Palm Beach production facility, the GTV assembly has been completed. The remaining four EDMs are in various stages of production.
- **Integration** – Due to the use of mature technology and existing interfaces, there are no known issues affecting current and future interrelationships. Weight-empty projections for first flight have increased to less than 100 pounds above the threshold parameter of 43,750 pounds at first flight, with low risk to future growth since 78 percent of aircraft has been weighed.

Conclusion: The CH-53K program, which uses a robust set of technical metrics and processes to assess progress and focus management attention, is on track to complete subsystem qualification and move into system-level testing on the GTV.

Consolidated Afloat Network Enterprise Services (CANES)

Prime Contractor: Northrop Grumman Information Systems

Executive Summary: CANES consolidates existing afloat networks and provides a common computing architecture for network applications, systems, and services to operate in the tactical domain. CANES supports all basic network services for Navy ships, aircraft, and maritime operations centers across multiple security enclaves. The program is in the Engineering and Manufacturing Development (EMD) phase with MS C planned during early FY 2013. The program was obliged to curtail its developmental test schedule following delays due to a contract protest; as a result, the program developed integration risks that required mitigation.

Mission Description: CANES will consolidate and reduce the number of afloat networks and provide a secure afloat network required for naval and joint operations. The program will reduce the infrastructure footprint, including logistics and training costs, and increase reliability, security, interoperability, and application hosting to meet warfighter requirements.

System Description: CANES provides a local area network (LAN) architecture with a common computing environment to support the fusion of warfighting, intelligence, and business mission area information in the tactical domain. CANES scales in configuration to provide network systems in unit-level, force-level, and submarine platforms.

Schedule: The program selected the prime contractor in February 2012. Down-selection to Northrop Grumman as the prime contractor was followed by a brief protest period. These schedule delays reduced the amount of time for developmental testing before the MS C decision and first ship installation, both scheduled during December 2012.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The DASD(SE) approved the SEP on August 31, 2010, to support MS B. The program is fulfilling the objectives of the SEP without waivers or deviations for initial systems. DASD(SE) worked with the program to identify systems engineering efforts needed to support development of full system capability. The program is on track to have the updated SEP approved by MS C.
- **Requirements** – The JROC approved the CDD in FY 2009 to support MS B and designated CANES as an IT Box program. The program is not required to develop a CPD because the three KPPs in the CDD continue to define system capability.
- **Program Protection Plan (PPP) –** DASD(SE) provided guidance and worked with the program to develop the PPP, including conducting the criticality analysis to identify critical program information. The program submitted this information to the Defense Intelligence Agency's Threat Analysis Center (TAC) for analysis to determine potential threats to the supply chain and mitigation strategies. The PPP is in formal Navy approval with results of the TAC analyses pending. The program is on track to have the PPP approved by MS C.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program's Life Cycle Sustainment Plan (LCSP) describes rolling baselines for network upgrades and logistics to mitigate obsolescence issues and provide sustainable configurations. The LCSP, part of the Acquisition Strategy, is on track to be approved by MS C.
- **Program Risk Assessment** – The program convenes a monthly Risk Review Board to identify, analyze, and mitigate program risks. The program uses an enterprise risk management tool to standardize risk assessment and reporting consistent with Navy policy. The program used this risk management process to identify the schedule risk to meet MS C and ship installation dates in December 2012. DASD(SE) identified integration risks to achieve planned capabilities in initial ships and recommended additional integration activities to mitigate these risks. The program plans to conduct force-level integration testing prior to installation aboard a CVN.

FY 2012 Systems Engineering Assessments

- DASD(SE) supported the program's DAES review conducted in June 2012. The program responded to DASD(SE) recommendations to initiate SEP and PPP reviews to support MS C.
- DASD(SE) began an assessment of the CANES system integration effort during FY 2012 to support MS C in early FY 2013. Major findings included the lack of operational test results to inform MS C, and the absence of planned systems engineering activities in the SEP to achieve full system capability in time to support fielding plans. These findings supported the integration risks DASD(SE) identified as part of the Program Risk Assessment mentioned above.

Measurable Performance Criteria

- **Reliability –** The program partially met the threshold requirements for mean time between failure (MTBF) and system availability. During the DT event, the program conducted 343 hours of the 495 hours of required testing without failure. The program conducted the remaining hours during the Operational Assessment with results not expected until 2nd quarter FY 2013.
- **Software –** The program is a system integration effort to consolidate legacy afloat networks onto a commercial-off-the-shelf (COTS)-based network infrastructure. No custom software is being developed. COTS software is adapted to the tactical environment using scripts to perform routine and repetitive functions and configuration settings to change interface timing and protocols. Use of both scripts and configuration settings has sufficiently addressed all COTS integration requirements as demonstrated during FY 2012 unit-level testing.
- **Manufacturing** – Manufacturing is limited to server and computer rack assemblies similar to currently fielded shipboard network systems. The program identified special provisions for shock and vibration isolation through modeling and simulation for correct dynamic design. Design baseline build-to packages are 100 percent complete and are under program configuration control. The program is on track to provide rack assemblies in time to meet ship installation schedules.
- **Integration** – The program has not demonstrated integration of the CANES system components to achieve a force-level capability, nor has it demonstrated integration of CANES with Afloat Core Services and other programs of record in a service-oriented architecture environment. The program plans to demonstrate force-level capabilities in shipboard installations in FY 2014 to support the limited deployment fielding plan.

Conclusion: The program is on track to begin ship installations and limited deployment during FY 2013.

E-2D Advanced Hawkeye Aircraft (E-2D AHE)

Prime Contractor: Northrop Grumman

Executive Summary: The E-2D AHE is a manned aircraft supporting battle management command and control in the maritime theater of operations. The program is an ACAT ID program in LRIP and is executing to cost and schedule. DASD(SE) engaged with the program to improve the radar reliability methodology.

Mission Description: The E-2D AHE is an all-weather, twin-engine, carrier-based airborne command, control, and surveillance aircraft designed to extend task force defense perimeters. The E-2D provides advance threat warning of approaching enemy surface units and aircraft, and provides real-time area surveillance, intercept, search and rescue, communications relay, and strike/air traffic control. Key objectives include improved battle space target detection and situational awareness, especially in the littorals, and support of theater air missile defense (TAMD) operations, particularly execution of naval integrated fire control-counter air for the carrier strike group commander.

System Description: The E-2D AHE includes the AN/APY-9 RADAR system; electronically scanned identification, friend or foe system; modernized tactical cockpit; new intercommunication system; generator and cooling upgrades to support all capabilities; and investments to reduce total ownership cost. The E-2D AHE will comply with the communications, navigation, surveillance/air traffic management requirements.

Schedule: The program is in LRIP. MS C was successfully completed in June 2009 and the FRP decision is planned for December 2012. Key FY 2011 systems engineering activities included technical interchange and Program Protection Plan (PPP) Working Integrated Product Team meetings.

FY2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The DASD(SE) approved the SEP in January 2009 to support the MS C decision. The program is fulfilling the objectives of the SEP without waivers or deviations. Future updates are not required.
- **Requirements** – The JROC approved the CPD in September 2008 in support of the MS C. The E-2D AHE program has 12 KPPs and 15 KSAs. The system is on track to demonstrate the KPPs and KSAs by the FRP decision. However, the program is striving to meet lower-level built-in-test false alarm rates and radar reliability technical performance measures (TPMs). Radar performance has improved; however, the program will verify Cooperative Engagement Capability (CEC) and TAMD mission performance after release of Initial Operational Test and Evaluation (IOT&E) data and follow-on testing. Program requirements are stable and reasonable.
- **Program Protection Plan (PPP)** – The program office approved the PPP in March 2008 to provide guidance for protecting critical technology, components, and information through Engineering and Manufacturing Development. DASD(SE) is working with the program office to update the PPP prior to the FRP decision in December 2012.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The initial sustainment concept for the E-2D AHE is interim contractor support. The program will conduct a performance-based logistics business case analysis before FRP to determine the long-range support strategy. The E-2D AHE met the sustainment KSAs and TPMs based on performance data before the start of IOT&E.
- **Program Risk Assessment** – The E-2D AHE program implemented a risk management process in accordance with the E-2D AHE Risk Management Plan and U.S Naval Air Systems Command policy. The program had several medium and high risks before the start of IOT&E. Several mitigation efforts throughout FY 2011 have improved the system performance, eliminating all high-level technical risks. IOT&E results will inform the status of the remaining medium-level technical risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) did not perform technical assessments in FY 2012 as the system was in the IOT&E phase for the majority of the year. At the conclusion of IOT&E, DASD(SE) will assess the program.
- DASD(SE) provided quarterly Defense Acquisition Executive Summary assessments.

Measurable Performance Criteria

- **Reliability** – The data to determine the overall system reliability is pending the release of IOT&E results. Radar reliability has trended below the radar reliability growth curve and was not on track to meet the reliability performance measures entering IOT&E.
- **Software** – The program experienced more software defects and a slower-than-expected burn-down rate in FY 2012. Several of the lingering defects were related to CEC integration and contributed to a decision to decouple CEC verification and validation from the baseline program. The defect discovery rate has decreased but remains above program estimates. DASD(SE) anticipates several Priority 1 and 2 deficiency reports will not be fully resolved until Follow-on Operational Test and Evaluation in FY 2013.
- **Manufacturing** – The program is in LRIP. The prime contractor delivered nine aircraft on or ahead of schedule. The contractor is meeting build-to packages, touch labor hour estimates, and production rates as planned. The prime contractor successfully managed parts issues and assembly delays without affecting E-2D AHE production deliveries.
- **Integration** – The CEC system provides connectivity between the E-2D AHE and other air, land, and sea platforms transferring fire control quality data essential to the TAMD mission. Delayed CEC system integration had an impact on the E-2D AHE system verification schedule. The impact to operational suitability is being evaluated; results are expected in 1st quarter FY 2013.

Conclusion: The program is on track to meet all 12 KPPs and 15 KSAs; however, key TPMs for built-in-test false alarm rates and radar reliability are below thresholds, and high-priority software discrepancies need to be resolved.

Littoral Combat Ship Mission Modules (LCS MM)

Prime Package Production and Assembly (PP&A) Contractor: Northrop Grumman

Executive Summary: The LCS MM program will provide focused warfighting capabilities to provide assured access against littoral threats. Mission Modules (MM) support mine countermeasures (MCM), surface warfare (SUW), and antisubmarine (ASW) Mission Packages (MPs). The program is in the Technology Development (TD) phase. DASD(SE) conducted a post-PDR assessment and SEP review in 2012 to support MS B.

Mission Description: LCS MPs will provide a modular capability to the combatant commanders for focused SUW, MCM, and ASW missions. MMs will provide systems to combat threats encompassing the different variations of mines, small surface ships, and submarines. Mission systems are added to the MP baseline incrementally as they reach a level of design maturity and readiness for shipboard integration.

System Description: LCS MMs combine mission systems, weapons, and support equipment housed in containerized units. MPs are composed of individual MMs with aviation assets, and trained sailors to execute specific LCS MCM, SUW, or ASW mission. The MCM MP consists of semisubmersible vehicles, manned and unmanned helicopters, an unmanned surface vehicle and multiple subsystems to perform bottom, deep-volume, surface, and coastal mine hunting, neutralization, and sweeping. The SUW MP consists of two 30-millimeter guns, long-range missiles, and manned and unmanned helicopters to destroy enemy small boat swarms. An 11-meter rigid hull inflatable boat is part of the maritime security module of the SUW MP. The ASW MP consists of a towed array and variable-depth sonar with data acquisition, signal processing, and display subsystems to detect, localize, and classify enemy submarines.

Schedule: LCS MM MS B is planned for FY 2013. MCM Increment (Inc) 1 and SUW Inc 1, 2 IOT&E events are planned for FY 2014. Future MCM, SUW, and ASW increments are in various levels of development with MS C still being planned. DASD(SE) conducted a post-PDR assessment of the MCM Inc 1 and SUW Inc 1, 2 designs; supported development and review of the SEP; and supported a program OIPT.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP) –** The SEP is currently in development and will be finalized in FY 2013 to support a MS B decision. It is the initial SEP for the LCS MM program.
- **Requirements** – LCS Seaframe and MMs share a common CDD, approved in June 2008. The MM program has a total of 14 KPPs. The program plans to satisfy its KPPs incrementally as individual MP designs mature. The requirements are reasonable and stable.
- **Program Protection Plan (PPP) –** The PPP is in development for planned approval in FY 2013.
- **Systems Engineering Support of Life Cycle Management and Sustainability –** Over the past year, the program office developed a Life Cycle Sustainment Plan to establish sustainment and

supportability metrics with their participating acquisition resource managers (PARMs). Plans to implement MM reliability, availability, and maintainability (RAM) are now documented in the SEP and integrated with PARM activities to achieve program materiel availability and train-to-certify KPP requirements.

- **Program Risk Assessment –** The LCS MM, associated PARMs, and Seaframe program have a joint risk management plan and co-chair the risk management board. Plans to mitigate and retire risk for MCM MP Inc 1 and SUW Inc 1, 2 are in place. Risks associated with future increments have been identified. Technical baselines have been established for the initial MPs. Technical baselines and mission systems for future increments are still maturing and will be defined at future PDR events.

FY 2012 Systems Engineering Assessments

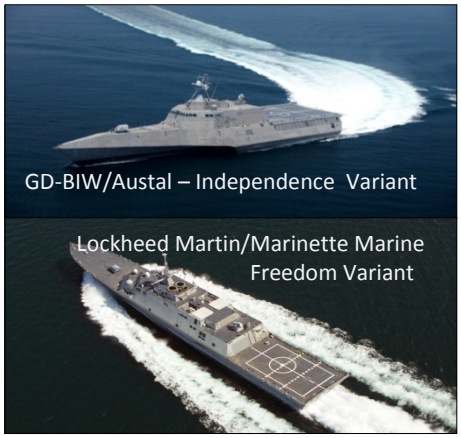
- DASD(SE) participated in four PDR equivalency briefs presented by the program office to establish the allocated baseline for MCM MP Inc 1 and SUW MP Inc 1, 2 designs prior to MS B. The actual PDRs for individual mission systems were conducted by the PARMs prior to FY 2012. Approximately 60 artifacts were provided to demonstrate an appropriate level of design maturity for the hardware and software configuration items for these MP increments. DASD(SE) assessed that the allocated baselines for MCM MP Inc 1 and SUW MP 1, 2 have been established and are maturing to a product baseline.
- DASD(SE) supported development and review of the LCS MM SEP and will continue to monitor the program's progress toward fulfilling the objectives of the SEP.

Measurable Performance Criteria

- **Reliability** – DASD(SE) worked with the program office to establish a RAM program plan and to document it in the SEP. The allocation of reliability requirements to individual mission systems integrated with the PARMs RAM plan will be completed in FY 2013. Executing to the planned activities is required to meet the intent of DTM 11-003. RMS is the only mission system executing a reliability growth plan. All other mission systems will be evaluated against their allocated reliability requirement.
- **Software** – Initial software builds for the MP computing environment are largely complete with the exception of the ASW MM. Mission system software is provided by the Navy PARMs who maintain ownership and development responsibility. Integrating mission system software into the common computing environment is relatively low risk.
- **Manufacturing** – The LCS MM program evaluates manufacturability at all Systems Engineering Technical Reviews and is planning for Production Readiness Reviews (PRRs). Manufacturing responsibilities, except for the support containers, resides with the individual PARMs.
- **Integration** – The program established quarterly mission ship system integration team (MSSIT) meetings to identify MM and Seaframe integration issues and risk. The MSSIT is effective in discovering and correcting ship integration deficiencies.

Conclusion: MCM MP Inc 1 and SUW MP Inc 1, 2 allocated baselines have been established and are stable. The program is on track and maturing the technical baseline for future MCM, SUW, and ASW MM increments. System-development efforts and risk-reduction activities are continuing for all future increments.

Littoral Combat Ship (LCS) Seaframes



Prime Contractors: Lockheed Martin/Marinette Marine (LCS 1, 3 plus 10 on the block buy contract); General Dynamics–Bath Iron Works (GD-BIW) (LCS 2, 4); Austal USA (10 LCS on the block buy contract)

Executive Summary: The LCS is a fast, agile, mission-focused platform designed for operation in near-shore environments yet capable of open ocean operation. It is designed to defeat asymmetric, anti-access threats such as mines, quiet diesel submarines, and fast surface craft. The LCS class consists of two variants, the Freedom variant and Independence variant, designed and built by the industry teams of Lockheed Martin/Marinette Marine and General Dynamics–Bath Iron Works (LCS 2, 4) and Austal USA, respectively. These ships will be outfitted with reconfigurable Mission Packages (MPs) composed of individual Mission Modules (MMs) that can be changed out quickly to execute a specific mission.

Mission Description: LCS provides the joint commanders with the flexibility to use the ships against asymmetric threats and employ multi-mission combatants on primary missions such as precision strike, battle group escort, and theater air defense. It will focus on three primary anti-access mission areas: mine countermeasures (MCM), surface warfare (SUW), and antisubmarine warfare (ASW). Its high speed and ability to operate at economical loiter speeds will enable fast and calculated response to small boat threats, mine laying, and quiet diesel submarines. Its shallow draft permits excursion into shallower areas for both mine countermeasures and small boat prosecution.

System Description: The LCS Seaframe is composed of the ship, crew accommodations, and hotel services with the capability to detect, identify, track, and protect itself against surface ships. Its propulsion system provides both low-speed, and high-speed sprint performance. It provides a flight deck and hangar facilities to support an air detachment and a mission bay to house embarked MMs. Its core systems provide ship self-defense, navigation, C4I (command, control, communications, computers, and intelligence), and the common interfaces required to support the three MMs.

Schedule: MS B was conducted in April 2011. An October 2012 Acquisition Decision Memorandum rescinded the requirement to conduct MS C. The LCS Seaframe program is currently in the Engineering and Manufacturing Development phase, with ship construction having started for both variants with a total of 24 ships authorized.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the LCS MS B SEP July 29, 2010. The program is following the SEP as planned without waivers or deviations. DASD(SE) is engaged with the program to ensure that metrics for tracking software quality, reliability, integration, and manufacturing are developed and being tracked to monitor progress to plan.
- **Requirements** – The JROC validated the LCS CDD for Flight 0+ on June 17, 2008. The LCS program has 10 KPPs, primarily concerned with speed, range at transit speed, mission module payload, draft, and crewing. The Seaframe requirements are reasonable and stable.

- **Program Protection Plan (PPP)** – The PPP update is in development for approval in FY 2013.
- **Systems Engineering Support of Life Cycle Management and Sustainability –** A Life Cycle Sustainment Plan (LCSP) for the program is in the final stages of development and review. The LCS program employs an integrated performance-based approach for product support, including software, during the life cycle of the ship. The Product Support Plan incorporates knowledge gained during the interim support period.
- **Program Risk Assessment –** The program faces technical risk related to the integration of MMs with the Seaframe. The program is conducting interface-validation and defining-integration processes for each Seaframe variant and MM. A moderate risk is being tracked pertaining to the watercraft Launch, Handling, and Recovery (LHRS) lift system. DASD(SE) is monitoring progress and verifying that the program is maintaining awareness of peer program office-related issues and risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) continued to focus on displacement and center of gravity service life allowance (SLA), hull cracking, and corrosion issues, and promoted empowering the mission ship system integration team (MSSIT) to better resolve identified integration issues. The program team is focusing its efforts on resolving these issues and identifying other first-of-class problems.

Measurable Performance Criteria

- **Reliability** – The CDD requirement for materiel availability is 0.64 threshold, and 0.712 objective. The operational availability requirement is 0.85. Reliability models indicate these requirements are achievable.
- **Software** – DASD(SE) conducted a 2010 PSR, which determined that the program was not employing Navy best practices for software-intensive systems. The SEP revision now includes software metrics for tracking effort and performance.
- **Manufacturing** – The FREEDOM (LCS 1) variant (Lockheed Martin/Marinette Marine) shipyard has delivered two ships, and the INDEPENDENCE (LCS 2) variant (General Dynamics–Bath Iron Works) shipyard has delivered one ship to the Navy. The second INDEPENDENCE variant (General Dynamics–Bath Iron Works) ship is scheduled to be delivered in 2013. Both shipyards have experienced initial design-for-manufacturability issues such as hull cracks/corrosion problems on the FREEDOM variant and corrosion/water jet cavitation problems on the INDEPENDENCE variant. The Navy corrected these routine first-of-class issues and is taking steps to improve design and manufacturing processes for future hulls.
- **Integration** – Interface design, integration and installation of individual mission packages presents unique challenges for both FREEDOM and INDEPENDENCE variants.

Conclusion: Three of four ships under the initial two contracts have been delivered. An additional 20 ships have been authorized, for a total of 24 ships. Each of the two shipyards (Lockheed Martin/Marinette Marine and Austal USA) will produce 10 of the 20 authorized ships. The Seaframes are delivered without the MPs. The greater challenge is the MP shipboard integration to provide the modular focused warfighting capability. Mission Packages are developed and delivered by a separate program office however both the Seaframe and MM program office are under the direction of Program Executive Office Littoral Combat Ship (PEO LCS).

MQ-4C Triton Unmanned Aircraft System (UAS)

Prime Contractor: Northrop Grumman Aerospace Systems

Executive Summary: The MQ-4C Triton provides persistent maritime intelligence, surveillance, and reconnaissance as a continuous source of information to help maintain the Common Operational and Tactical Picture in the maritime battle space. The program is in the Engineering and Manufacturing Development (EMD) phase. DASD(SE) participated in the Test Readiness Review (TRR) and maintained regular engagement with the program by conducting two Systems Engineering Working Integrated Product Teams (SE WIPTs) and leading the MS C Program Protection Plan/Anti-Tamper (PPP/AT) Working Group (WG) to assist the program in preparing for MS C and LRIP.

Mission Description: The MQ-4C Triton will operate both independently and with other assets to provide a more effective and supportable persistent maritime surveillance capability than currently exists. Data collected by the Triton will be made available on the Global Information Grid (GIG) and will support a variety of intelligence activities and nodes.

System Description: The MQ-4C Triton system consists of land-based unmanned aircraft, interactive mission payloads, line-of-sight (LOS) and beyond LOS communications systems, a mission control system, and associated support equipment. The Triton will incorporate networked communications architecture in alignment with the DoD Global Information Grid (GIG) through the Distributed Common Ground/Surface System–Navy and Global Command and Control System–Maritime.

Schedule: MS B was held in April 2008 and MS C is planned for October 2013. DASD(SE) participated in the TRR, multiple SE WIPTs, multiple PPP/AT WGs, an Integrating Integrated Product Team, and an OIPT to prepare the program for an In-Process Review DAB in November 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The MQ-4C Triton MS B SEP was approved in January 2008 to support the EMD phase. The SEP is being revised to support the MS C Production and Deployment (P&D) phase and to comply with the revised SEP format and requirements. The program has been executing to the approved MS B SEP without waivers or deviations.
- **Requirements** – The JROC approved the CDD in May 2007. The draft CPD is being reviewed in support of MS C. The program has seven KPPs, which are projected to meet all threshold requirements and to be demonstrated during Initial Operational Test and Evaluation (IOT&E). Program requirements are stable and on schedule.
- **Program Protection Plan/Anti-Tamper (PPP/AT)** – The MS B PPP/AT was approved March 2006. DASD(SE) is leading a PPP/AT WG to update the PPP/AT plan, identify critical program information, and complete vulnerability analysis in preparation for MS C.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program uses the systems engineering processes to influence the design to reflect the support strategy and equipment operating environment, and to support iterative reliability, availability, and maintainability analyses.
- **Program Risk Assessment** – The program has a comprehensive risk management process and effectively allocates resources to address risks. Key risks are software development and the maturation of radar. DASD(SE) will conduct a software-focused PSR in 2nd quarter FY 2013 to assist the program in mitigating software risk.

FY 2012 Systems Engineering Assessments

- DASD(SE) participated in the TRR in March 2012, quarterly performance and production assessments, and an SE WIPT to assess the program's progress toward first flight, reliability planning, and software development risk. The reviews indicated that the program had an integrated design that is projected to meet system requirements.
- DASD(SE) reviewed software issues including the lack of standardized accounting of equivalent software lines of code (ESLOC) and SLOC, by subcontractors and integrated mission management computer (IMMC) corrective actions. The program conducted Integrated Design Reviews of interim software builds and included the reviews in the program Integrated Master Schedule. Software development is the primary schedule driver to the Operational Assessment.
- DASD(SE) is working with all stakeholders to complete the analysis needed to support the PPP development. Lessons learned from the Global Hawk program are being applied, and the program is participating in the Defense Exportability Features working group.

Measurable Performance Criteria

- **Reliability** – The SEP and CDD specify reliability requirements and technical performance metrics (TPMs). Based on approved reliability and maintainability TPMs, the KPPs are projected to meet or exceed their threshold requirements.
- **Software** – Coding of software for the major subsystems started in FY 2011, and releases to the system integration laboratories began in late FY 2011. Software development delays have contributed to a 6-month schedule delay to the Operational Assessment. The program's current software total of 2.293 million ESLOC exceeds the estimate of 1.854 million ESLOC. The planned total for SLOC is 7.95 million, of which 4.56 million is either reused or modified.
- **Manufacturing** – The production of EMD aircraft started in mid-FY 2011. Late delivery of components by subcontractors delayed delivery of the first EMD aircraft (SDD-1) to test until June 2012. The second EMD aircraft (SDD-2) will be delivered to test in October 2012. The program is working to mitigate potential manufacturing impacts caused by a delay in receiving authorization to expend procurement funding and the reduction in Global Hawk procurement.
- **Integration** – The program has developed Interface Requirements Specifications between the Triton system and 12 segments using an approved DoD Architectural Framework.

Conclusion: The MQ-4C Triton UAS program uses a thorough systems engineering process and remains on track to meet its operational requirements but will be challenged to meet the baseline schedule to MS C.

Next Generation Jammer (NGJ)

Prime Contractor: Source Selection

Executive Summary: NGJ is a Navy program to develop a new standoff/mod-escort tactical jamming system (TJS) to replace the existing ALQ-99 TJS on the EA-18G. NGJ will be the EA-18G's primary offensive airborne electronic attack system. NGJ is currently in Technology Maturation (TM) phase prior to MS A. DASD(SE) conducted a Focused Review in November 2011 in support of an In-Process-Review (IPR) DAB in June 2012.

Mission Description: The NGJ airborne electronic attack (AEA) capability supports the joint force commander's requirement to gain and sustain access to the battle space. AEA capabilities tie directly to the capstone concept for joint operations joint operating concepts and joint functional concepts. NGJ will assist major combat operations by gaining operational access, denying the enemy battlespace awareness, denying the enemy freedom of action, and disrupting the enemy's ability to command and control his forces. The typical scenario under which NGJ will be utilized is suppression of enemy air defenses (SEAD). However, NGJ also will be used in conventional and irregular warfare when operating in non-defended airspace.

System Description: The NGJ program is pursuing an incremental strategy with Increment 1 focused on the mid-band threats and integration on the EA-18G. The current strategy is to retain the ALQ-99 Low Band Transmitter (LBT) in the near future. The design objectives include modernized power amplifiers, exciters, arrays, and power generation in a modular, scalable open architecture podded design capable of ensuring future growth. NGJ will provide improved AEA capabilities against a wide variety of radio frequency (RF) targets including radars, communications, data links, and other RF-based systems. The system will provide improved agility and precision, both spectrally and spatially, for improved interoperability and increased target capacity to degrade, deny, and deceive adversary RF systems. NGJ will dramatically increase effective isotropic radiated power over legacy systems to enable robust jamming at greater standoff ranges. NGJ also will address non-traditional RF targets to provide improved AEA for Irregular Warfare. Increment 1 initial operational capability is planned for 2020.

Schedule: The program conducted a System Requirements Review (SRR) in February 2012, which established performance requirements and non-tradable design requirements with the potential contractors. DASD(SE) participated in the SRR. An IPR DAB was conducted in June 2012, authorizing the release of the TD phase RFP. MS A is scheduled for April 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The draft NGJ SEP is in U.S. Naval Air Systems Command (NAVAIR) routing for Component approval. DASD(SE) has worked closely with the program on SEP development and anticipates DASD(SE) approval in March 2013 to support the April 2013 MS A. No waivers or deviations are anticipated.

- **Requirements** – The JROC approved AEA ICD in November 2004. The program conducted an SRR in February 2012. Program maturation and design refinements are expected to result in a second SRR in late FY 2013. The program requirements are reasonable and stable. There are four KPPs and seven KSAs.
- **Program Protection Plan (PPP)** – DASD(SE) has been working with the NGJ program office to develop the PPP. The draft is in routing for NAVAIR approval, and DASD(SE) approval is expected in February 2013 to support the MS A.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The Life Cycle Sustainment Plan is currently in development and will be submitted for approval prior to MS A. The program has three draft sustainment KSAs: materiel reliability, ownership cost, and system training. The sustainment strategy will be based on a performance-based life-cycle (PBL) product support approach.
- **Program Risk Assessment** – During the TM phase, each contractor developed and maintained separate risk management processes. The program has also implemented a formal risk and opportunity management process based on DoD and NAVAIR Risk Management Policy. Using the standard NAVAIR risk process, the program is identifying and actively managing risks, and mitigation actions are on track.

FY 2012 Systems Engineering Assessments

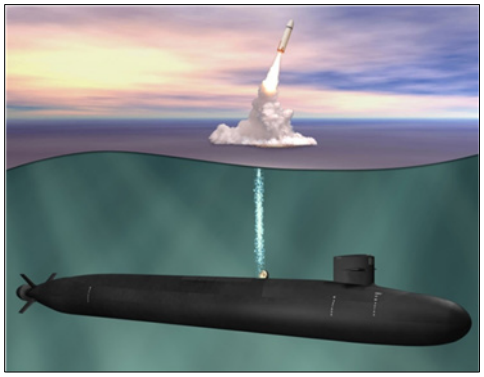
- DASD(SE) conducted two assessments in FY 2012, a Focused Review and a program SRR. The Focused Review provided the Assistant Secretary of Defense for Research and Engineering (ASD(R&E)) and USD(AT&L) with a detailed engineering and technology-based assessment of progress and risk on each of the four TM vendors. Recommendations contributed to an extension of TM and restructure of the Acquisition Strategy to include down-selection to one vendor entering the TD phase at MS A.
- DASD(SE) participated in the program SRR and identified risks to the program regarding phasing of capabilities and the proposed block approach. A lower risk incremental approach has subsequently been implemented.
- DASD(SE) participated in multiple integration reviews with the program, EA-18G (lead platform), and the Jammer Technique Optimization group to ensure contractors participating in TM were adequately addressing issues and requirements.

Measurable Performance Criteria

- **Reliability** – DASD(SE) worked with the NGJ program to establish a reliability growth and improvement program. The program anticipates meeting the system-level draft CDD requirement of 23 mean flight hours between operational mission failure.
- **Software** – Software development is not expected to be a significant program challenge based on experience with the development of similar capabilities.
- **Manufacturing** – Manufacturing risks are not expected to be significant based on experience and existing production of similar components and technologies.
- **Integration** – Four vendors competing for single award at MS A have varying subsystem performance allocations based on past performance of legacy programs. Although the individual vendors are reporting success for the respective allocations, the rollup of risks for space, weight, power, and cooling is assessed as medium.

Conclusion: NGJ has implemented a revised strategy to pursue a single contractor during TD based on progress and competition in the TM phase. MS A is planned for April 2013 with contract award in 3rd quarter FY 2013.

OHIO Class Submarine Replacement



Prime Contractor: General Dynamics Electric Boat Division

Executive Summary: The OHIO Replacement program will design and construct a replacement for the OHIO Class fleet ballistic missile submarines (SSBNs), which begin retiring at a rate of one per year beginning in 2027. PB13 funding cuts resulted in a 2-year shift for lead ship procurement from FY 2019 to FY 2021. DASD(SE) supported Working Integrated Product Team (WIPT) meetings, an OIPT, and a DAB In-Process Review meeting.

Mission Description: The OHIO Replacement ballistic missile submarine will provide the future undersea contribution to the nuclear deterrence triad in support of national policy and objectives. The strategic nuclear deterrence function of the OHIO Replacement submarines is met through the deployment of the TRIDENT II D5 LE strategic weapon system (SWS), which satisfies the required capabilities of a sea-based strategic deterrent. The OHIO Replacement is expected to be the most survivable leg of the nuclear deterrence triad.

System Description: The OHIO Replacement is a nuclear-powered ballistic missile submarine designed and constructed to replace the existing OHIO Class SSBNs. The new design integrates four major subsystem areas: the submarine hull, mechanical, and electrical (HM&E) systems; the propulsion plant; the common missile compartment (CMC) with its SWS, and the non-propulsion electronic systems (NPES). Twelve OHIO Replacement SSBNs, each with 16 missile tubes capable of containing TRIDENT II D5 missiles, will be constructed with a 42-year service life.

Schedule: The program is in the Technology Development (TD) phase and achieved MS A in January 2011. PB13 funding reductions resulted in a 2-year schedule shift for lead ship construction start from FY 2019 to FY 2021.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP on September 28, 2010, to support MS A and RDT&E (research, development, test, and engineering) activities during the TD phase. The program is fulfilling the objectives of the SEP without waivers or deviations. An update is planned to support MS B in FY 2016.
- **Requirements** – The program has a JROC-approved ICD. A Service CDD was approved by the Chief of Naval Operations in August 2012. The requirements are being translated by the OHIO Replacement Program Office PMS397 into specifications, informed by cost trades, system concepts, and early stage component development. This detailed system design specification development will be completed in FY 2014. The program has challenging requirements associated with the coordinated stern, stealth, propulsion plant, and the CMC design build strategy. OPNAV N97 established a working group to evaluate design trade-offs for key attributes with a focus on affordability while maintaining the required capabilities.

- **Program Protection Plan (PPP)** – The strategy to identify critical program information and develop a PPP is documented in both the SEP and the Technology Development Strategy. PPP development has not started.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program is using a design, build, and sustain systems engineering process. Activities include design for affordability and reduction of total ownership cost initiatives. More than 600 ideas to reduce design, construction, or sustainment costs have been identified. Major design initiatives include the elimination of a midlife refueling overhaul and evaluation of the OHIO Replacement design from both at-sea and in-port maintainability perspectives to ensure the OHIO Replacement meets its at-sea strategic-deterrent availability requirement.
- **Program Risk Assessment** – The program has a risk management plan and effectively allocates resources to address risk. The coordinated stern, CMC, SWS, and electric drive design initiatives represent unique engineering and integration challenges. The CMC is being developed with the United Kingdom, and the CMC risk register is regularly reviewed and managed.

FY 2012 Systems Engineering Assessments

- DASD(SE) participated in WIPT meetings and reviewed program design and development activities for the coordinated stern, torpedo room, CMC, and other ship design arrangements excluding the propulsion plant. Engineering design activities are expected to remain constant and not ramp up due to the PB13 funding cuts and the 2-year schedule shift. The CMC baseline schedule will be maintained to support the UK SUCCESSOR program. Preliminary design arrangements mapped to major modules incorporate lessons learned from the VIRGINIA Class. Design for affordability and should-cost initiatives are embedded in all research and development activities.

Measurable Performance Criteria

- **Reliability** – A Reliability, Availability, Maintainability and Cost (RAM-C) manual is being developed to guide design, build, and sustainment plans. The program is developing a RAM Program plan to address the key tenets of sustainment and to guide future reliability engineering activities.
- **Software** – The rehosting of SWS software from the OHIO Class to the OHIO Replacement class design represents the largest software-development effort in the program. PARMs (participating managers) will be responsible for all NPES software. Metrics to capture the program-wide software engineering efforts still need to be developed.
- **Manufacturing** – The program successfully reconstituted the CMC integrated tube and hull quad pack manufacturing industrial base. Spatial arrangements and integration of major modules are defined in the Manufacturing Assembly Plan (MAP).
- **Integration** – Major Area Integration Teams (MAITs) are responsible for overarching technical oversight and integration. MAITs interface with Major Area Teams (MATs) to resolve issues or conflicts with the MAP and integration of major ship subsystem modules. System integration teams and process integration teams support the platform across specialty subsystem areas and major modules.

Conclusion: PB13 funding cuts resulted in the shift of lead ship procurement from FY 2019 to FY 2021. Engineering design effort will remain constant and will not ramp up as originally planned over the next 2 years. The CMC baseline schedule was retained to support the joint U.S.-UK development efforts in support of the lead UK SUCCESSOR SSBN in-service date of 2028. The lead OHIO Replacement SSBN is now planned to complete construction in FY 2028 and attain Initial Operating Capability in FY 2031.

P-8A Poseidon Multi-Mission Maritime Aircraft

Prime Contractor: The Boeing Company

Executive Summary: The P-8A Poseidon is an ACAT ID program designed to replace the P-3C Orion. It will serve as an antisubmarine Warfare (ASW) and antisurface warfare (ASuW) platform providing intelligence, surveillance, and reconnaissance (ISR) as a portion of a maritime patrol and reconnaissance force (MPRF) family of systems. The program is in LRIP. DASD(SE) tracked system verification and performance during integrated testing to assess the system's readiness to begin Initial Operational Test and Evaluation (IOT&E).

Mission Description: The primary roles of the P-8A are persistent ASW and armed ASuW and to serve as an ISR aircraft capable of broad-area, maritime, and littoral operations. The P-8A will sustain and improve these capabilities for U.S. Naval forces in traditional, joint, and combined roles as part of the MPRF family of systems, which also includes the MQ-4C Triton Unmanned Aircraft System, the EP-3, and the Tactical Operations Center.

System Description: The P-8A is a military variant of the Boeing Commercial Airplanes (BCA) 737-800ERX configuration, with the addition of unique P-8A structures and systems. Future capability improvements include automatic identification system, multi-static active coherent, high-altitude ASW capability, rapid capability insertion (RCI) acoustics algorithms, Tactical Operations Center updates, and net-ready improvements.

Schedule: The program entered LRIP in August 2010 and began IOT&E in September 2012. DASD(SE) participated in several Systems Engineering Working Integrated Product Team (SE WIPT) meetings and test readiness meetings in 2012.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the program SEP on August 9, 2010, in support of the August 2010 MS C decision. The program is fulfilling the objectives of the SEP, and there are no approved waivers or deviations. DASD(SE) began working with the program office in 2012 to update the SEP for Increment 1 and to reflect technical planning for the Increment 3 MS A decision planned next year.
- **Requirements** – The JROC validated the P-8A CPD for Increment 1 (the baseline aircraft) in June 2009. The P-8A program has seven stable KPPs, which have been demonstrated or are on track to be demonstrated in the IOT&E.
- **Program Protection Plan (PPP)** – USD(AT&L) approved the program PPP in August 2010 in support of the MS C decision. The program is updating the PPP in preparation for the 2013 FRP and Increment 3 MS A decisions to ensure the program plans protect critical information and mitigate supply chain risks.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program's use of flight trainers for 70 percent of initial and proficiency training avoids up to $3.1 billion in aircraft and support costs. The program is taking advantage of the P-8A's commercial aircraft derivation to use the commercial supply chain to support common parts replacement and

reduce logistics support costs. The program is on track to meet availability requirements by Initial Operating Capability.
- **Program Risk Assessment –** The program is currently correcting several known ASuW and ISR-related software deficiencies. However, the updated software is not scheduled for release until after the completion of IOT&E. Therefore, there is a risk that the Beyond LRIP Report will not contain an evaluation of these fixes.

FY 2012 Systems Engineering Assessments
- DASD(SE) did not perform any formal assessment during 2012 but participated in multiple SE WIPTs and Test and Evaluation WIPTs to monitor system maturation and corrective actions. The program entered IOT&E in September 2012, one month ahead of the October threshold start date. Extensive integrated test phase evaluations indicated that acoustic ASW sensor performance is exceeding that of all legacy P-3 systems and is also exceeding P-8 ASW mission requirements. However, isolated ASuW and ISR-related software deficiencies remained at the time of entry into IOT&E, which negatively impact system performance. The program is working to correct these deficiencies. DASD(SE) advised the program to retain software staffing in order to burn down the high number of software trouble reports (STRs).
- DASD(SE) participated in 11 Acquisition and SE WIPTs to shape the planning and technical approach for the P-8A Increment 3 program.
- DASD(SE) is planning a PSR in 2013 to assess readiness for the FRP decision and the Increment 3 MS A decision.

Measurable Performance Criteria
- **Reliability** – The program tracks and reports progress against its reliability growth curve and is currently meeting the reliability requirement.
- **Software** – Software defects contributed to developmental and integrated test delays (5-month delay to IOT&E); however, the volume of STRs has steadily declined from more than 300 priority 1 and 2 STRs in late FY 2011 to no priority 1 and 42 priority 2 STRs in August 2012. Sixty-five STRs are being deferred for resolution prior to the 2013 Follow-on Operational Test and Evaluation.
- **Manufacturing** – All aircraft, including the three IOT&E aircraft, were delivered on time or within days of scheduled delivery. Traveled work is declining, and Boeing implemented and is tracking mitigation activities with key suppliers.
- **Integration** – The program proactively mitigated integration risks through the use of multiple system integration labs. The program is working to address insufficient weapons bay heating to ensure Mk 54 torpedo temperature operating envelope.

Conclusion: The P-8A program has appropriately managed systems engineering activities and will meet its KPPs, but completion of ongoing software deficiency corrections is necessary to improve performance. The program is one of few to track to its original cost and schedule requirements. It has maintained disciplined technical planning and has expeditiously resolved technical issues as it seeks to avoid a gap in ASW/ASuW warfighting capabilities currently provided by the P-3C.

Presidential Helicopter Fleet Replacement (VXX)

Prime Contractor: TBD, pre-source selection

Executive Summary: VXX is a non-standard Navy program to replace the legacy fleet of executive lift helicopters. The acquisition approach to satisfy the Presidential vertical lift requirement is a competitive procurement for the replacement air vehicle and integration of Government-defined mission systems by the prime contractor. Because of the use of mature technologies and a proven, existing aircraft, this approach does not require a Technology Development phase.

Mission Description: The VXX mission is to transport the President and Vice President of the United States, visiting heads of state, and other parties as directed by the Director, White House Military Office. This involves two missions defined by different requirements: routine administrative lift (MT-1) and contingency lift (MT-2). Missions are accomplished today with a combination of VH-3D and VH-60N aircraft. VXX will procure a single type aircraft.

System Description: An airworthy certified aircraft will be selected from existing, in-production vertical lift platforms with proven and mature technologies. Mission systems developed by the Government will be provided to the selected prime contractor for integration and installation, which may require an update to the airworthiness certification.

Schedule: The program is pre-MS B. The CDD is under JROC review for final approval. DASD(SE) reviewed and provided comment to the CDD to ensure the requirements were reasonable based on Analysis of Alternatives (AoA) findings and systems engineering principles. The JROC is expected to approve the CDD before the pre-Engineering and Manufacturing Development (pre-EMD) review in the 2nd quarter FY 2013. The pre-EMD review will authorize the release of an RFP to industry for integration, and production. MS B, planned for 3rd quarter FY 2014, will be the first formal acquisition milestone.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – A draft SEP is in final review and will be included with the draft RFP, which details the technical planning and management for the program. The SEP will be approved to support the Pre-EMD review in 2nd quarter FY 2013 and will be included with the final RFP. No waivers or deviations are planned.
- **Requirements** – The draft CDD was based on the cancelled VH-71 program CDD and has been updated and informed by an extensive AoA. Stakeholder organizations reviewed and approved changes to the original requirements to facilitate the procurement and delivery of a cost-effective solution. The program has established a senior-level board representing all stakeholders to monitor and mitigate mission and system requirements changes during the development process.
- **Program Protection Plan (PPP)** – The program commenced PPP development activities with a June 2012 criticality analysis planning meeting supported by DASD(SE). The critical program information assessment will begin during a 1st quarter FY 2013 Systems Engineering Working Integrated Product Team (SE WIPT) meeting.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – DASD(SE) has reviewed reliability and maintainability engineering activities planned as documented in the SEP, and will monitor program progress during technical reviews and SE WIPTs. Due to the use of mature technologies and a proven, existing aircraft, a demonstrated sustainability performance baseline will be included in industry proposals.
- **Program Risk Assessment** – DASD(SE) is working with the program's systems engineering organization to establish a risk and opportunity management process. Initial risk has been assessed in the areas of integration, air worthiness certification, and weight management. The program will perform a risk assessment as part of source selection and will update the assessment after contract award.

FY 2012 Systems Engineering Assessments

- DASD(SE) participated in the Integrating Integrated Product Team and OIPT meetings leading to an In-Process Review (IPR) DAB to support approval of the program's acquisition planning. DASD(SE) conducted two technical working groups to refine the program's systems engineering planning, participated in multiple SE WIPTs and the Mission Communication System (MCS) System Requirements Review (SRR).
- In FY 2013 DASD(SE) will provide systems engineering subject matter expertise to the OSD RFP peer review and will conduct a PSR in preparation for the pre-EMD DAB, and continue to monitor the MCS development at the MCS technical design reviews.

Measurable Performance Criteria

- **Reliability** – System reliability will be heavily dependent on the platform selected to meet the VXX requirement. Market research and existing data support the assessment that requirements are achievable. The inherent maturity of the candidate aircraft and the use of proven communications technology serve to mitigate risk.
- **Software –** The draft SEP defines software architecture priorities, addresses interface control requirements, and identifies appropriate metrics such as requirements stability, lines of code, memory usage, and processor throughput that will be used to manage software development on the program. The 1st quarter FY 2013 PDR for the Government design of the MCS will provide additional insight into software configuration plans for this software-intensive element of VXX.
- **Manufacturing** – All expected offerors have existing production lines with sufficient capacity to support the planned production levels.
- **Integration** – The program understands the interrelationships, dependencies, and synchronization with complementary systems within the existing presidential transportation environment. The associated integration effort will depend on the platform selected and on the Government plans for developing the mission systems.

Conclusion: The VXX program has effectively used the trade study process to establish a reasonable set of achievable requirements. This approach, along with the program's informed systems engineering, program planning, and RFP development efforts, should result in an executable acquisition program.

Remote Minehunting System (RMS)

Prime Contractor: Lockheed Martin Undersea Systems

Executive Summary: The AN/WLD-1(V)2 RMS is an unmanned mine reconnaissance system designed to detect, classify, identify, and localize bottom and moored mines in shallow and deep water. RMS is in the Engineering and Manufacturing Development (EMD) phase. DASD(SE) has been involved in a Critical Systems Review, Design Review, and Systems Engineering Working Integrated Product Teams (SE WIPTs) as part of the Acquisition Decision Memorandum (ADM)–directed reliability growth program (RGP) to improve RMS reliability performance.

Mission Description: RMS is launched from the Littoral Combat Ship (LCS) as part of the Mine Countermeasures (MCM) Mission Package (MP). It enables LCS to detect, identify, and localize mines for avoidance or subsequent neutralization by other MCM MP systems while keeping LCS at a safe standoff distance from the minefield.

System Description: RMS is an integrated system consisting of an unmanned semi-submersible diesel-powered remote multi-mission vehicle (RMMV) with an AN/AQS-20A towed variable-depth sensor. RMS operates autonomously with pre-programmed search patterns, recording mine detection and localization data for post-mission analysis onboard LCS.

Schedule: The program is in EMD. The previous MS C decision was rescinded in June 2010 due to a Nunn-McCurdy breach; a new MS C is planned for FY 2014. In 2012, RMS continued to address reliability issues highlighted in an ADM of June 2010. Key FY 2012 DASD(SE) activities included support of the ADM-directed Critical Systems Review and Design Review processes, assessment of technical risk, and participation in the evaluation of the RGP.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP on June 10, 2011, to support the EMD phase. The program is executing the SEP without waivers or deviations. This SEP focuses on engineering activities needed to grow system reliability to meet the ADM requirements identified during the 2010 Nunn-McCurdy breach process. An update to the SEP is planned to support MS C in FY 2014.
- **Program Protection Plan (PPP) –** The program is developing a PPP for submission to DASD(SE) in July 2013 to support MS C.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – DASD(SE) is monitoring the RMS RGP, which will have a direct impact on life cycle costs and sustainability. The RGP is on track and will aid the program in meeting its mandatory sustainment KPPs for materiel availability and operational availability. The RMS Operational Availability Working Group is concentrating its efforts to improve downtime drivers such as mean time to repair and logistics delays, in order to achieve the operational availability KPP.
- **Program Risk Assessment –** RMS has a risk management plan in which the PMO reviews risks and mitigation efforts weekly. The program has significant risk associated with RMMV launch,

handling, and recovery (LH&R), AN/AQS-20 false detection rates, shipboard integration and implementation, and overall RMS reliability performance. The program initiated a risk mitigation plan for LH&R in 4th quarter FY 2012. Mitigating risk in time to support LCS Initial Operational Test and Evaluation is a priority.

FY 2012 Systems Engineering Assessments

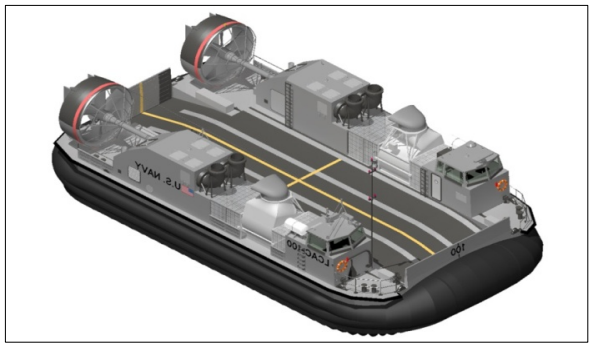
- DASD(SE) participated in technical reviews that included a Critical Systems Review, Design Review, and SE WIPTs focusing on reliability growth initiatives during FY 2012. The reviews identified corrective actions for reliability deficiencies highlighted in the 2010 Nunn-McCurdy review. As part of this effort, the program has implemented 18 fixes for previously identified high-impact failures and will conduct verification of the fixes in FY 2013.
- DASD(SE) continues to assess the effectiveness of the RMS RGP and continues to work with the PMO to assess technical deficiencies, process improvements, and the use of predictive reliability models.
- DASD(SE) will assess RMS systems engineering efforts, including the reliability growth progress, during quarterly Defense Acquisition Executive Summary assessments and scheduled SE WIPTs.

Measurable Performance Criteria

- **Reliability** – The RMS program has a reliability threshold requirement of 75 hours mean time between operational mission failure (MTBOMF). The program demonstrated initial measurements of 45 hours MTBOMF, triggering the need to establish an RGP to grow reliability to the requirement. The program has incorporated corrective actions for 32 known deficiencies (29 failure modes and 3 process changes) into the RMMV design and has implemented four supply chain management changes. Reliability validation measurements in FY 2012 indicate improved performance to 63 hours MTBOMF relative to the 75-hour requirement. The reliability growth curve projects 115 hours in FY 2013.
- **Software** – RMS software provides the command and control system, vehicle-to-LCS communication interface, and minehunting data-processing functionality. RMS software has been updated to include corrective actions required to meet vehicle reliability requirements and in the future will require only fact-of-life software modifications and improvements. PMS403 has the responsibility for all software components associated with RMS.
- **Manufacturing** – Manufacturing facilities are in place; however, no significant manufacturing activity will take place until successful completion of the RGP.
- **Integration** – RMS has integration facilities at Naval Surface Weapons Center, Panama City, Florida. Integration testing on board LCS has uncovered handling and communication problems. The program is pursuing design and procedural improvements to address the problems. The SE WIPT is monitoring progress on integration resolutions.

Conclusion: RMS is addressing the reliability deficiencies that have an impact on technical performance and suitability. Systems engineering processes are in place to discover and correct these deficiencies.

Ship-to-Shore Connector Amphibious Craft (SSC)



Prime Contractor: Textron, Inc.

Executive Summary: The SSC is an air cushion vehicle (ACV) that transports joint forces engaged in operational maneuver from the sea from over-the-horizon distances. It operates from amphibious ships and mobile landing platforms and is the functional replacement for the current Landing Craft, Air Cushion (LCAC). SSC is in the Engineering and Manufacturing Development (EMD) phase. DASD(SE) conducted post-PDR and PSR assessments in 2012, to ensure successful program initiation and to help the program manager identify risk in support of the MS B DAB decision.

Mission Description: The SSC will bridge the projected capability gap as LCACs retire from service by providing ship-to-shore transport of joint forces. SSC will enable the transfer of combat-ready personnel, equipment, and supplies to austere littoral access points ashore in numerous scenarios and environmental conditions. The SSC will support conventional combat operations and other noncombatant and nonmilitary operations, such as humanitarian aid.

System Description: The SSC provides advances over the LCAC in performance, such as speed, range, cargo capacity, automation, reliability, and maintainability. The craft has an overall length of 28 meters and a beam of 15 meters. The SSC's air cushion is formed by a flexible skirt that surrounds the bottom of the craft and is then filled with air from two centrifugal lift fans. The lift fans and propulsion drive trains use four gas turbine engines as prime movers. The craft has identical port and starboard systems consisting of lift fans, propulsors, bow thrusters, and craft service generators. The craft has a C4N (command, control, communications, computers, and navigation) suite to support command and control operations, a command module that houses the central command station, and a module for personnel and their equipment.

Schedule: SSC received MS B DAB approval to enter EMD and initiate detail design and construction in June 2012. DASD(SE) activities included post-PDR and PSR assessments and MS B SEP updates, review, and approval.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the program SEP on June 26, 2012. The program is following the SEP without waivers or deviations and has provided it to the contractor for incorporation into the contractor's technical planning activities.
- **Requirements** – JROC validated and approved the CDD on June 10, 2010. SSC has eight KPPs: payload capacity, interoperability with amphibious and well deck ships, net-ready, force protection, survivability, manpower, materiel availability, and inland accessibility. Materiel reliability and ownership costs are KSAs. The program requirements are reasonable and stable. SSC is on track to achieve its performance requirements.
- **Program Protection Plan (PPP)** – DASD(SE) approved the program PPP on January 13, 2012.
- **Systems Engineering Support of Life Cycle Management and Sustainability –** The SSC life cycle sustainment approach melds current LCAC supportability concepts with performance

measures to evaluate future options. The approach is supported by reliability and maintainability projections. Sustainment requirements are materiel availability and materiel reliability.

- **Program Risk Assessment** – The SSC program has three moderate technical risks: (1) main engine, (2) drive train integration, and (3) C4N control system. To mitigate (1) and (2), the program selected an engine with an extensive marine operating history and has employed an incremental drive train integration and test approach. SSC's C4N Control System design includes equipment common to other USN ships. This commonality and the shipbuilder's proposed greater than 80 percent software reuse, provides acceptable risk mitigation for (3).

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted an assessment of the SSC PDR process and allocated baseline artifacts. DASD(SE) also completed a pre-MS B PSR. The results of these two assessments supported the MS B DAB and entry into the EMD phase.
- DASD(SE) review of the Navy-developed technical specifications and drawings identified inconsistencies in the allocation of some subsystem requirements. The top-level craft reliability requirements were identified but were not traceable to all subsystems. DASD(SE) assessed the RFP technical documentation package as sufficient to ensure competition.
- DASD(SE) completed a Pre-MS B PSR, which assessed the program for appropriate engineering and management processes, and for resources sufficient to achieve its goals in balancing cost, schedule, and performance while managing risk. The program has addressed the majority of the recommendations and has implemented the technical measures and metrics into the SEP and the Textron contract.
- DASE(SE) will assess the program's artifacts for maturity to a product baseline during quarterly design reviews and Systems Engineering Technical Review (SETR) events planned in FY 2013.

Measurable Performance Criteria

- **Reliability** – The program has CDD-required thresholds for materiel availability of 59.5 percent and materiel reliability of 85 percent for a 12-hour mission. Current design projections estimate materiel availability of 61.9 percent and materiel reliability of 88 percent. SSC has a reliability growth curve documented in the SEP.
- **Software** – A Software Development Plan is a contract deliverable for FY 2013. The shipbuilder's proposed software size is 874,000 SLOC, consisting of greater than 80 percent reuse. The SSC C4N system will be integrated in the contractor's system integration laboratory (SIL).
- **Manufacturing** – The Detail Design and Construction (DD&C) contract was awarded to Textron, Inc., in July 2012. Textron was the original manufacturer of the LCACs. The SSC will be manufactured using similar materials and processes, and Textron has begun defining the assembly line necessary to support LRIP quantities.
- **Integration** – The contractor's SIL facilities include the ability to dynamically represent the craft through simulations and stimulations (SIM/STIM). As subsystems are ready to be integrated, that subsystem replaces the applicable SIM/STIM. The contractor will integrate the C4N equipment and software in the SIL using an incremental build-test-fix process.

Conclusion: The SSC allocated baseline artifacts, prototyping insights, and the DD&C contract requirements constitute a stable technical baseline for the program office and contractor to develop into a producible craft detailed design. DASD(SE) will continue to assess the design maturity toward the product baseline through event-driven SETR interactions.

SSN 774 VIRGINIA Class Submarine (VCS)

Prime Contractor: General Dynamics, Electric Boat Division; Huntington-Ingalls Industries, Newport News Shipbuilding

Executive Summary: The VCS program is a multi-mission nuclear-powered attack submarine optimized for littoral and deep ocean operations. It replaces the aging and decommissioning LOS ANGELES Class of submarines. The program is in the Production and Deployment phase; 9 of 30 planned ships have been delivered. DASD(SE) approved the SEP in FY 2012. The SEP addresses the systems engineering processes and challenges to reduce ship construction costs for Blocks III and IV designs.

Mission Description: VCS uses state-of-the-art stealth, enhanced features for special operations forces, and effective command, control, communications, and intelligence capabilities to support operational missions in the 21st century. The operational commander will employ the VCS to conduct open-ocean and littoral covert operations in support of the following submarine mission areas: strike warfare; antisubmarine warfare; intelligence, surveillance, and reconnaissance; electronic warfare; antisurface ship warfare; naval special warfare; mine warfare; and battle group operations.

System Description: VCS is a nuclear-powered, deep-diving attack submarine that incorporates new technologies and stealth. Armament includes MK48 advanced capability torpedoes and vertical-launch cruise missiles.

Schedule: The program is in FRP. Milestone III was achieved with the signing of the Acquisition Decision Memorandum (ADM) on September 3, 2010. Of the 30 ships planned, 9 have been delivered. The program is building two ships per year, but funding limitations might result in a procurement reduction of one ship in FY 2014.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP on August 22, 2012, to support Block III and IV cost-reduction initiatives. The SEP addresses the reliability deficiencies identified during the FY 2010 PSR and Beyond LRIP report, and implementation of a reliability program plan in accordance with DTM 11-003. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The program has an approved Operational Requirements Document (ORD) dated October 27, 2009. The requirements are stable, and all KPPs have been demonstrated.
- **Program Protection Plan (PPP) –** The program completed an information assurance threat/vulnerability/risk mitigation study approved by the Navy before the current PPP requirement. The program is in FRP, and the generation of a separate PPP is not applicable.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – Block III implements design-for-affordability (DFA) changes to reduce acquisition cost. Block IV engineering activities are targeted toward the reduction of total ownership cost (RTOC) and increasing operational availability by decreasing depot maintenance with little to no increase in

acquisition costs. The program intends to achieve the goal by increasing scheduled deployments by one (increase from 14 to 15), and by reducing the number of depot maintenance periods by one (decrease from four to three) through these DFA and RTOC initiatives. The life of ship reactor design will not require a long and expensive mid-life refueling overhaul.

- **Program Risk Assessment –** The program has a risk management process and effectively allocates resources to address risks. Key risks include the achievement of DFA and RTOC initiatives to effectively realize the Block IV 3-15 (depot maintenance-deployment) improvements without increasing ship construction costs or creating schedule delays associated with the block upgrades.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted technical exchange meetings supporting the development of the program SEP and reliability program plans. DASD(SE) also reviewed plans to mitigate reliability deficiencies such as the debonding of special hull treatment.
- DASD(SE) conducted quarterly Defense Acquisition Executive Summary assessments to support OSD leadership and staff oversight.

Measurable Performance Criteria

- **Reliability** – The program developed a reliability, availability, and maintainability (RAM) program plan including reliability growth curves for the four unique Block III design modifications: VIRGINIA payload tubes (VPT); large aperture bow (LAB) array; payload support electronics systems (PSES); and common weapons launcher (CWL). The RAM program plan includes a failure mode, effects, and criticality analysis; detailed reliability allocations, thresholds, and objectives; and a plan for sustainment. A reliability growth analysis (RGA) report for the LAB array was completed and documents the reliability baseline against which future measurements can be compared.
- **Software** – The program established software reliability growth curves and metrics for VPT, LAB Array, PSES, and CWL in the SEP. RGAs, which include hardware and software, will provide a measurable benchmark for evaluating the reliability of future software drops.
- **Manufacturing** – The program is delivering ships with progressive quality and schedule improvement, with the last ship (USS MISSISSIPPI, SSN782) delivering nearly a year ahead of contract, within budget, and with Navy Board of Inspection and Survey results rating green in all 22 areas. The program set a goal of delivering ships in 60 months by the FY 2012 ships and is on its way to achieving that goal with the last ship delivering in 63 months. The process for applying special hull treatment has been improved but will not be fully implemented until the 12th ship of the class.
- **Integration** – The program is successfully managing the integration of Government-furnished equipment from approximately 17 participating acquisition resource managers. The reactor plant is managed separately by NAVSEA 08. The Submarine Warfare Federated Tactical System (SWFTS) is the acknowledged system-of-systems engineering approach that delivers mission-critical hardware and software supporting integrated platform operations.

Conclusion: The program is on track and inserting DFA and RTOC initiatives to improve availability and affordability.

T-AO(X) Fleet Replenishment Oiler

Prime Contractor: TBD

Executive Summary: The T-AO(X) program will provide the primary fuel pipeline linking Navy ships and their embarked aircraft with logistics nodes ashore. The program is pre-MS A. DASD(SE) has conducted a PSR and provided lessons learned and best practices to improve the program's planning in areas such as: self-defense requirements, intellectual property considerations for future reprocurements, material supply chain risks, and system reliability growth planning with incremental verification methodology.

Mission Description: The T-AO(X) will shuttle bulk petroleum products and dry stores/packaged cargo from resupply ports to customer ships. When Fast Combat Support Ships (T-AOEs) are unavailable, T-AOs will pair with a Dry Cargo/Ammunition Ship (T-AKE), to operate as a substitute to remain on-station with a carrier strike group (CSG) or an amphibious ready group (ARG) to provide fuel and stores as required. In that case, the station T-AO is linked to logistics nodes ashore by other T-AOs operating in a shuttle mode.

System Description: The T-AO(X) transports bulk petroleum products and dry stores/packaged cargo from shore depots for replenishment of underway forces. The design will be in voluntary compliance with the Oil Pollution Act of 1990 and International Convention for the Prevention of Pollution from Ships requirement for tankers to be double hulled. Underway replenishment (UNREP) will occur via current USN standard connected replenishment (CONREP) and vertical replenishment (VERTREP) equipment and procedures. Heavy E-STREAM equipment and procedures are being developed to support F-35 engine logistics. The C4I (command, control, communications, computers, and intelligence) capability needed to support and operate with Fleet and other afloat assets will be by Government off-the-shelf (GOTS) and commercial off-the-shelf (COTS) turn-key systems. The ship will be capable of operating with a CSG or ARG and will be available for tasking a minimum of 270 days each year. No new technology is required to deliver this ship class.

Schedule: The program received a Materiel Development Decision (MDD) in February 2011. A MS A decision is planned for 2nd quarter FY 2013. DASD(SE) has conducted a PSR for MS A and has recommended improvements to the program's technical and reliability planning, Acquisition Strategy (AS), and Systems Engineering Plan (SEP).

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The program submitted draft SEPs for review. The program accepted DASD(SE) recommendations for metrics definitions and technical planning strategies relating to event-based design reviews to be included in the SEP and the Detailed Design and Construction (DD&C) RFP for bidding contractors.
- **Requirements** – The JROC approved the ICD on January 4, 2011. A Service-endorsed CDD is available for MS A which improves program cost estimating.
- **Program Protection Plan (PPP)** – The PPP is in development; an initial draft has been routed for informal comment. The PPP will be available for MS A.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program's basis for life cycle logistics planning is Military Sealift Command's (MSC) proven structure for T-AO life cycle management and sustainability. MSC actively tracks the material condition of its ships and will maintain T-AO(X) to its high operational availability requirement in a similar logistics approach.
- **Program Risk Assessment** – The PSR was comprehensive and culminated in one significant risk, the potential loss of the auxiliary ship industrial base. To address auxiliary shipbuilding industrial base stability risk, the Navy has offered the use of a Shipbuilding Capabilities Preservation Agreement (SCPA). These agreements allow the contractor to claim certain indirect costs attributable to its private sector work as allowable costs on Navy shipbuilding contracts.

2012 Systems Engineering Assessments

- DASD(SE) contributed to the technical planning efforts of the program and conducted a pre-MS A PSR. DASD(SE) has assisted in defining KPP and KSA threshold and objective values of the Service-endorsed CDD to enhance the engineering trade space of the design. The program examined and realigned the technical design reviews to support the generation of the ship specification for the DD&C RFP. The program has submitted an AS for review. DASD(SE) recommended adding provisions for defining technical baselines with the associated event-driven Systems Engineering Technical Reviews to reduce overall program risk.
- DASD(SE) recommended that the Littoral Combat Ship (LCS) speed-related sensitivity analysis, used to inform the Analysis of Alternatives (AoA) for the total number of ships, remain an influence on the T-AO(X) CDD. LCS average speed and actual fuel consumption rates contribute to determining the final tanker inventory.
- DASD(SE) will maintain continuous engagement through Systems Engineering Working Integrated Product Teams during FY 2013.

Measurable Performance Criteria

- **Reliability** – The program initiated efforts to define reliability, reliability growth, and program technical tracking metrics in concert with development of the MS A SEP.
- **Software** – Software development is minimal. The C4I will be provided as Government-furnished equipment, and machinery control system (MCS) software will be delivered as part of the turn-key original equipment manufacturer product.
- **Manufacturing** – The industrial base for these ships is limited but is capable of building the baseline double-hull tanker.
- **Integration** – DASD(SE) influenced the integration planning of the C4I and MCS suites. The C4I suite will be verified at the SPAWAR Test Integration Facility and the MCS will be provided by the propulsion system vendor directly for installation onboard the ship. The program plans to allocate sufficient time to find and resolve problems encountered during system light off.

Conclusion: The T-AO(X) AoA bounded a potential materiel development solution, and the PSR influenced the system specification and the AS necessary to acquire the oiler, shaping the program for a successful MS A review.

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4.3 DASD(SE) Assessments of Air Force Programs

Assessments are as of the end of FY 2012 (September 30, 2012); however, some assessments may include information on program status through the 1st quarter FY 2013 (December 31, 2012). This section includes summaries on the following 15 programs:

- Air Operations Center–Weapon System, Increment 10.2 (AOC-WS Inc 10.2)
- B-2 Defensive Management System Modernization (B-2 DMS)
- B61 Mod 12 Life Extension Program Tailkit Assembly (B61 TKA)
- Combat Rescue Helicopter (CRH)
- Defense Enterprise Accounting and Management System (DEAMS)
- Expeditionary Combat Support System (ECSS)
- F-22 Raptor Advanced Tactical Fighter Aircraft (F-22A Inc 3.2B)
- Joint Air-to-Surface Standoff Missile–Extended Range (JASSM-ER)
- Joint Space Operations Center (JSpOC) Mission System (JMS)
- KC-46A Tanker Modernization
- MQ-9 Reaper Unmanned Aircraft System (UAS)
- Next Generation Operational Control System (OCX)
- Small Diameter Bomb Increment II (SDB II)
- Space-Based Infrared Satellite GEO 5/6 Satellite Replenishment Production (SBIRS GEO 5/6 SRP)
- Space Fence Ground-Based Radar System (SF)

Air Operations Center–Weapon System, Increment 10.2 (AOC-WS Inc 10.2)

Prime Contractor: Northrop Grumman Corporation, Defense Systems Division

Executive Summary: AOC-WS Inc 10.2 will integrate 50-plus disparate third-party mission applications into a net-centric structure. The program initiated Technology Development (TD) phase risk-reduction activities in January 2012, preparing for the March 2013 MS B. DASD(SE) advocated establishing a quarterly Systems Engineering Working Integrated Product Team (SE WIPT) to encourage early risk-mitigation strategies, to specify requirements, and to address third-party application integration and security engineering risks.

Mission Description: The AOC-WS is the combined and joint force air component commander's weapon system for planning, executing, and assessing theater-wide air operations.

System Description: The AOC-WS 10.2 establishes a common service-oriented and standards-based infrastructure to integrate mission systems and services developed by third-party capability providers outside of the AOC-WS program. The AOC-WS 10.2 infrastructure employs the fielded AOC-WS 10.1 hardware, virtualized applications, and thin servers/clients. It enables a common user interface, increases the speed of command, and provides modular applications with standard interfaces and shared data to support agile integration and rapid fielding of future capabilities.

Schedule: The program is in the TD phase and is executing continued risk-reduction activities before approval to enter the Engineering and Manufacturing Development (EMD) phase. MS B is scheduled for March 2013. Key FY 2012 systems engineering activities included the System Requirements Review (March), Integrated Baseline Review (July), Interim Design Review (August), and multiple SE WIPTs (June, July, August).

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(C3ISR & IT Acquisition) approved the Inc 10.2 SEP on May 2, 2008. The program is fulfilling the objectives of the SEP without waivers or deviations. An AOC-WS Acquisition Decision Memorandum, dated June 23, 2010, changed the acquisition strategy and necessitated a revision to the SEP. Currently under revision, Version 2 will align with the DASD(SE) SEP Outline dated April 20, 2011, and will incorporate the contractor's systems engineering process improvements in support of the spring 2013 MS B.
- **Requirements** – The JROC approved the Inc 10.2 CDD on October 3, 2006, and approved an update on December 11, 2009. There are four KPPs: net-ready, collaboration, materiel availability, and system training.
- **Program Protection Plan (PPP)** – The Inc 10.2 PPP will be approved prior to MS B. DASD(SE) led the program staff through a PPP development workshop in July 2012, ensuring the PPP will capture the results of criticality analysis, software assurance, and supply chain risk analysis.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – At the Initial Design Review the contractor developed a model and methodology to address total ownership cost and recommended the program focus on two main cost drivers (operations personnel and software licensing).
- **Program Risk Assessment** – Key program risks involve the limited configuration control of the 50-plus mission applications to be integrated and information security certification risks. The program has an effective risk management program, conducted monthly, to identify and review program risks and their corresponding mitigation steps.

FY 2012 Systems Engineering Assessments

- DASD(SE) executed continuous program engagement throughout FY 2012 to support the FY 2013 MS B assessment. Engagement included the System Requirements Review, Integrated Baseline Review, Interim Design Review, three SE WIPTs, and SEP and PPP development workshops.
- DASD(SE) assessed that the program successfully initiated pre-EMD risk-reduction efforts as directed in the June 2010 Acquisition Decision Memorandum (ADM).
- The program is on track to hold a PDR in December 2012. In accordance with the WSARA, DASD(SE) will prepare a post-PDR assessment to confirm the program's readiness to proceed to the MS B decision in March 2013. DASD(SE) also will also assess the adequacy of the program's management efforts in support of the upcoming Critical Change Review.

Measurable Performance Criteria

- **Reliability** – The system reliability requirement measure is defined as the mean time between critical failure (MTBCF) with established threshold and objective value of greater than 1,200 hours. The program is developing reliability predictions and corresponding technical performance measures to assess progress.
- **Software** – Software requirements primarily focus on the necessary "glue code" to implement more than 50 distinct mission application integration patterns for Inc 10.2. The program gained insight into the software development effort as it developed two prototype software builds in FY 2012 for user feedback and limited early installation in FY 2013.
- **Manufacturing** – Inc 10.2 will employ the commercial off-the-shelf/Government off-the-shelf hardware architecture fielded with Inc 10.1; hence, manufacturing concerns are minimal.
- **Integration** – The primary focus of the Inc 10.2 modernization program is the integration of 50-plus distinct third-party mission applications into a seamless service-oriented, single-user interface architecture. The program reduced integration risks in FY 2012 by mapping the mission applications to operational mission threads and requirements and prioritizing their integration into a series of prototype software builds. The first build will be used to gain user feedback in early FY 2013 after limited early installation in the Combined Air Operations Center–Experimental (CAOC-X).

Conclusion: The program is on track to meet the March 2013 MS B by actively mitigating the technical risk-reduction actions as directed in the June 2010 ADM.

B-2 Defensive Management System Modernization (B-2 DMS)

Prime Contractor: Northrop Grumman Aerospace Systems

Executive Summary: B-2 DMS is a pre-Major Defense Acquisition Program to replace the legacy DMS receivers, antennas, and display processor. The modernization will improve the B-2's ability to detect, identify, geo-locate, and avoid threats, significantly enhancing aircrew situational awareness. DASD(SE) supported the Electronic Support Measure (ESM) subsystem System Functional Review (SFR) in July 2012, which established the program's functional baseline.

Mission Description: The B-2 is an all-wing, two-person crew aircraft with twin weapons bays capable of carrying a 40,000 pound bomb load. The aircraft is a multi-role, low-observable (LO) bomber capable of delivering conventional and nuclear munitions. The B-2 employs an array of signature-reduction techniques to significantly enhance the aircraft's ability to penetrate enemy defenses. The B-2 is tasked to attack global targets, day or night, in all weather and in highly defended threat areas at the strategic, operational, and tactical levels of warfare.

System Description: The B-2 DMS is a principal enabler for survivability for the B-2 stealth bomber. The legacy DMS Threat Emitter Locator System (TELS) detects, identifies, and locates enemy radar systems and facilitates real-time threat avoidance by providing threat warning and threat situational awareness information to the aircrew via the tactical situation display. The B-2 DMS modernization will replace TELS and its associated antennas with a more current ESM subsystem for improved threat detection and an expanded aircraft display processing system to increase situational awareness.

Schedule: The program is in the Technology Development (TD) phase. MS A was held August 2011 and MS B is planned for 3rd quarter FY 2014. Initial Operating Capability is expected in FY 2018.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the MS A SEP in August 2011. The SEP will guide technical planning and execution through TD. There are no waivers or deviations, and the SEP objectives are being met.
- **Requirements** – The program's requirements are leveraged off of the 2009 Electronic Warfare and the 2010 Airborne Strategic Deterrence ICDs. The Director, Cost Assessment and Program Evaluation approved the Analysis of Alternatives in March 2011. A draft CDD includes nine KPPs and has been developed and coordinated within the Service as a guide to the early TD phase effort. An approved CDD is not required until MS B in 3rd quarter FY 2014.
- **Program Protection Plan (PPP)** – The program does not yet have a PPP. The B-2 program has agreed to develop a platform-level PPP and is expected to develop program-level documents or annexes for future increments and milestones.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The B-2 DMS modernization will emphasize reliability in the design process, in order to sustain a two-level

maintenance concept and reduce the deployment footprint. The program has a draft KPP for materiel availability.

- **Program Risk Assessment** – At the SFR in July 2012, DASD(SE) assessed the B-2 DMS program as having risk in the areas of software, hardware, integration, and verification. The program has a robust risk identification and mitigation program in place.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted no formal assessments of the B-2 DMS in FY 2012; however, DASD(SE) participated in the ESM SFR and System Requirements Review. Throughout the TD phase, focus areas will include software development and subsystem integration/maturation. The program office and DASD(SE) will continue to monitor performance trade space going forward.
- DASD(SE) plans to conduct a PSR and post-PDR assessment in FY 2013 in support of MS B.

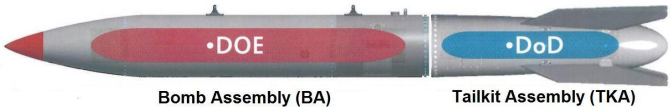
Measurable Performance Criteria

- **Reliability** –The program expects to achieve materiel reliability KSAs: mission reliability and mean time between maintenance. In addition, the program's SEP includes reliability growth planning to the expected requirement and addresses plans to ensure the contractor "designs in" reliability.
- **Software** – The program conducted a system-level SFR in May 2011 with DASD(SE) participation, which highlighted software development as a key program risk. The program has made this an area of emphasis and has revised the Software Development Plan to address shortfalls and details on the software prototyping strategy. Based on the risk, the program office sought additional support. ASD(R&E) coordinated and funded external software technical support to mitigate risk and maintain schedule.
- **Manufacturing** – B-2 DMS subsystems will leverage fielded systems or systems already in development, and excessive manufacturing risk is not expected. The SEP reflects program plans to assess manufacturing readiness throughout the life cycle during all Systems Engineering Technical Reviews and in support of major milestones. An initial Manufacturing Maturity Plan is expected to be developed by PDR with a final version ready to support CDR.
- **Integration** – The B-2 DMS program considered integration throughout development planning and will continue to treat integration as a focus area going forward. The program's single increment/two-phase TD phase approach was selected as a risk-mitigation opportunity. The selected ESM contractor will optimize the overall system and reduce integration risk by defining interfaces and subsystem allocations prior to down-selection on the critical ancillary subsystems.

Conclusion: The program is on track and well positioned to address software development and integration challenges through Engineering Manufacturing and Development.

B61 Mod 12 Life Extension Program Tailkit Assembly (B61 TKA)

Prime Contractor: TBD



B61-12

Executive Summary: The life extension of the B61-12 (B61) ensures the United States and its allies will continue to have nuclear deterrence options provided by the B61 into the future. The B61 Tailkit Assembly (TKA) is an ACAT ID pre-MDAP. The original plan was for the program to have a combined Materiel Development Decision (MDD) and MS A in FY 2012. At the MDD in February 2012, USD(AT&L) directed entry into MS B in November 2012. DASD(SE) completed a pre-MS A PSR in November 2011 and conducted a MS B PSR in August 2012.

Mission Description: The B61 TKA provides weapon-delivery accuracy to achieve the desired operational effects. The TKA system enables consolidation of multiple bomb assembly modifications (B61-3/4/7/10) into a single all-up round, the B61-12, reducing the number of life extension programs and life cycle costs for both DoD and the Department of Energy (DOE). The goal of the multi-agency B61 program is to extend the life of the weapon while modernizing within existing capabilities as directed by the Nuclear Weapons Council and documented in the June 2008 Tasking Memorandum.

System Description: The B61-12 all-up round consists of two major assemblies: the Bomb Assembly (BA), developed and managed by the DOE, and the TKA, developed and managed by the DoD. The B61 TKA requirements and design provide ballistic and guided delivery operating modes.

Schedule: USD(AT&L) directed the B61 TKA program to enter the acquisition life cycle at MS B planned for November 2012. DASD(SE) completed a MS A PSR in November 2011 and conducted a MS B PSR in August 2012.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the B61 TKA SEP in September 2012 for the November 2012 MS B DAB. The B61 TKA SEP does not include the SEP for the BA or the TKA/BA integration activities. The SEP will be updated prior to PDR and will guide technical planning and execution through Engineering and Manufacturing Development (EMD). The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC approved the CDD in September 2012 for MS B. The Director, Cost Assessment and Program Evaluation provided an Analysis of Alternatives (AoA) Sufficiency Report in lieu of a full AoA. DASD(SE) and other key stakeholders provided initial support as B61 TKA is a modification of an existing capability, and alternatives are limited by direction from key strategic planning documents and authorities.
- **Program Protection Plan (PPP)** – The USD(AT&L) approved the interim PPP in October 2012 for MS B with an update expected after contract award and prior to PDR at the end of FY 2013.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The ASD(L&MR) approved the Life Cycle Sustainment Plan in September 2012.
- **Program Risk Assessment** – The program has an established risk management process documented in the SEP. Program risks relate to DOE integration, F-35A integration, test assets

availability, reliability, operational environments, and certification. The program has funded mitigation plans in place to address the risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) completed a MS A PSR in November 2011 to support the original acquisition strategy. DASD(SE) conducted a second PSR in August 2012 for MS B.
- Positive observations included a strong concept characterization and technology development effort and an experienced program office staff. The MS B PSR team noted the program had addressed MS A PSR recommendations related to establishing a robust early developmental plan, requirements generation, DOE integration, and reliability planning. The MS B PSR determined the program has risks in the areas of DOE integration/BA dependency, suitability, and F-35A integration.
- DASD(SE) plans to participate in the B61 TKA PDR in late FY 2013 and will conduct a post-PDR assessment in accordance with the 2009 WSARA.

Measurable Performance Criteria

- **Reliability –** The B61 TKA program office developed reliability requirements and metrics. The reliability requirements are documented in the CDD approved in October 2012. In accordance with MS A PSR recommendations, the program added reliability growth planning details to the SEP to include design-for-reliability methods and techniques to grow reliability during EMD. In addition, as part of the MS B SEP, the program developed a Reliability, Availability, Maintainability, and Cost Report. The program has also established a rigorous reliability growth program.
- **Software –** Software development is not expected to be a program challenge based on experience with the development of similar capabilities.
- **Manufacturing** – Manufacturing risks are not expected based on current vendor experience producing similar components and technologies. Tolerances may warrant additional attention given the planned operational environment.
- **Integration** – The B61 TKA is dependent upon interagency coordination with DOE for weapon system development and test assets. The Air Force Nuclear Weapon Center is responsible for all-up-round integration of the BA with the TKA, as well as aircraft integration on multiple U.S. and NATO aircraft. The program is also dependent upon the industrial base for inertial guidance, radiation hardening, and long-dormant nuclear-specific technologies. In addition, the program is dependent on the F-35A program for platform environmental, fitment, and interface data. These interdependencies present additional technical challenges and will require close attention and development of well-defined interfaces and documentation (e.g., interface control documents).

Conclusion: The B61 TKA program is prepared to execute to the proposed schedule. Several of the key risks are associated with concurrent development and integration of the BA.

Combat Rescue Helicopter (CRH)

Prime Contractor: TBD; pre-source selection

Executive Summary: The CRH program will replace the Air Force's aging HH-60G Pave Hawk helicopter fleet with new air vehicles, training systems, and product support as required for the Personnel Recovery (PR) mission. This program will procure 112 aircraft and will enter the acquisition process at MS B. The CRH program intends to conduct a full and open competition to procure an existing, mature, and proven medium-lift helicopter and integrate existing and available subsystems, avionics, and mission equipment. Based on these aircraft and subsystem criteria, this approach does not require a Technology Development phase.

Mission Description: The primary mission of the CRH aircraft is to recover isolated personnel from hostile or denied territory. CRH also will execute humanitarian missions, civil search and rescue, disaster relief, casualty/medical evacuation, and non-combatant evacuation operations.

System Description: The CRH will be a dual-piloted, multi-engine, vertical takeoff and landing platform that will provide updated vertical lift along with command and control communications technology to meet Air Force PR mission requirements. The platform shall be capable of employment day or night, in adverse weather, and in a variety of threat spectrums from terrorist attacks to chemical, biological, radiological, and nuclear threats. The platform shall be designed as safe, reliable, available, and maintainable with enhanced survivability capabilities.

Schedule: The program is in the pre-Engineering and Manufacturing Development (EMD) phase. A Materiel Development Decision DAB was held in February 2012. A follow-on In-Process Review DAB in May 2012 approved release of a competitive aircraft procurement RFPs. The program will enter the acquisition cycle at MS B in July 2013. DASD(SE) assisted the program in developing the Acquisition Strategy, participated in the RFP peer review, and began a PSR to inform the MS B decision and assist the program with the transition to EMD.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) worked with the program to develop the technical planning and document it in a SEP. DASD(SE) reviewed the first draft of the SEP and provided comments and recommendations. The SEP is on track to support MS B. No waivers or deviations are expected.
- **Requirements** – JROC approved the program CDD in July 2010 as the HH-60 Recapitalization CDD. A July 2012 JROC memorandum acknowledged the clarification of some requirements (KSAs), and the six KPPs remain stable. The Acquisition Strategy limits the introduction of new technology, focusing on the integration of existing systems into a proven air vehicle. The CRH requirements are reasonable and stable.
- **Program Protection Plan (PPP)** – The program is developing a PPP. DASD(SE) completed an initial review in support of the program's RFP release and provided contract language and improved program PPP/Anti-Tamper planning.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – Sustainment remains dependent on the solution selected at contract award. The program requirements include

a mandatory Sustainment KPP. DASD(SE) worked closely with the program office to ensure planned reliability and maintainability requirements and engineering activities were realistic and adequately defined in the RFP, the SEP, and the Reliability, Availability, Maintainability, and Cost Report.

- **Program Risk Assessment –** The program has conducted an initial risk assessment of potential systems expected to respond to the RFP. The PSR identified the key risks associated with concurrent production and integration, software development, and air vehicle performance and certification.

FY 2012 Systems Engineering Assessments

- DASD(SE) participated in program assessments, two Integrating Integrated Product Teams, and two OIPTs to support the program MDD and In-Process Review DABs. DASD(SE) initiated a PSR and participated in the OSD RFP peer review, providing comments on acquisition documents including the Acquisition Strategy, System Specification, and RFP statement of work and supporting material.
- The program has worked closely with DASD(SE) to ensure the RFP documents and the development strategy include a strong emphasis on systems engineering
- The PSR assisted the program in preparing for EMD. The review team identified key risks, reviewed program planning, and developed recommendations for mitigating risk. DASD(SE) assisted the program to develop MS C draft entrance criteria for the Acquisition Decision Memorandum authorizing RFP release.

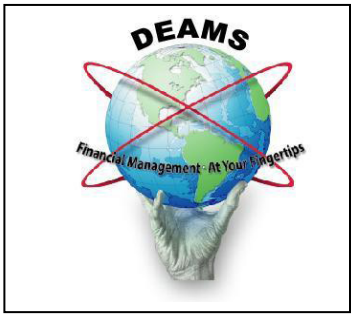
Measurable Performance Criteria

- **Reliability** – System reliability will depend on the platform selected to meet the CRH requirement. Market research and existing data support the assessment that requirements are achievable without reliability growth efforts.
- **Software** – The program will not fully understand the complexity of software development until the proposals are evaluated and the System Requirements Review is complete. DASD(SE) will continue to work closely with the program to assess and assist the software effort.
- **Manufacturing** – All expected offerors have existing production lines with sufficient capacity to support the planned CRH production levels.
- **Integration** – Subsystem integration is anticipated to be the most challenging aspect of CRH program development. The concurrent production and integration activities introduce risk. The program will need to ensure close management of the production line to avoid unplanned changes that could result from a late understanding of integration requirements for space, weight, power, cooling, wiring, and electro-magnetic shielding.

Conclusion: The CRH program has made a dedicated effort to incorporate sound systems engineering and program planning and to ensure the RFP will result in an executable acquisition program.

Defense Enterprise Accounting and Management System (DEAMS)

Prime Contractor: Accenture Federal Services LLC



Executive Summary: DEAMS is a financial management program to transform business and financial management processes and systems to provide accurate, reliable, and timely business information to support effective business decision making. DASD(SE) involvement enhanced the Release 1 and 2 CDR by shaping the content, identifying new risk areas and mitigations, focusing on technical skill requirements of staff, and compiling project metrics critical to achieving success. The program accepted all DASD(SE) recommendations. The DEAMS PMO was reorganized to recover schedule and achieve audit readiness by 2017.

Mission Description: DEAMS supports the warfighter with timely, accurate, and reliable financial information enabling efficient and effective decision making by DoD managers in the execution of their duties as responsible stewards of the public trust.

System Description: DEAMS is an implementation of Oracle commercial-off-the-shelf (COTS) and custom-developed software that will provide a modern accounting and finance system to the Air Force. DEAMS will replace existing accounting and finance legacy systems to provide core funds management consistent with financial management laws, regulations and policy, general ledger, funds management, payments, receivables, cost and revenues, and fiduciary reporting. DEAMS integrates accounting and finance to manage both DoD appropriated and working capital funds, and it rolls up multiple financial systems for global visibility. DEAMS is planned for 74 Air Force sites.

Schedule: The 2012 CDR included Releases 1 and 2 for development and deployment to a total of 14 sites. The PDR was held in June 2012, and the CDR was held in August 2012. Future Release Decisions in 2013 include Approval to Proceed (ATP) for Release 2 coding and test. Rollout is based on the Operational Assessment Plan.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) supported the SEP update for the DAB approved Milestone B on January 10, 2012. A DASD(SE)-approved update to the SEP is planned in early FY 2013. The program has created a minor release, 2C, which DASD(SE) is supporting and which should cause no deviation from the planning in the current SEP.
- **Requirements** – The DEAMS program requirements are directed to achieve FY 2017 audit readiness as presented in the System Capabilities Document (SCD). Seven of nine KPPs focus on financial reporting. DASD(SE) has actively participated in identifying KPPs affected by nonconformance to requirements. The CDR and an Operational Assessment (OA) in June 2012 identified issues with these seven financial KPPs by reviewing functionality provided by custom development. DASD(SE) identified that the Standard Procurement System interface placed three financial KPPs at risk due to poor scalability and accuracy of the interface. DASD(SE) explained the required redesign to achieve the KPPs.
- **Program Protection Plan (PPP)** – DASD(SE) co-led a multiskilled Systems Engineering Working Integrated Project Team to expedite development of the PPP. This team worked with DEAMS to support custom-developed Reports, Interfaces, Conversions, Extensions, and Workflow (RICEW) objects. Expected approval is late November 2012.

- **Risk Assessment –** In the CDR, DASD(SE) identified that the Standard Procurement System interface placed three financial KPPs at risk due to poor scalability and accuracy of the interface. The OA identified seven of nine KPPs are at risk due to nonperforming financial interfaces for DEAMS, and these risks are now being mitigated.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – Systems engineering efforts have focused on closing gaps between financial and accounting capabilities required for audit readiness versus the functionality off-the-shelf in the Oracle eBusiness Suite. The Life Cycle Sustainment Plan was last updated March 2012.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted informal PDR and CDR assessments for Increment 1, Releases 1 and 2, which provide RICEW objects to integrate 12 new sites into DEAMS. As a result of the CDR, DASD(SE) advised the program office on issues regarding its new role as Lead Integrator and mitigations addressing requirements definition/decomposition, scope management, and technical competencies of staff. DEAMS has accepted and is addressing all DASD(SE) inputs in order to resolve test issues. The DEAMS product baseline was confirmed at the CDR and is under configuration control.
- To prevent delay in Release 1 due to lack of Government-furnished information (GFI), design and development of five RICEW objects were moved to a delayed Release 2C.

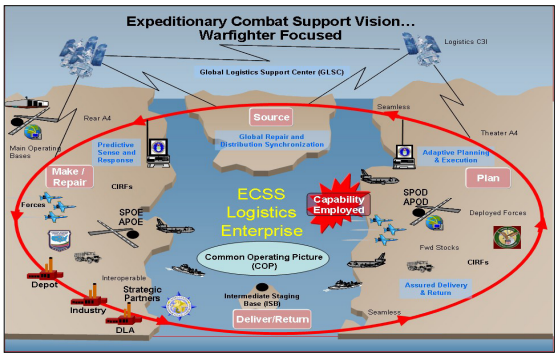
Measurable Performance Criteria

- **Reliability** –The reliability growth curve for DEAMS, includes data from four testing cycles in addition to four Corrective Action Periods (CAPs). CAPs addressed hardware design changes, software reprogramming/debugging, and training regiments addressing human/operator errors. Test trend analyses verified a decrease in software failure metrics, and verification will continue for each subsequent test phase. DEAMS reliability is defined as mean time between system abort (MTBSA). For Release 2, DEAMS reported reliability of 1,150 hours of MTBSA against a threshold of 654 hours.
- **Software** – Seventeen RICEW objects were planned for Releases 1 and 2, but Release 1 completion is inhibited because seven technical designs were not accepted. Acceptance will occur after completion of development because an Agile methodology is being used for this increment.
- **Manufacturing/Deployment** – DEAMS is a software program implemented on a COTS infrastructure with no manufacturing component. Full deployment to all organizations and sites was originally planned for October 2009 but has been delayed due to a previous lack of program management, subject matter expertise, and contracting expertise in COTS programs and Oracle eBusiness Suite. In addition, lack of GFI and issues with scalability have caused delays.
- **Integration** – DEAMS has established required memoranda of agreement (MOAs) that detail the interface management expectations/specifications with each of the 35 legacy systems that it integrates. DASD(SE) is advising DEAMS on interface performance improvement, an issue identified in testing.

Conclusion: The reorganization of DEAMS was needed for the program to achieve audit readiness in 2017. DASD(SE) is supporting mitigation of risks that include low availability of skilled Oracle eBusiness Suite personnel, GFI for RICEW objects, and Lead Integrator responsibilities. DASD(SE) will continue to monitor and provide support with a focus on issues raised in testing.

Expeditionary Combat Support System (ECSS)

Prime Contractor: Computer Sciences Corporation (CSC) contract was terminated by the Air Force on March 19, 2012.



Executive Summary: ECSS was a logistics initiative intended to provide the Air Force with a single Enterprise Resource Planning (ERP) IT software solution allowing universal access to consistent, real-time information across the logistics and financial enterprises. The program developed a Critical Change Report (CCR) in February 2012 to suggest restructuring the program in lieu of cancellation. DASD(SE) reviewed the CCR and provided recommendations related to requirements, scope management, technical competencies of staff, and risk management. The Air Force accepted the recommendations. Following termination of the CSC contract, the Air Force sought to restructure the program and assumed the role of Systems Integrator. The Air Force presented, in August 2012, a revised delivery schedule to meet the Financial Improvement Audit Readiness compliance by 2017, but it was unacceptable. Further, the viability of the largely unaltered technical approach was questioned and when coupled with the associated expedited acquisition strategy, it drove the untenable assumption of risk. Given all of these considerations, the Air Force recommended cancellation, and the DoD cancelled the program and initiated formal congressional notification procedures in December 2012.

Mission Description: ECSS was intended to enhance warfighter capabilities by enabling the transformation of the Air Force logistics and financial operations into an enterprise-wide solution in an integrated data environment.

System Description: The ECSS program was designed to transform logistics processes and replace ~240 legacy systems through an Enterprise-wide integrated single software platform approach. However, the program has been unsuccessful in proving logistics transformation concepts in a cost-effective and efficient manner.

Schedule: The CCR was to be delivered to Congress in May 2012, but the Air Force delayed delivery in order to continue its effort to update the Service Cost Position and attempted to improve the Acquisition Strategy. A draft proposed schedule was prepared and reviewed with Air Force leadership in August 2012. However, instead of improving the schedule, initial capability delivery was further extended by approximately 1 year.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The Air Force/Program Executive Office approved the ECSS SEP in May 2010 to support MS B during September 2011 and to document the technical planning for the Engineering and Manufacturing Development (EMD) phase. Plans to update the SEP were pending approval of the CCR. The program had no approved waivers or deviations from the SEP. However, the objectives of the SEP were not being met. Prior to initiation of re-scoping efforts in spring 2012, ECSS was not tracking to critical metrics and underestimated the software development effort. DASD(SE) worked with the program office to develop additional metrics to more accurately track the program's performance against the requirements.

- **Requirements** – The ECSS program had four KPPs and three KSAs. Four of the seven KPP/KSAs were not likely to meet threshold values. Increment 1 requirements were not reasonable based on the size and complexity of the system. The program was not tracking to the 2011 CCR success criteria, and overall probability for program success was low based on the assessed level of risk achieving KPP/KSAs.
- **Program Protection Plan (PPP)** – The program manager approved an abbreviated ECSS PPP for Increment 1 on April 20, 2010. The PPP addressed only system capabilities, program information, and a review of the process in determining that no CPI currently exists for Release 1. DASD(SE) reviewed the ECSS abbreviated PPP in July 2011 and recommended it be updated in accordance with the latest PPP policy guidance.
- **Program Risk Assessment** – The program's mitigation plans for both technical and integration risks were ineffective, as documented in the CCR assessment, which resulted in a 6-month schedule slip and 100 percent cost growth. The level of effort in system design, the program size, and the program's complexity were risks that contributed to the slip in the program schedule, resulting in the February 2012 CCR and ultimate decision to cancel the program.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – DASD(SE)'s focus was on improving program performance of KPP/KSAs with an emphasis on data migration/data quality and user responsiveness. Both were at risk of not meeting program thresholds.

FY 2012 Systems Engineering Assessments

- DASD(SE) supported the management portion of the ECSS CCR review in FY 2012.
- DASD(SE) conducted quarterly assessments for quality performance and production.

Measurable Performance Criteria

- **Reliability –** The ECSS program had a reliability threshold requirement of 168 hours for mean time between critical failure (MTBCF). No measured MTBCF data existed. Evaluation of Pilot C was to include MTBCF as a key metric.
- **Software –** ECSS software requirements were linked to the completion of 239 blueprinted Reports, Interfaces, Conversions, Extensions, Forms, and Workflow (RICEFW) objects for the Pilots of Increment 1. Increment 1 was not on track to achieve this requirement, having accomplished only 167 of the 239 RICEFW objects before the program assessment. Pilot C accounts for 143 of 239 RICEFW objects or 59 percent of the functional requirement of Increment 1. A high failure rate occurred during integration testing due to the underestimated size and complexity of the program. As a result, the program was redesigning many of the RICEFW objects, which would have further delayed system fielding.
- **Manufacturing** – ECSS was a software program operating on Air Force infrastructure with no manufacturing component.
- **Integration** – The program faced significant challenges in developing an overarching integrated end-to-end-process-based architecture that would successfully collapse 240-plus legacy systems into a single Oracle-based solution. There was also risk in ensuring the design would support the Air Force's vision at the implementation level to optimize intra-system and inter-system compatibility assurances for an integrated system across 62 external trading partners.

Conclusion: On November 14, 2012, the Air Force submitted a recommendation to cancel ECSS, along with a draft alternative proposal to address near-term logistics transformation through legacy remediation activities. An ADM was signed on December 11, 2012, officially cancelling the program. Final ECSS shutdown activities are to be completed no later than March 31, 2013.

F-22 Raptor Advanced Tactical Fighter Aircraft (F-22A Inc 3.2B)

Prime Contractor: Lockheed Martin Aeronautics

Executive Summary: DASD(SE) previously assessed the F-22A modernization as too large and complex to execute as an engineering change proposal. The revised incremental approach, approved in December 2011, identified Increment (Inc) 3.2B as a separate ACAT ID program. DASD(SE) conducted a PSR and identified several findings and recommendations, including a Government staffing risk, which the program office mitigated by addressing key positions and increasing full-time personnel allotments by 19 slots.

Mission Description: The F-22A is a fifth-generation single-seat, twin-engine fighter designed for air dominance and survivable first-day and beyond air-to-ground capability.

System Description: The F-22A incorporates advanced avionics and is low-observable, highly maneuverable, and capable of supersonic cruise. Inc 3.2B is a hardware and software modernization for air-to-air missile upgrades (AIM-120D, AIM-9X) and additional electronic protection, geo-location, data link, and stores management system improvements. Selected computer hardware and processors also will be replaced to improve throughput and margins.

Schedule: The F-22A is in Operations and Support with follow-on modernization efforts ongoing. USD(AT&L) conducted the Inc 3.2B Materiel Development Decision (MDD) in October 2011. MS B is scheduled for February 2013 with capability delivery to the fleet beginning in FY 2018. Key FY 2012 DASD(SE) activities included a PSR, post-PDR assessment, and acquisition/systems engineering planning activities.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) worked with the program to develop the Inc 3.2B SEP. DASD(SE) approved the SEP in August 2012, contingent on the Air Force's updating the program office staffing plan within 90 days of MS B. The SEP will guide the program's technical planning and execution through EMD. There are no waivers or deviations and the SEP objectives are on track.
- **Requirements** – The JROC validated the F-22A Enhanced Global Strike Inc 3 CPD in April 2007. The baseline program has 11 KPPs, including the materiel availability KPP established by an April 2011 JROC memorandum. The Air Force recently established two supporting KSAs for reliability and unit cost. DASD(SE) raised concerns at the MDD that the program has no Inc 3.2B-specific KPPs. Although Inc 3.2B addresses two of the Inc 3 KSAs, geo-location and AIM-9X/120D integration, previous blocks (3.1 and 3.2A) already addressed the Inc 3 KPPs. The JROC rescinded authority for the Air Force to trade the critical air-to-air missile integration KSA in response to DASD(SE) concerns for the lack of 3.2B KPPs. The Inc 3.2B requirements are stable. The Air Force expects future blocks or increments to address additional capabilities.
- **Program Protection Plan (PPP)** – DASD(SE) worked with the program to resolve PPP issues. The PPP is in final staffing for USD(AT&L) approval to support MS B.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The PSR identified a risk with software sustainability due to the highly integrated and closed architecture. Mitigation steps, as part of a future modular open systems architecture roadmap, include re-assessment / procurement of data rights and distributed processing.
- **Program Risk Assessment –** There are technical risks in the areas of software and hardware integration, verification, schedules, and manufacturing. All risks are assessed as manageable, and plans are in place for mitigation. The program has a risk mitigation plan and an active monthly risk process to reduce levels of risk.

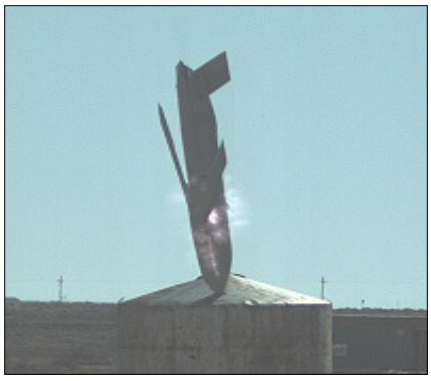
FY 2012 Systems Engineering Assessments
- DASD(SE) conducted a PSR and a post-PDR assessment for MS B.
- The PSR resulted in manageable findings and recommendations and highlighted five program-level risks in the areas of Government staffing, integrated schedule, manufacturing, contractor workforce, and software sustainability. The program accepted the findings and is in the process of mitigating the risks by increasing full-time staffing from 5 to 19+ personnel, realigning the IPT structure, building a single integrated schedule across all 3.2B efforts, addressing software sustainment and open-architecture deficiencies, and developing a business case opportunity to reduce an excessive delivery gap between hardware qualification and production.
- DASD(SE) participated in the combined System Functional/Systems Requirements Review, two PDR technical interchange meetings, and the system-level PDR in FY 2012. DASD(SE) conducted a post-PDR assessment and found the design is projected to meet the requirements and an allocated baseline is established. The PSR and post-PDR assessment findings were consistent.

Measurable Performance Criteria
- **Reliability** – The program formulated an acceptable reliability and maintainability program that is consistent with USD(AT&L) policy. The design is projected to meet Inc 3.2B requirements.
- **Software** – Inc 3.2B includes approximately 273,000 new airborne and 262,000 new ground equivalent source lines of code (ESLOC). An additional 181,000 airborne and 88,000 ground ESLOC were completed during earlier hardware risk-reduction efforts (enablers) and will be integrated into Inc 3.2B. The PSR indicated that, barring external perturbations, software development is achievable within the given schedule and resource assumptions. Overall computer resource requirements are adequate from new processor and display hardware.
- **Manufacturing** – The program is implementing the DASD(SE) recommendation to develop a business case prior to the MS B DAB to address delivery gaps between hardware developed early in the program and the beginning of production. Resolving the gap could result in a 1-year earlier delivery of capability. The gap contributes to concerns regarding diminishing manufacturing sources for hardware to support Inc 3.2B.
- **Integration** – Inc 3.2B requires integration and verification of a large amount of software, AIM-9X and AIM-120D, and updated processors. The program has a stovepiped and inefficient contracting structure. The program faces a schedule risk in that it lacks an Integrated Master Schedule covering all Inc 3.2B-related efforts and linking internal and external requirements. The program will be highly dependent on successful synchronization of incremental software builds with limited lab and verification resources.

Conclusion: DASD(SE) worked extensively with the program in FY 2011 and 2012 to shape the acquisition strategy. The program is working on known issues and is tracking to plan but will need to closely monitor execution of the integration and manufacturing risk mitigation plans.

Joint Air-to-Surface Standoff Missile-Extended Range (JASSM-ER)

Prime Contractor: Lockheed Martin Missile and Fire Control



Executive Summary: JASSM (baseline) is a highly survivable, long-range standoff missile for attacking fixed and relocatable, highly valued targets. JASSM-ER is an extended-range derivative of the baseline missile. In FY 2012, DASD(SE) monitored the Initial Operational Test and Evaluation (IOT&E) for missile performance and reliability growth.

Mission Description: The JASSM is a highly survivable, long-range standoff missile for attacking fixed and relocatable, highly valued targets. JASSM, designated AGM-158A, is in FRP. JASSM-ER, designated AGM-158B, is a derivative of the baseline to extend range. These missiles provide fighter and bomber aircraft with the capability to strike critical, high-value, heavily defended targets early in a campaign.

System Description: The JASSM-ER adds a turbofan engine and fuel capacity within essentially the same outer mold line and low-observable design to maintain the baseline capabilities. These modifications more than double the range of the baseline missile.

Schedule: The program completed IOT&E events late in FY 2012, and the IOT&E report is expected to be released in December 2012. The JASSM-ER program achieved MS C in December 2010 and FRP is planned for July 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The DASD(SE) approved the SEP in August 2010 to guide technical activity for the Production and Deployment (P&D) phase. The JPO updated the SEP in April 2012. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC validated the CPD in April 2010. Indications based on results leading into IOT&E showed the program was on track to successfully demonstrate all four KPPs by the end of IOT&E. The requirements are reasonable and have been stable throughout the program.
- **Program Protection Plan (PPP) –** The USD(AT&L) approved the PPP in December 2010 to document the protection of critical technologies, components, and information through LRIP and IOT&E. The program office will submit a PPP update to support FRP.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – In December 2010 the USD(AT&L) approved the Life Cycle Management Plan, which includes the Life Cycle Sustainment Plan (LCSP). The logistics support structure has been in place since 2003 for the baseline. The JASSM-ER program will capitalize on the existing structure and common warranty-based all-up-round maintenance philosophy in the LCSP in support of FRP.
- **Program Risk Assessment** – Based on continuous engagement to include the FY 2011 PSR, DASD(SE) assessed the JASSM-ER program as having risks in the areas of Common Test Instrumentation Kit (C-TIK) availability, low production rate, and fuze obsolescence. The program has funded risk mitigations in place for all three risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) did not conduct any formal JASSM-ER systems engineering assessments in FY 2012; however, DASD(SE) completed four quarterly Defense Acquisition Executive Summary assessments focusing on the areas of performance and production.
- DASD(SE) will conduct a production-focused PSR in 3rd quarter FY 2013 in support of FRP.

Measurable Performance Criteria

- **Reliability** – Based on developmental test results, JASSM-ER is on track to meet or exceed the 85 percent free-flight missile reliability KSA. Reliability risk was significantly reduced over the original JASSM test program since JASSM-ER is highly common with the baseline missile and benefits from previous reliability improvement programs. The program is also addressing DASD(SE) MS C PSR recommendations from FY 2011 to pursue development of a reliable fuze and low-cost C-TIK to improve system reliability and facilitate testing. Fuzes have long been a reliability issue, and the C-TIK is needed to provide a means to continue surveillance testing of the JASSM-ER, which was not previously feasible. The prime contractor, with Independent Research and Development funding, initiated development of an Electronic Safe Arm Fuze (ESAF). The contractor conducted the ESAF PDR in July 2012, and the program expects to incorporate the ESAF into production in FY 2014 (JASSM Lot 13).
- **Software** – The JASSM-ER software is stable and mature. The software is 95 percent common with the baseline JASSM. JASSM-ER uses mature software development processes established by the baseline program. Software modifications affect only four software configuration items associated with engine performance and missile six-degree-of-freedom-model weight and performance changes. Metrics are in place and change-control processes are adequate. Changes associated with the introduction of JASSM-ER are minimal. The program completed qualification testing on mission-planning software on schedule in August 2012, and the software is approved for release.
- **Manufacturing** – The Air Force conducted an independent manufacturing readiness assessment of JASSM-ER for MS C and found all areas ready to support LRIP. The FY 2011 PSR team agreed with the assessment and supported entry into LRIP. Twelve JASSM-ERs were delivered as of September 2012, one month behind schedule.
- **Integration** – The JASSM-ER design introduced no new interfaces as the design is 70 percent common with the baseline. The B-1B is the threshold platform, and the nominal integration issues (e.g., oil seepage and scavenge) have been addressed through minor redesigns.

Conclusion: Progress through developmental test indicates the system is on track to meet all key performance requirements.

Joint Space Operations Center (JSpOC) Mission System (JMS)

Prime Contractor: N/A, the JMS System Program Office (SPO) performs the system integration role

Executive Summary: JMS is a pre-MAIS program that incrementally provides space situational awareness and command and control (C2) capabilities. An Information Technology Acquisition Board (ITAB) was scheduled for October 2012 to review JMS Increment (Inc) 1 for MS C and Inc 2 for MS B. DASD(SE) conducted a joint PSR/Independent Program Assessment (PSR/IPA) in July 2012 in preparation for the ITAB. As recommended by the PSR/IPA, the October ITAB was postponed and both program milestone decisions were delayed to FY 2013.

Mission Description: JMS missions include space object identification, spectrum characterization, launch and reentry (excluding intercontinental ballistic missiles), support to contingency operations, and joint space support. The Joint Space Operations Center (JSpOC) serves as the central node for C2 of assigned and attached space forces to supply tailored global and theater space effects to the warfighter.

System Description: The technical foundation for JMS is a net-centric service-oriented architecture (SOA) consisting of hardware, software, data, and network connectivity. The JMS design features a modular, open-systems approach with standard interfaces. JMS will replace certain legacy capabilities, such as the Space Defense Operations Center system and Astrodynamic Support Workstation.

Schedule: The proposed October ITAB was intended to review Inc 1 for MS C and Inc 2 for MS B. The July 2012 joint PSR/IPA assessed that neither increment was ready for a milestone decision in October. As a result, Inc 1 MS C review and Inc 2 MS B review were postponed until 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) worked with the program office to provide guidance for the development of the JMS SEP in compliance with the latest OSD SEP Outline. DASD(SE) provided feedback on the draft SEP in the areas of schedule assessment, technical requirements, engineering and risk management, technical reviews, and technical products. The program office is updating the draft SEP in preparation for upcoming milestone reviews.
- **Requirements** – The JROC validated the JMS CDD in July 2012. Inc 1 and 2 intend to satisfy all KPPs, 5 of 10 KSAs, and 16 of 35 OSAs (other system attributes), and will meet the initial prescribed capability needed to migrate off legacy JSpOC systems.
- **Program Protection Plan (PPP) –** DASD(SE) worked with the program office to develop the PPP and provided guidance in the areas of critical program information, critical components, vulnerability assessment, information assurance, software assurance, anti-tampering, and countermeasures. The program office is updating the PPP for the upcoming milestone reviews.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program office is developing the Life Cycle Support Plan for JMS with an emphasis to increase reliability

and decrease the logistics footprint. The program has established reliability requirements but has no plan for reliability growth. DASD(SE) is working with the program office to include a reliability growth program in the JMS systems engineering process.

- **Program Risk Assessment** – The program has commercial-off-the-shelf (COTS) software uncertainties and unrealistic integration and test schedule assumptions for Inc 2 that have put at risk a planned 4th quarter FY 2014 delivery. The program is in the process of restructuring its integration approach and delivery schedule.

FY 2012 Systems Engineering Assessments

- DASD(SE) co-led the joint PSR/IPA in July to support the planned October ITAB review.
- Positive assessment findings include the following: The program is augmenting its staff by arranging for a Space and Naval Warfare Systems Center (SPAWAR) engineering team to serve as the JMS software integrator, and the program is using the SPAWAR Rapid Integration and Test Environment process to integrate JMS software products. However, the assessment team found the following areas of concern: Due to an unrealistic integration and test schedule, Inc 2 as planned is not executable to meet the requirement for initial operational capability by 4th quarter FY 2014. The program needs to conduct an early purchase and risk reduction of the disparate COTS software products to reduce Inc 2 system integration, schedule, and performance risk. The review team also found that a lack of clear interface definitions between the JMS and Space Fence programs presents a risk to both programs and that under its Agile development process, the program has not planned for system-level design reviews.
- As recommended by the joint PSR/IPA, the program office is taking actions to restructure Inc 2, purchase and integrate initial COTS software upfront for Inc 2 risk reduction, establish interface definitions between JMS and Space Fence programs, and revise its systems engineering process and planning to include the system-level reviews, such as PDR and CDR.

Measurable Performance Criteria

- **Reliability –** Measurable reliability metrics for JMS include operational availability, mean time between critical failure, and mean time to restore function. The requirements to include a reliability growth program in the JMS systems engineering process will be addressed during the next SEP review.
- **Software** – The program has established a comprehensive set of program metrics but lacks some detailed metrics for software integration and software quality. DASD(SE) is working with the program office to include these software metrics in the SEP.
- **Manufacturing –** JMS involves no manufacturing efforts.
- **Integration** – USD(AT&L) authorized the program office to purchase initial COTS software in advance of the MS B review to reduce integration risk for Inc 2. The program office is working to establish interface definitions upfront between JMS and Space Fence programs. In addition, software quality and integration metrics for JMS will be submitted as part of the comprehensive metrics in the next SEP update.

Conclusion: JMS Inc 1 is progressing toward deployment with a minor delay. The Air Force is restructuring Inc 2 for MS B review.

KC-46A Tanker Modernization

Prime Contractor: Boeing

Executive Summary: The KC-46A is a military version of Boeing 767-2C commercial aircraft. The system is in the Engineering and Manufacturing Development (EMD) phase and successfully completed its PDR in April 2012.

Mission Description: The KC-46A's primary mission is to provide aerial refueling (AR) support to the Air Force, Navy, and Marine Corps as well as to allied nation coalition force aircraft. Secondary missions include emergency AR, airlift, communications gateway, aeromedical evacuation (AE), forward area refueling point, combat search and rescue, and treaty compliance.

System Description: The KC-46A will be a derivative of the commercial 767-2C provisioned freighter, Federal Aviation Administration type-certified aircraft. The aircraft will be modified to include an enhanced flight deck with military avionics for worldwide operations, a boom refueling system, a centerline hose and drogue refueling system, provisions for multipoint wing air refueling pods (WARP), an AR operator station, passenger / cargo / AE capabilities, an AR receptacle, and survivability enhancements, including a three-turret large aircraft infrared countermeasures system.

Schedule: The MS B was conducted in February 2011. The program successfully completed a Systems Requirements Review in June 2011, a System Functional Review in November 2011, and a system PDR in April 2012. The next major event is the CDR planned for 4th quarter FY 2013.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The DASD(SE) approved the SEP in January 2012. The SEP will guide the technical planning and execution EMD. The program is fulfilling the objectives of the SEP without waivers or deviations. The program plans to update the SEP to support MS C.
- **Requirements** – The JROC approved the CDD for the KC-135 Replacement Aircraft in December 2006. The CDD addresses Air Refueling ICD shortfalls and documents specific capabilities KC-46A must provide. The KC-46 program is responsible for the development, testing, and production of a drogue-equipped WARP system to meet CDD requirements for simultaneous refueling of two probe-equipped receivers. The program requirements are reasonable and stable. Based on progress through preliminary design, the program is on track to meet all nine KPPs and all five KSAs identified in the CDD. The KPPs, KSAs, and other requirements identified in the CDD were further synthesized into 372 mandatory and 93 non-mandatory requirements, which are documented in the KC-46 System Requirements Document. At contract award, all of the mandatory requirements formed the technical performance baseline as embodied in the KC-46 System Specification.
- **Program Protection Plan (PPP)** – The USD(AT&L) approved the PPP in December 2010. The PPP will guide protection of the program's critical technology, components, and information. An update is required to support the MS C decision in 4th quarter FY 2015.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The Air Force is planning for 100 percent organic management of the KC-46A sustainment. The Air Force plans to leverage the commercial parts system as much as possible.

- **Program Risk Assessment** – Overall, Government and contractor program risks are known and well understood. Integration of military hardware into the commercial aircraft, development of a three-dimensional remote boom operator vision system, and schedule concurrencies of the development, test, and production program phases have been identified as risks and are being mitigated. DASD(SE) highlighted the availability of Government-provided receiver aircraft to support the contractor's aerial refueling flight test as a risk because of the numbers required given an aggressive test schedule and potential impacts to the fixed priced contract. The program acknowledged the risk and is working mitigation strategies. Risks and mitigation plans are reviewed jointly by the Government and contractor on a monthly basis. The KC-46A development effort has a robust risk identification and mitigation program in place.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted a post-PDR assessment on the April 2012 PDR. The allocated baseline was established in accordance with the KC-46 Integrated Master Plan. DASD(SE) assessed the program as having a high likelihood of accomplishing its intended mission with no remedial action necessary to achieve the Acquisition Program Baseline. The program adopted DASD(SE)'s PDR recommendation to add the receiver aircraft risk and risk mitigation steps.
- DASD(SE) will perform a CDR assessment at the end of 4th quarter FY 2013.
- DASD(SE) provided quarterly Defense Acquisition Executive Summary assessments.

Measurable Performance Criteria

- **Reliability** – During the EMD phase, the program established a growth and improvement program to track reliability of select KC-46A components and configured subsystems to ensure each is achieving its respective reliability allocations. The program is on track to meet or exceed reliability requirements, including the 92 percent mission-capable-rate KSA.
- **Software** – Current software estimates of ~9.5 million SLOC represent a reduction of 2 million SLOC from Boeing's submitted proposal. Boeing plans to reuse about 76 percent of software code from legacy systems. The program adopted DASD(SE)'s recommendation to establish a software working group to define and track software metrics.
- **Manufacturing** – Boeing is on track to produce the systems to support EMD. Subsystem PDR reviews verified that all 16 manufacturing PDR entrance criteria were successfully achieved. Contractors have demonstrated the capability to produce systems, subsystems, and components in a production-representative environment. Boeing has produced more than 1,000 767 aircraft and Cobham has delivered more than 2,000 air refueling systems to the armed forces of 17 countries, including the U.S. Air Force and Navy.
- **Integration** – The CDD identifies several key external interfaces including Military Satellite Communications (SATCOM), civil SATCOM, Link 16, ultra high frequency/very high frequency, and net readiness and information assurance provisions, which are controlled through interface control documents. All interface control documents were reviewed in support of the PDR and placed under Boeing control as part of the allocated baseline. The KC-46A system has a system-of-systems reliance on the Global Positioning System (GPS) and closely monitors the GPS program to ensure compatibility/interoperability. The program is implementing key subsystem interfaces such as the boom assembly to the 767-2C subsystem using open standards. Many systems resident on the 767-2C are designed for a plug-and-play installation concept.

Conclusion: The design and development of the KC-46A is proceeding as planned and is expected to meet required KPPs and KSAs.

MQ-9 Reaper Unmanned Aircraft System (UAS)

Prime Contractor: General Atomics Aeronautical Systems Incorporated (GA-ASI)

Executive Summary: The MQ-9 Reaper is a medium-to-high altitude, hunter-killer and intelligence, surveillance, and reconnaissance (ISR) UAS with long endurance and multiple sensor and weapons capabilities. DASD(SE) provided a technical assessment that found the Block 5 design was sufficiently mature to proceed to MS C and LRIP. The program was authorized to enter the Production and Deployment (PD) phase following the September 2012 DAB. The MS C ADM redesignated the MQ-9 as an Acquisition Category IC MDAP.

Mission Description: The Reaper has a primary hunter-killer role and a secondary ISR role. Weapon interfaces and target data processing allow prosecution of critical and time-sensitive targets. Future smart weapons with the ability to update information in-flight will enhance precision strike capability against high-value assets including moving targets. A modular architecture allows mission tailoring to employ specialized weapons and payloads.

System Description: The system consists of an air vehicle with an array of sensors, weapons, and communications systems, a ground control station, and ground support equipment.

Schedule: The program is in the PD phase following the September MS C DAB, which was previously planned for July 2013. DASD(SE) conducted a Block 5 CDR assessment in May to confirm system maturity for production. The program is incrementally adding capability through software and hardware enhancements to support full Increment 1 capability. The program is fielding the core set of CPD capabilities via a modified Block 1 configuration to meet urgent warfighter needs. Block 1 is currently deployed; full CPD capability (Increment 1) is planned for FY 2014.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP) –** A SEP to support MS C and guide PD phase activities was approved in December 2011 with no waivers or deviations. The SEP was in development when the April 2011 template was released and does not comply with the current format. No future updates to the SEP are planned. The objectives of the SEP are being met.
- **Requirements –** The Increment I CPD was approved in January 2007 with three KPPs. The killer KPP was validated in operational testing (OT). OT of the hunter and net-ready KPPs is planned for FY 2014. The secure data-link element of the net-ready KPP requires integration of the Predator Primary Data Link (PPDL). Full capability is not expected until October 2015. Requirements instability due to operational demands and Urgent Operational Needs (UONs) has resulted in schedule overruns and integration risk. UONs are now addressed via a requirements analysis and prioritization process to balance emerging needs against planned development. Revised reliability requirements were approved by the Air Force Requirements Oversight Committee (AFROC) in July. The revised requirements support user needs and are achievable.

- **Program Protection Plan (PPP)** – The PPP was updated for LRIP to identify and develop protection measures for critical program information and to assess and mitigate supply chain vulnerabilities. The PPP was approved on October 25, 2012.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – Contractor logistics support was planned for the life of the program at inception, but scope growth led to revised life-cycle support plans. The program completed a business case analysis and a Life-Cycle Sustainment Plan in FY 2012 to inform a long-term strategy.
- **Program Risk Assessment** – The program has a comprehensive risk management process and allocates resources to mitigate risks. DASD(SE) identified risks related to PPDL integration and immature software processes. The PPDL integration risk is being mitigated through Reaper and Predator developmental test efforts.

FY 2012 Systems Engineering Assessments

- DASD(SE) participated in three Joint Reliability and Maintainability Evaluation Team meetings with the program and Air Combat Command to revise unachievable reliability requirements. The AFROC approved the revised requirements in July 2012.
- DASD(SE) led PPP/Anti-Tamper (AT) working groups to assess the sufficiency of PPP/AT planning for the September MS C decision. The PPP is in formal coordination for approval.
- DASD(SE) initiated a working group with the program to review the status of open CDR action items. The program office closed out the CDR and briefed remaining risks at the IIPT and OIPT.
- Through ongoing program engagement and assessment, DASD(SE) identified and elevated software process, PPDL integration, and ARC-210 wingtip antenna performance risks to the OIPT and the MS C DAB.

Measurable Performance Criteria

- **Reliability** – The program recognized that initial reliability requirements were in excess of user need and unachievable. DASD(SE) assisted the program in assessing and prioritizing those areas of improvement that would contribute to reducing system life cycle costs.
- **Software** – The system has approximately 800,000 total lines of code. DASD(SE) assessed software development as reactive and driven by unstable requirements and system configuration. The program will implement software process improvements in a December 2012 contract and DASD(SE) will conduct a software focused review in FY 2013.
- **Manufacturing** – The contractor was late delivering six aircraft and two Ground Maintenance Training Devices in FY 2012 because technical data for the Infrared Nose Camera had not been updated following a change in vendors. Deliveries have resumed and the program office is addressing the technical data timeliness issue. The delivery schedule calls for 48 aircraft to be delivered in FY 2013 and in FY 2014, which is within the contractor's production capacity. The production rate falls to 24 per year beginning in FY 2015.
- **Integration** – The program maintains interface control documentation between major components of the system. The contractor makes effective use of systems integration laboratories to mitigate hardware and software integration risk before new components and systems are added to the UAS. The program does not have an Integrated Master Schedule that captures all development contracts (GCS, PPDL, Block 5 SDD and Production), but will place the contractor on contract to produce an IMS in March 2013.

Conclusion: The Reaper UAS program is having significant operational success despite the challenges of balancing the addition of urgent and emergent user capabilities while concurrently completing the integration of systems to meet CPD threshold requirements.

Next Generation Operational Control System (OCX)

Prime Contractor: Raytheon Intelligence and Information Systems

Executive Summary: OCX is the next-generation command and control system for the modernized Global Positioning System (GPS), currently in the Engineering and Manufacturing Development phase. DASD(SE) participated in a Follow-up Independent Program Assessment (IPA) in February 2012 to assess how the program was addressing recommendations from the September 2011 IPA. DASD(SE) also conducted a Software Deep Dive in July-September 2012 to assess the progress of the program's software development effort in support of MS B.

Mission Description: The GPS mission is to provide and maintain the best navigation services worldwide to military and civil users and to maintain the capability for space-based nuclear detection. The OCX portion will provide a modernized satellite command and control (C2) system for the overall GPS capability.

System Description: The GPS OCX program is a modernized satellite C2 system capable of operating all GPS III and legacy satellites. OCX replaces the current GPS Operational Control System (OCS). The new system will include increased information assurance protection and computer security. OCX will be delivered in blocks to support GPS III capabilities. An interim delivery of the Launch and Checkout System (LCS) will support launches of GPS III satellites prior to delivery of the OCX initial capability.

Schedule: The FY 2012 Annual GPS Enterprise Review (AGER) reviewed MS B readiness and deferred the MS B decision to allow the program time to implement the recommendations of the Follow-up IPA. The program reached MS B in October 2012.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the GPS Enterprise SEP with associated OCX Annex on June 6, 2012. The SEP documents the program's technical planning for the program's EMD phase systems engineering activities. There are no approved waivers or deviations. The objectives of the SEP are being met.
- **Requirements** – The CDD was validated in 2009 with eight KPPs. These KPPs were assessed to be achievable at the June 2011 PDR. Requirements are stable and reasonable.
- **Program Protection Plan (PPP)** – USD(AT&L) approved the PPP in December 2010. The program is updating the PPP to address recent policy changes and has conducted pilot criticality and vulnerability analyses. DASD(SE) has adjudicated all comments to the revised PPP with the program office, and the final version is ready for staffing.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The OCX program has a sustainment KPP, which is composed of a materiel availability KPP, materiel reliability KSA, and an ownership cost KSA.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted three assessments in FY 2012. DASD(SE) participated in a follow-up IPA for the OCX in February 2012 to support the FY 2012 Annual GPS Enterprise Review (AGER). The program made several improvements recommended at the previous joint IPA/PSR, including creating a systems integration organization with strengthened integration functions, drafting an enterprise specification, improving enterprise risk management processes, and documenting a rule set to govern movement of requirements between software iterations. The review identified continuing issues with requirements drift, an underestimated schedule, and incomplete CDR planning. The program addressed these issues before MS B.
- DASD(SE) conducted an OCX post-PDR assessment in support of MS B. The program achieved the majority of the PDR objectives and demonstrated a high likelihood of accomplishing its mission; however, the program had two open PDR issue notices (PINs) concerning reliability, maintainability, and availability (RMA) and fault management directive (FMD) requirements. The PINs took 12 months to close and as a result are considered risk areas for the CDR.
- DASD(SE) conducted a Software Deep Dive to assess progress to date and quantify schedule risk for delivering the three OCX blocks. The assessment projects significant variation from the contractor schedule and some variation from the proposed Acquisition Program Baseline (APB) thresholds. The DASD(SE) schedule projections align with a similar analysis by CAPE, as well as with the OCX program Service Cost Position (SCP). At the MS B DAB, the MDA directed the Air Force to fund the program to the SCP estimate and to adjust the APB thresholds to the dates suggested by the DASD(SE) Deep Dive and CAPE analysis.

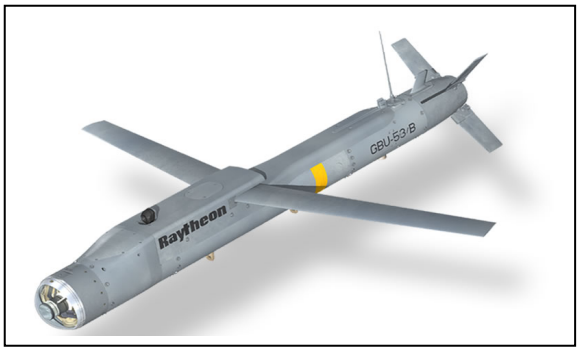
Measurable Performance Criteria

- **Reliability –** At PDR, GPS Enterprise reliability requirements were not adequately allocated to OCX configuration items. The program has since completed this requirements allocation. However, the length of time it took to complete this effort poses a risk to completing the subsequent critical design work required for the CDR. DASD(SE) is participating in the iterative CDRs scheduled from June 2012 until March 2014 to ensure adequate development progress is made and that the risks are properly addressed.
- **Software –** The OCX program will be delivered in two blocks. Block 1 is estimated at 1.14 million equivalent source lines of code (ESLOC), and Block 2 at 45,000 ESLOC. The program manages and tracks software metrics, which have identified work being deferred to later iterations, ESLOC growth in each iteration, and software deficiency report generation/resolution rates. These metrics were contributors to the Software Deep Dive analysis. The program is taking action to address the resulting schedule risk (as identified by the September 2011 Joint IPA/PSR), and APB schedule thresholds have been adjusted accordingly.
- **Manufacturing –** The OCX program uses COTS and high heritage hardware.
- **Integration** – The OCX program has 35 interface control documents and interface specifications to define external interface connections. All 35 interface control documents and specifications were approved and baselined at the PDR. The planned delivery of OCX Block 1 lags availability of GPS III space vehicles, which requires OCX in order to make the GPS III satellites operational. To mitigate this risk, the program office will deliver the LCS for the first GPS III launch. This approach will enable sustainment of the current GPS constellation with at least legacy capability; however, full capability of GPS III satellites launched with LCS will not be available until Block 1 is operational.

Conclusion: The program is on track. Program performance to date has added cost and schedule risk, but the Government baseline established at MS B contains sufficient margin to contain this risk.

Small Diameter Bomb Increment II (SDB II)

Prime Contractor: Raytheon Missile Systems



Executive Summary: The SDB II is a 250-pound class glide weapon designed to attack moving targets in all weather. The SDB II is an ACAT ID program in the Engineering Manufacturing and Development (EMD) phase. In FY 2012, DASD(SE) monitored developmental and integrated testing results for indications of system performance.

Mission Description: The SDB II addresses the following warfighter requirements: attack moving and stationary targets, adverse weather operations, multiple kills per pass, multiple ordnance carriage, precision munitions capability, reduced munitions footprint, increased weapons effectiveness, minimized potential for collateral damage, and reduced susceptibility of munitions to countermeasures. The SDB II provides a network-enabled weapon capability via Link 16 and Ultra High Frequency Weapon Data Link.

System Description: The SDB II is a 250-pound class glide weapon designed to attack moving targets through weather. The threshold aircraft are the F-15, F-35B, and F-35C. The weapon has three principal attack modes: normal, laser-illuminated, and coordinate attack.

Schedule: The program is in the EMD phase. USD(AT&L) held a MS B in July 2010 and MS C is planned for January 2014. Key FY 2012 DASD(SE) activities included participation in the August 2012 Program Management Review.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP in May 2010 to support MS B and to document EMD technical activity. The program office will submit a SEP update to support MS C. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC validated the CDD in June 2009. All seven KPPs are on track for demonstration on the F-15E by FRP in 2016. The requirements are reasonable and stable. All seven KPPs are delayed for demonstration on the F-35 because of delayed F-35 development.
- **Program Protection Plan (PPP)** – USD(AT&L) approved the MS B PPP in July 2010 to guide the protection of critical technology, components, and information through EMD. The program office will submit a PPP update to support MS C.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – As documented in the program manager-approved Acquisition Strategy/Life Cycle Management Plan (September 2009), the SDB II is an all-up round weapon that requires no scheduled preventive maintenance, corrosion control for in-container storage, or periodic testing. The weapon will use the existing munitions support infrastructure and is covered by a 20-year warranty. The warranty will be supplemented by contractor logistics support for non-warranty repairs, sustaining engineering, fielding, and the Weapon System Evaluation Program.
- **Program Risk Assessment –** DASD(SE) assessed the SDB II program as having risks in the areas of weapons effectiveness, real-time classification, requirements verification, and F-35 B/C integration. The requirements verification risk is related to range limitations for testing in

stressing environments (e.g., weather, backgrounds, etc.). The program has funded risk mitigations in place for all four risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) did not conduct any formal systems engineering assessments in FY 2012; however, the team completed four quarterly Defense Acquisition Executive Summary assessments in the areas of performance and production.
- DASD(SE) is planning a PSR in FY 2013 to support MS C.

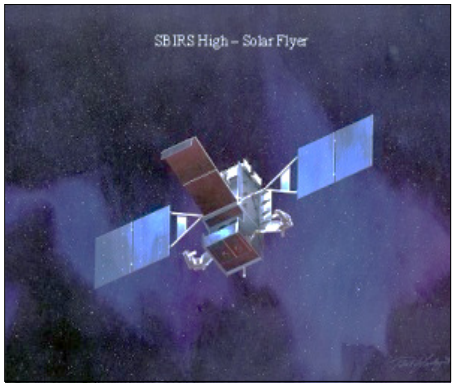
Measurable Performance Criteria

- **Reliability** – The SDB II program has reliability requirements and metrics. Based on the DASD(SE) 2011 CDR assessment and program-provided quarterly updates, system reliability predictions indicate all reliability, availability, and maintainability requirements will be met at weapon maturity with margin in accordance with the system's approved reliability growth plan. Maturity is defined in the CDD at production Lot 5.
- **Software** – SDB II software includes approximately 633,000 source lines of code, which fall mainly across three computer software configuration items. The software will be developed iteratively over six builds. No notable software development risks exist as of the end of FY 2012, although the program has limited software metrics.
- **Manufacturing** – Although the program is not in production, a manufacturing assessment conducted in conjunction with the January 2011 CDR indicated the program is on track to develop affordable and executable manufacturing processes by the end of EMD. The Air Armament Center, Engineering Directorate (AAC/EN) assessed manufacturing readiness during the CDR with the same conclusion. The Program Management Review indicated Raytheon is on track for manufacturing.
- **Integration** – The SDB II program uses several integration labs to evaluate interface requirements: software and hardware integration labs, Electronic Systems Integration Lab, Tower Testing, Eglin Guided Weapons Evaluation Facility, and Seeker Captive Flight Testing to simulate interfaces with 13 elements. F-35B/C availability lags SDB II development by 2 years, creating a risk that unforeseen design changes could affect the weapon and/or carriage interface. The SDB II program is working closely with F-35 to mitigate this risk.

Conclusion: The SDB II program is progressing to schedule.

Space-Based Infrared Satellite GEO 5/6 Satellite Replenishment Production (SBIRS GEO 5/6 SRP)

Prime Contractor: Lockheed Martin Space Systems



Executive Summary: GEO 5/6 are the first two replenishment satellites of the SBIRS constellation. Air Force is proceeding toward awarding the production contract for GEO 5/6. In June, USD(AT&L) authorized the Air Force to expend $487 million for specific long-lead item and nonrecurring engineering (NRE) services in support of GEO 5/6 production. DASD(SE) conducted a joint Program Support Review/Independent Program Assessment (PSR/IPA) in June in preparation for the July DAB to review Air Force's request for authorization to release the RFP and award the GE0 5/6 production contract. As a result of the DAB, USD(AT&L) authorized the program to release the RFP.

Mission Description: SBIRS supports four mission areas: missile warning to provide timely warning of strategic and theater ballistic missile attacks; missile defense to detect, track, and cue missile defense systems; technical intelligence to provide data to technical intelligence analysts; and battlespace awareness to provide an infrared view of the battlefield to the warfighter.

System Description: The SBIRS constellation consists of four satellites in Geosynchronous Earth Orbit (GEO), two hosted payloads in Highly Elliptical Orbit (HEO), and a Ground System. GEO 5/6 satellites are the first two replenishment satellites for SBIRS constellation. SBIRS replaces the Defense Support Program (DSP).

Schedule: Air Force awarded an advanced procurement (AP) contract in June for initial NRE activities of the obsolete parts identified for GEO 5/6 production. USD(AT&L) authorized the Air Force to release the RFP for the GEO 5/6 production contract as a result of the July DAB review but requested that the Air Force return for a Defense Acquisition Executive (DAE) review of the results of the contract negotiation.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan** – DASD(SE) worked with the program office to develop the SBIRS GEO 5/6 SEP to support the GEO 5/6 production RFP. DASD(SE) approved the SEP in August 2012. The SEP provides guidance for technical planning of GEO 5/6 production. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The SBIRS Operational Requirements Documents (ORD), dated October 1996, is the SBIRS requirements document. It has been revalidated several times, most recently in December 2005 as part of the Nunn-McCurdy certification activities. There are no requirements changes for GEO 5/6 production. SBIRS GEO 5/6 has 18 KPPs, which will be tracked for meeting the requirements during execution of GEO 5/6 production contract.
- **Program Protection Plan (PPP)** – DASD(SE) reviewed a draft PPP and the RFP language in support of the GEO 5/6 production contract award. The review areas included threats, critical information and components, vulnerability assessment, information assurance, software assurance, anti-tampering, and countermeasures. All issues have been resolved. Upon DoD Chief

Information Officer (CIO) approval of the Information Assurance Strategy (IAS), the updated PPP is ready for USD(AT&L) approval.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – No reliability growth is planned for GEO 5/6. GEO 5/6 are replenishment satellites based on GEO 3/4 design.
- **Program Risk Assessment** – The GEO 5/6 program is following the risk management process described in the approved SEP. Risk areas include availability of obsolete parts and schedule risks associated with redesigning, qualifying, and deliveries of NRE components. The program has a risk-mitigation plan in place to address the risks.

FY 2012 Systems Engineering Assessments

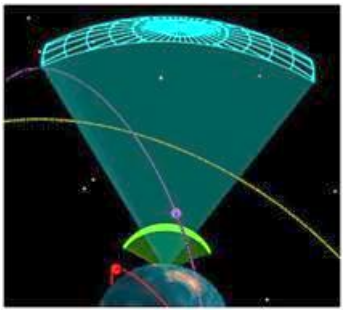
- DASD(SE) conducted one systems engineering assessment in FY 2012, a joint PSR/IPA to support the GEO 5/6 production DAB review. The joint PSR/IPA found that the program office is manned with competent and well-focused staff. GEO 5/6 design is mature and stable, and has a well characterized manufacturing process.
- The review team found the following concerns: The schedule for the GEO 5 launch availability date may be too optimistic. The program has proposed eliminating the acoustic test, which could increase the operational performance risk of the satellites when they are on orbit. The program lacked system-level design reviews and a comprehensive set of program metrics. The program also will face the challenge to instill "cultural change" at the program office, at the prime contractor, and at major subcontractors, as they make a transition from a cost to a fixed-price type contracting environment.
- As recommended by the PSR/IPA, at the July DAB, USD(AT&L) approved the release of the RFP for GEO 5/6 contract but requested the Air Force to return for a DAE review of the results of the negotiations, including the negotiated outcome on the option for acoustic testing. The final SEP, approved in August 2012, includes the plan to conduct a system-level delta CDR as well as a comprehensive set of metrics.

Measurable Performance Criteria

- **Reliability** – The SBIRS program has a comprehensive reliability plan for GEO 5/6. GEO 5/6 program reliability metrics are based on those of GEO 3/4. Measurable reliability metrics include operational dependability, on-orbit space vehicle reliability, mean time between critical failure, and mean time to restore function. Current reliability predictions meet or exceed ORD requirements.
- **Software** – GEO 5/6 software is expected to be limited to changes resulting from obsolete parts since GEO 5/6 are the functional equivalent of GEO 4. Software metrics include estimated number of lines of code, software productivity, software defects, and programmer experience**.**
- **Manufacturing** – The program office conducted the GEO 5/6 parts obsolescence study and Production Readiness Review and concluded that the manufacturing risk of the program is at a minimum. Program metrics include measurable manufacturing metrics.
- **Integration** – The SBIRS program has mature interface control documents describing the system, its dependencies and external interfaces, and the space-to-ground interface. Integration metrics include total number of external interfaces planned versus actual, and total number of external interfaces defined versus completed.

Conclusion: The GEO 5/6 SRP program is on track to award its production contract.

Space Fence Ground-Based Radar System (SF)



Prime Contractor: In source selection; previous phase (PDR) contractors were Raytheon and Lockheed Martin.

Executive Summary: SF is a ground-based radar system used to detect and track small objects in Low Earth Orbit (LEO) with a FY 2017 Initial Operational Capability (IOC). The program is at the end of Technology Development (TD) phase, after competitive prototyping and preliminary design. MS B is planned for FY 2013. DASD(SE) co-led a PSR/Independent Program Assessment (PSR/IPA) to support the pre-Engineering and Manufacturing Development (EMD) Review DAB.

Mission Description: SF will deliver an uncued capability to find, fix, and track small objects primarily in LEO, with secondary capabilities for Medium Earth Orbit (MEO) surveillance and responding to tasking for high-priority objects.

System Description: SF is a ground-based S-band, phased array radar system. The system will consist of up to two radar sites outside Continental United States (OCONUS) and a consolidated operations center. SF will provide a net-centric, open architecture to integrate with the space command and control enterprise.

Schedule: The program is at the end of the TD phase. Key Decision Point A (KDP A) was in March 2009, and MS B is planned for FY 2013. At MS B, SF will enter a combined EMD/Production and Deployment (PD) phase. Key FY 2012 DASD(SE) activities included participating in the February system PDR, preparing the statutory PDR assessment, developing the Systems Engineering Plan (SEP) and Program Protection Plan (PPP), and conducting a joint PSR/IPA with the office of the DASD for Space and Intelligence (DASD(S&I)).

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – The current SEP was approved in 2008 for KDP A. There are no waivers or deviations, and the SEP objectives are being met. DASD(SE) worked with SF to document the program's technical planning for the EMD phase systems engineering activities to support the RFP and the FY 2013 MS B in an updated SEP.
- **Requirements** – The JROC approved the CDD in June 2012. During TD, SF conducted 19 major trades and more than 100 cost/schedule/performance excursions to refine the final CDD, reducing projected acquisition cost from $6.3 billion (at SDR) to $2.2 billion (at PDR). SF has seven KPPs, all on track for demonstration by IOC/FOC (Full Operational Capability). Requirements are stable.
- **Program Protection Plan (PPP)** – DASD(SE) reviewed the draft PPP for the pre-EMD milestone and assessed it as sufficient for the milestone.
- **Systems Engineering Support of Life Cycle Management and Sustainability –** During the TD phase, SF conducted extensive trade studies at all levels of the design, with particular attention to producibility, maintainability, and life cycle cost.
- **Program Risk Assessment** – SF has a well-structured risk management process. Top program risks relate to integration, software development, and net-centricity. The program is addressing risks and accepted PSR/IPA recommendations to improve EMD planning in several areas.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted two FY 2012 assessments. DASD(SE) co-led a PSR/IPA prior to the Pre-EMD Review DAB, to assess technical planning and program management prior to release of the EMD/PD RFP. DASD(SE) also participated in the program PDR between December 2011 and February 2012 and prepared a post-PDR assessment. The assessments found mature approaches, two successful prototypes, and complete PDRs. The demonstrated performance of the prototypes significantly reduces cost risk.
- The PSR/IPA assessed SF as technically mature, but the program office lacked necessary staffing and planning maturity for a fixed-price EMD phase. The PSR/IPR team documented findings and recommendations in several areas: insufficient planning for the scope of Government activity during EMD/PD, funding shortfalls, immature systems engineering plans and test and evaluation plans, and insufficient qualified technical staff. The program is addressing these issues, and the PSR/IPA team conducted several follow-up sessions to monitor progress.
- The SF PDR was a series of events to review each contractor's preliminary design. Both designs are technically mature and are validated by working prototypes. The PDR showed that the preliminary system designs are sufficiently mature to enter EMD/PD.
- DASD(SE) will participate in the SF CDR in FY 2013 and will prepare a post-CDR assessment for USD(AT&L).

Measurable Performance Criteria

- **Reliability** – SF is on track to achieve reliability requirements by IOC. Both contractors incorporated design for reliability and maintainability into their processes. Operational availability predictions, at 98.8-99.8 percent, exceed threshold and objective requirements. SF does not have a reliability growth curve, as there will be only a single system for IOC and (depending on budget actions) a second system to meet FOC requirements. Subsystem and component design efforts do include reliability planning and tracking; these efforts are on track.
- **Software** – The Technical Requirements Document provides the software requirements, and the SEP identifies key software metrics for management. The program is on track to achieve these requirements by IOC. Details of the software effort will depend on the chosen EMD contractor's design, as the competitors have different approaches.
- **Manufacturing** – Both contractors included manufacturing considerations during design, evaluated total cost through multiple life-cycle cost estimates, and used prototype assembly to validate production planning for the IOC system. Prototypes demonstrated key hardware and software elements representative of the final designs. Both contractors conducted supply chain planning and technical trades focusing on producibility or reducing costs.
- **Integration** – Internal integration is well supported by requirements definition and testing. The prototypes, which will also support software and net-centric integration efforts during EMD, demonstrate the overall integration maturity.
    - The consumer for SF is the Joint Space Operations Center (JSpOC) Mission System (JMS). The C2 space situational awareness (SSA) net-centric environment is not mature, and SF will effectively be defining that interface for JMS. Both programs are working closely to establish interoperable net-centric elements (e.g., schemas, services, vocabularies, etc.). SF and JMS produced a joint interface definition to guide SF.
    - SF will be highly dependent on network availability and bandwidth between the consolidated operations center and the sensor sites. The program is identifying needed Service-level agreements with the Defense Information Systems Agency and site networks.

Conclusion: SF is a technically mature program post-PDR and is on track to MS B.

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4.4 DASD(SE) Assessments of DoD Programs

Assessments are as of the end of FY 2012 (September 30, 2012); however, some assessments may include information on program status through the 1st quarter FY 2013 (December 31, 2012). This section includes summaries on the following five programs:

- Chemical Demilitarization–Assembled Chemical Weapons Alternatives (ACWA)
- F-35 Joint Strike Fighter Aircraft
- Joint Light Tactical Vehicle (JLTV)
- Key Management Infrastructure, Capability Increment 2 (KMI CI-2)
- Multi-Functional Information Distribution System Joint Tactical Radio System (MIDS JTRS)

Chemical Demilitarization – Assembled Chemical Weapons Alternatives (ACWA)

Service: Army (lead)

Prime Contractors:
Pueblo – Bechtel National, Inc.
Blue Grass – Bechtel-Parsons Blue Grass, A Joint Venture

Executive Summary: The ACWA program consists of two plants designed to destroy the chemical weapons (CWs) stored at Pueblo and Blue Grass Army Depots. The ACWA program is an ACAT ID program in the Engineering Manufacturing and Development (EMD) phase. The program was reapproved for MS B in FY 2012, following activities to respond to a FY 2011 Nunn-McCurdy review during which the USD(AT&L) rescinded the previous MS B.

Mission Description: ACWA will ensure the safe and environmentally sound destruction of CWs stored at the Blue Grass Army Depot located near Richmond, Kentucky, and the Pueblo Chemical Depot located near Pueblo, Colorado.

System Description: ACWA will acquire the services, systems, and equipment required to develop, refine, and demonstrate alternative (to incineration) chemical agent destruction technologies while destroying the CWs stored at Pueblo and Blue Grass. The Pueblo plant will use neutralization followed by biotreatment. The Blue Grass plant will use neutralization followed by supercritical water oxidation.

Schedule: The ACWA program is conducting EMD phase activities and is currently in the plant phases designated as Construction and Systemization. USD(AT&L) approved the program's MS B in an Acquisition Decision Memorandum (ADM) dated March 21, 2012.

- Pueblo is in the EMD/Systemization phase during which all machinery will be installed into the plant and then integrated and tested.
- Blue Grass is in the earlier EMD/Construction phase during which the plant is being built and the machinery is being fabricated.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP) –** DASD(SE) approved the SEP in February 2012 to support MS B. The SEP follows the April 2011 DoD SEP Outline and reflects the program's technical planning for the EMD phase and beyond. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC waived the requirement for a CDD in February 1996; there are no KPPs. The Acquisition Program Baseline requires the following characteristics, which the program monitors: (1) compliance with safety laws, (2) minimal chemical agent releases, (3) minimal chemical agent exposures, and (4) compliance with environmental laws.
- **Program Protection Plan (PPP) –** The program's analysis of critical program information and its Physical Security Plan satisfy the PPP requirement as indicated in the MS B ADM.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – Each ACWA plant has process equipment that must be maintained using contractor logistics support during

CW destruction. When all CWs are destroyed, no requirement exists for sustaining the plant. The sites will be closed in compliance with the Resource Conservation and Recovery Act environmental permit. This approach is acceptable.

- **Program Risk Assessment –** The DASD(SE) worked closely with the program office to establish a rigorous risk management process. After reviewing the program's risks quarterly, DASD(SE) assessed the ACWA program as having one additional risk at Blue Grass and at Pueblo, each related to low facility availability estimates. The program has funded risk mitigations in place for both risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted no assessments in FY 2012 but assessed the program's performance and production in the quarterly Defense Acquisition Executive Summary assessments.
- The Blue Grass site team conducted two technical reviews in FY 2012.
  - The PEO conducted the Rocket Cutting Machine (RCM) Technical Review in March 2012 to assess the readiness of this machine to be implemented at Blue Grass. This was an event-driven review that indicated the RCM was ready for implementation.
  - The PEO also conducted the Rocket Shear Machine (RSM) Technical Review in June 2012 to assess the readiness of this equipment to be implemented at Blue Grass. This was an event-driven review that indicated the RSM was ready for implementation.
- DASD(SE) plans no systems engineering assessments in FY 2013.

Measurable Performance Criteria

- **Reliability –** Neither Pueblo nor Blue Grass has a reliability requirement; however, each plant design is first-of-a-kind and has a conservative reliability estimate based on results of the technical risk reduction program, throughput analysis, and factory acceptance testing (FAT).
- **Software –** Software for each site primarily falls within the facility control system (FCS) with link to the process equipment. The FCS for each site is meeting its requirement.
- **Manufacturing** –The program is tracking each plant phase (i.e., Construction, Systemization, Full System Integration, and Demonstration and Operations) and how well each is leading to the next phase using turnover skylines. For example, both Pueblo and Blue Grass are tracking Construction-to-Systemization package turnovers. Once the expected turnover is complete, the next phase can begin. This approach is acceptable.
- **Integration** – Each ACWA site is composed of facilities with machinery for processing CWs. Each machine is fabricated, tested, and shipped during the EMD/Construction phase. Each plant was modeled in 3-D to assist personnel in understanding interfaces between machines and the FCS. Systemization is the phase in which all process equipment will be integrated for full system testing. This phase is scheduled for multiple years, making integration a low risk.

Conclusion: The ACWA program is on track with EMD activities.

F-35 Joint Strike Fighter Aircraft

Service: Air Force (lead)/Navy/Marine Corps

Prime Contractor: Lockheed Martin Aeronautics

Executive Summary: The F-35 is a three-variant family of multi-role fighter aircraft. The ACAT ID program successfully completed MS B to reenter the System Development and Demonstration (SDD) phase, while continuing LRIP simultaneously. DASD(SE), in collaboration with other OSD offices, conducted an USD(AT&L)-directed Quick Look Review (QLR) to inform the Milestone Decision Authority on concurrency-related technical issues and risks that ultimately contributed to a production slowdown.

Mission Description: The F-35 is a single-seat, single-engine aircraft capable of performing and surviving lethal strike missions using advanced technologies to meet an advanced threat, while affordably improving lethality, survivability, and supportability. The F-35 will be operated by the U.S. Air Force, Navy, Marine Corps, international partners, and foreign military sales customers.

System Description: The program will provide three variants: the Air Force Conventional Takeoff and Landing (CTOL), the Marine Corps Short Takeoff and Vertical Landing (STOVL), and the Department of Navy Carrier Variant (CV). All variants have requirements to interoperate with air, land, and sea nodes of U.S., joint, and combined force structure operating within the projected C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) architecture.

Schedule: USD(AT&L) recertified MS B in February 2012 and approved an updated Acquisition Program Baseline. A MS C/FRP decision is expected in the 2nd quarter FY 2019. DASD(SE) participated in several technical reviews including an annual Production Readiness Review (PRR), Concurrency QLR, Helmet Mounted Display Systems (HMDS) PDR, Air System Block 3 software PDR, and various acquisition/systems engineering planning activities. DASD(SE) also conducted periodic software analyses with the support of the Joint Program Office (JPO) and the contractor.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP in December 2009 to guide technical planning and execution. An update in November 2010 included improvements in risk management. There are no approved waivers or deviations from the SEP, and the objectives of the SEP are being met. OSD will require an updated SEP to support each milestone.
- **Requirements** – The JROC validated the MS B Operational Requirements Document in April 2000. The program has eight KPPs: combat radius, STOVL performance, CV recovery, radio frequency signature, reliability, sortie generation rate, logistics, and interoperability. Although challenges exist, the program is on track to meet the KPPs with limited margin in many areas. Program-level requirements are stable, but additional lower-level derived requirements emerged from the dual helmet path and Concurrency QLR.
- **Program Protection Plan (PPP)** – The USD(AT&L) approved the PPP in December 2010. The PPP will guide protection of critical technologies, components, and information through SDD.

USD(AT&L) directed the JPO to address supply-chain risks and vulnerabilities and to provide an updated PPP for FRP.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The program has a reliability growth plan and mitigation plans to address sustainment risks.
- **Program Risk Assessment** – The program implemented an acceptable risk management process with DASD(SE) assistance following the 2010 Nunn-McCurdy critical unit cost breach. Since then, the program has identified numerous risks in development, production, and sustainment. Funded risk mitigation plans are in place.

FY 2012 Systems Engineering Assessments

- DASD(SE) presented the QLR results to USD(AT&L) in November 2011. The review identified technical issues and risks with production/development concurrency consequences. The results were a factor in the decision to reduce production rates across the FY 2013 President's Budget.
- DASD(SE) led the USD(AT&L)-chartered F-35 Threat Tiger Team. Phase 1 provided USD(AT&L) with an assessment of F-35 capabilities and limitations. Phase 2 provided USD(AT&L) system and test infrastructure investment recommendations.
- DASD(SE) parametric software analysis indicates the full-capability delivery of Block 3F software at the end of System Development and Demonstration will not support planned milestone dates. DASD(SE) has worked with the program since 2009 to develop and monitor software metrics, refine schedule projections, and provide recommendations for improved software processes now in place.
- DASD(SE) participated in the LRIP 6-7 PRR and noted risks in all of the assessment areas, especially with regard to achieving FRP in a timely manner. The program has developed and implemented mitigation plans and will continue to conduct annual PRRs to assess progress.
- DASD(SE) conducted four quarterly Defense Acquisition Executive Summary assessments in the areas of performance and production. DASD(SE) staff engages with the program on a routine basis to inform senior leadership on performance and progress to plans.

Measurable Performance Criteria

- **Reliability** – Air vehicle reliability is well below goals, as may be expected early in development. The program will need to aggressively address and fund reliability growth.
- **Software** – Software delivery for the remainder of Blocks 2 and 3 is a challenge because of the sheer size and complexity of software. Achieving all planned Block 3 capabilities before the end of development poses a risk. DASD(SE) forecasts show the potential for several-month delays for both Blocks 2 and 3 and potential for delays and functionality to cascade into subsequent blocks.
- **Manufacturing** – The program completed an annual PRR in December 2011 in support of LRIP 6 and 7. Although the program has mitigated many production risks and issues over the past 2 years, FRP will be a challenge. Composite manufacturing processes are immature, parts shortages still exist, and quality (rework and escapes) shows only slow improvement. Three production risks remain, and the program has yet to demonstrate its ability to meet yearly production goals (13 of 20 in CY 2011 and on track for only 30 of 40 in CY 2012).
- **Integration** – Integration risks include implementing an Operational Requirements Document-compliant HMDS, sensor fusion algorithms, and pilot-vehicle interface. The program completed a successful dual-path HMDS PDR in April 2012, but delivery of an operationally acceptable HMDS in time to support Block 2 software testing and initial fielding remains a challenge.

Conclusion: F-35 completed major baseline changes to extend schedules and add needed resources to development and verification. Software and helmet integration are the main threats.

Joint Light Tactical Vehicle (JLTV)

Service: Army/Marine Corps

Prime Contractors: Oshkosh, Lockheed Martin, and AM General

Executive Summary: JLTV is a light truck intended to increase protection, payload, and performance over the High-Mobility Multipurpose Wheeled Vehicle. DASD(SE) completed a PSR and a post-PDR assessment during FY 2012. Through these and multiple other support engagements, DASD(SE) assessed that the program's requirements' stability, detailed Systems Engineering Plan (SEP), and comprehensive Program Protection Plan (PPP) demonstrated the technical readiness to enter the Engineering and Manufacturing Development (EMD) phase. DASD(SE) informed the DAB recommending program entry at MS B August 2012.

Mission Description: The JLTV is a joint Service program that consists of a family of vehicles with companion trailers, capable of performing multiple mission roles that will be designed to provide protected, sustained, networked mobility for personnel and payloads across the full range of military operations (traditional to irregular).

System Description: The JLTV is composed of two variants based on a common automotive vehicle platform—a two-seat variant to satisfy the Combat Support Vehicle (CSV) requirement and a four-seat variant to satisfy the Combat Tactical Vehicle (CTV) requirement—and a companion trailer for each variant. The two-seat CSV variant has one base vehicle platform, the Utility/Shelter Carrier (UTL). The CSV will have a payload capacity of 5,100 pounds, versus 3,500 pounds for the CTV four-seat variant. The four-seat variant has two base vehicle platforms, the Close Combat Weapons Carrier and the General Purpose.

Schedule: The program entered the EMD phase at MS B August 2012. During FY 2012 DASD(SE) completed both a PSR and a post-PDR assessment in accordance with the WSARA.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) assisted the program's development of a detailed SEP to support its competitive prototyping Acquisition Strategy in the EMD phase. DASD(SE) approved the MS B SEP in June 2012. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – JROC approved the JLTV CDD in March 2012. DASD(SE) actively participated in the program's knowledge point review process that supported the development of the CDD. Seven knowledge point reviews during the Technology Development (TD) phase informed requirements trade decisions, leading to a stable requirements set including eight KPPs and four KSAs.
- **Program Protection Plan (PPP)** – DASD(SE) assisted the program office to develop the PPP after identifying it as a shortfall during the PSR. The USD(AT&L) approved the PPP August 2012.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – The JLTV program's strategy defers the development of logistics products until LRIP. DASD(SE) recommended the program accelerate a logistics demonstration prior to the Multiservice Operational Test and Evaluation event to facilitate corrective actions of Integrated Electronic Technical Manuals, troubleshooting procedures, etc. prior to the event.
- **Program Risk Assessment** – DASD(SE) assesses that no high-level technical risks remain after the TD phase; however, weight management, as it underpins the mobility and transportability KPPs, is a watch item. The reliability risk identified in the TD phase was reduced from moderate to low, with the lowering of the reliability threshold requirement. The SEP and Risk Management Plan establish adequate processes to mitigate these risks.

FY 2012 Systems Engineering Assessments

- DASD(SE) completed the PSR assessing the program's TD phase results and preparation for the EMD phase in the areas of requirements, integration, reliability, manufacturing readiness, and technology readiness. The program made TD phase trade-offs to balance vehicle performance capabilities and affordability. The PSR team assessed mobility as a moderate risk because of escalating force protection requirements. At the conclusion of the review, the program was assessed as "Ready for MS B" with mature technologies and a stable and achievable requirements set. The program office continues to do a commendable job managing a Joint program.
- DASD(SE) completed the post-PDR assessment in April 2012 to check the program's establishment of a benchmarked allocated baseline derived from the three TD phase vendor baselines. DASD(SE) will incorporate information from the DUR events in the CDR assessment to support the MS C.

Measurable Performance Criteria

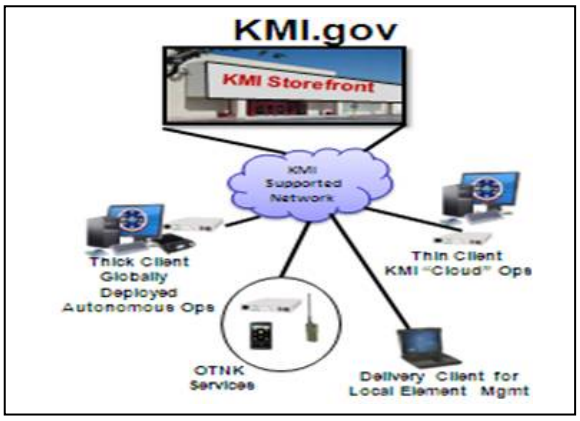
- **Reliability** – The JROC-approved CDD requirement of 2,400 mean miles between operational mission failure is achievable. The parameter reflects a 47 percent drop from the TD phase draft CDD requirement.
- **Software** –The EMD prototypes are expected to have 120,000 new lines of code, plus approximately 210,000 lines of modified existing code. The program plans to track software productivity, defects, releases, and reuse metrics in EMD through a series of contract deliverables.
- **Manufacturing** – The three EMD contractors demonstrate adequate planning to deliver a total of 66 full system prototypes for Government testing. The program maintains awareness of each contractor's manufacturing and quality processes through a series of contract deliverables.
- **Integration** – Each contractor will deliver 22 fully integrated vehicles for test but will retain control of the architecture and interfaces throughout the EMD phase. The program monitors the integration effort through a series of contract deliverables in EMD.

Conclusion: The program's SEP sufficiently describes the program's plans to execute systems engineering activities during the EMD phase, to achieve KPPs and KSAs, and to inform trades.

Key Management Infrastructure, Capability Increment 2 (KMI CI-2)

Service: DoD

Prime Contractor:
Spiral 1 - General Dynamics, C4 Systems
Spiral 2 - SAIC



Executive Summary: KMI replaces the unsustainable Electronic Key Management System (EKMS) and provides the foundation for future secure key and software provisioning capability to meet net-centric warfighting needs. During FY 2012 the KMI program declared a Critical Change Report (CCR) due to a breach in cost and schedule. DASD(SE) recommendations drove the development of a more realistic Acquisition Program Baseline (APB), including a revised schedule and cost estimate to provide the needed development timeframe to increase schedule confidence.

Mission Description: KMI CI-2 builds the foundation for the future secure key and software-provisioning capability to meet the requirements of net-centric warfighting. KMI CI-2 provides enterprise-level ordering, distribution, and management services of cryptologic products for both users and devices to enable secure communications.

System Description: KMI CI-2 establishes a secure presence for key provisioning. This capability enables customer transition from EKMS to KMI. KMI provides web-based key ordering for all key types and over-the-network keying directly to KMI-aware end cryptographic units.

Schedule: KMI reached MS C in October 2011 and subsequently declared a CCR breach of cost and schedule. DASD(SE) led the management structure review team during the CCR. KMI CI-2 completed Initial Operational Test and Evaluation (IOT&E) in 2012. KMI CI-2 includes two spiral developments.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP)** – DASD(SE) approved the SEP in August 2011 to support MS C. No further approved updates are planned as the program is post MS C. The program is fulfilling the objectives of the SEP without waivers or deviations.
- **Requirements** – The JROC approved the KMI CI-2 CPD on February 9, 2012. The requirements contained in the CPD are reasonable but until recently were unstable due to changes in the legacy EKMS system. The Department has now stabilized these requirements by locking down the EKMS baseline, moving future capability needs into KMI. The program has seven KPPs and three KSAs and is overcoming difficulties in achieving the portion of a KSA associated with the reliability of the KMI Token.
- **Program Protection Plan (PPP)** – DASD(SE) supported the program protection planning to address critical program protection and supply chain risks. The KMI PPP is in OSD formal coordination for approval.

- **Systems Engineering Support of Life Cycle Management and Sustainability** – KMI is currently focused on reducing the account transition time (EKMS to KMI) and improving the help desk operations to facilitate transitioning off EKMS. These efforts will increase user satisfaction and ensure that the end-to-end system can be expanded to the desired scale.
- **Risk Management Assessment** – KMI risk management processes are mature and effective. The program identifies risks early and, through mitigation activities, reduces the risks over time.

FY 2012 Systems Engineering Assessments

- DASD(SE) significantly contributed to the formal CCR assessment in FY 2012. DASD(SE) led the Management Structure Review portion of the CCR, which included other offices within OSD.
  - DASD(SE) concluded that the majority of the program's processes were sufficient. Examples of proactive systems engineering management by the program office include their decision to compete the Spiral 2 development contract and change the development methodology from waterfall to Agile.
  - DASD(SE) recommendations to extend the development schedule were accepted through a change to the APB. The results of the software parametric analysis were used to justify the increased duration of the development schedule to raise the confidence of a successful development to the industry standard, 50 percent.
- DASD(SE) assisted with updating the program's reliability growth planning to focus attention on identifying token reliability issues along with developing corrective actions and forecasting growth.
- DASD(SE) plans to reassess KMI's software development planning through another software parametric analysis after the Spiral 2 development metrics have stabilized.

Measurable Performance Criteria

- **Reliability** – KMI is achieving its availability requirements for both the storefront and the client node; however, achieving the mean time between operational mission failure has been a challenge for the KMI Token. DASD(SE) has assisted KMI in developing and tracking the reliability growth plan. The KMI Token reliability has improved as failure modes are corrected by design enhancement, manufacturing improvement, and software corrections.
- **Software** – The cost and schedule breach resulted mainly from optimistic software estimation and development for Spiral 1. DASD(SE) conducted a software parametric analysis, the results of which were used to establish the new APB for Spiral 2. The program has taken steps to increase the rigor of the development effort. The program has included software development metrics in the new contract to better manage the development effort, and a follow-on parametric analysis is planned to gauge performance to plan.
- **Manufacturing** – The program has a manufacturing responsibility for the KMI Client Node. This node has two custom products (Advanced Key Processor (AKP) and KMI Token) which are integrated with several commercial-off-the-shelf components to provide the KMI User Portal functionality for the KMI customers. Although challenges persist with token manufacturing, the program has systematically reduced the manufacturing difficulties.
- **Integration** – KMI is working to improve the integration of its capability with the overall network to address nonstandard configurations that vary by installation site by increasing the scope of the preinstallation site visits. Spiral 2 will address integration with other dependent systems such as Advanced Extremely High Frequency, Mobile User Objective System, and F-22.

Conclusion: KMI CI-2 is following the new APB and is on track to meet its requirements. The program met the entry criteria for IOT&E. The program has engaged with DASD(SE) and other OSD stakeholders to identify and solve problems as early as possible.

Multi-Functional Information Distribution System Joint Tactical Radio System (MIDS JTRS)

Prime Contractor: ViaSat and Data Link Solutions (DLS)

Executive Summary: The MIDS JTRS product provides a software defined radio with Link 16, J-Voice, and tactical air navigation (TACAN) functionality plus three additional 2 megahertz (MHz) to 2 gigahertz (GHz) programmable channels. MIDS JTRS is in the Full Production and Fielding (FPF) acquisition phase. DASD(SE) conducted a technical review with the MIDS JTRS program office to validate that the deficiencies identified during the Initial Operational Test and Evaluation (IOT&E) were corrected and implemented into the LRIP, serving as an enabler for an FPF decision in April 2012.

Mission Description: MIDS JTRS provides support to the combatant commander, joint mission areas, and computer environments by enabling secure, mobile, ad-hoc, wideband, and cross-band radio frequency (RF) Link 16 connectivity capabilities. MIDS JTRS supports joint mission/joint mission tasks listed in the CJCSM 3500.04, Universal Joint Task List, and Service-specific planning guidance requiring information exchanges using radio frequency transmissions.

System Description: The MIDS JTRS design is plug-and-play interchangeable for all Service platforms using the Multifunctional Information Distribution System-Low Volume Terminal version 1 space, weight, and power specifications. The MIDS JTRS design adds improvements such as Link-16 Enhanced Throughput (ET), Link 16 frequency remapping (FR), and programmable cryptography. In addition to the Link 16 and TACAN functionality, MIDS JTRS provides three additional 2 MHz to 2 GHz programmable channels to accommodate incremental delivery of the advanced JTRS waveforms through MIDS JTRS Platform Capability Packages.

Schedule: MIDS-JTRS received FPF approval for the MIDS JTRS terminal in April 2012. The MIDS program office subsequently awarded contracts to ViaSat and Data Link Solutions also in April 2012. Current software upgrades on contract include crypto modernization. Planned future efforts include four nets concurrent multinetting with concurrent contention receive (CMN-4), a Link 16 enhancement, and the integration of the tactical targeting network technology (TTNT) waveform. During CMN-4 and TTNT several hardware upgrades will take place to include processor upgrades to ensure proper margins are met as additional capability is added to the terminal.

FY 2012 Systems Engineering Activities

- **Systems Engineering Plan (SEP) –** The MIDS JTRS SEP was approved prior to WSARA in October 2007 by the JTRS Joint Program Executive Office to support the Limited Production and Fielding Decision. No update is planned. The objectives of the SEP are currently being met without waivers or deviations.
- **Requirements –** The JROC validated the MIDS JTRS CPD in 2008. The MIDS JTRS product has seven KPPs. Six of seven KPPS were demonstrated in the F/A-18 E/F IOT&E. The KPP for

four-channel operations was not demonstrated due to the Navy's willingness to accept the MIDS-JTRS with Link 16 and TACAN.

- **Program Protection Plan (PPP)** – The MIDS JTRS PPP for FPF was submitted to OSD for approval in late FY 2012, with approval expected in 1st quarter FY 2013.
- **Systems Engineering Support of Life Cycle Management and Sustainability** – The MIDS JTRS has a product Life Cycle Management and Sustainment Plan dated August 2011.
- **Program Risk Assessment –** MIDS JTRS developed a risk mitigation plan addressing the microprocessor throughput upgrade risks. The plan was presented to OSD in March 2012. DASD(SE) evaluated the plan and agreed with the programs' proposed risk resolution.

FY 2012 Systems Engineering Assessments

- DASD(SE) conducted technical exchanges with the MIDS program office on the implementation of the IOT&E deficiency closure plans December 2011–January 2012 that resulted in the closeout of all deficiencies. In addition, DASD(SE) validated implementation of fixes into its limited production terminal production through technical exchange meetings with the program office technical staff.
- DASD(SE) reviewed the FPF Acquisition Decision Memorandum (ADM) and provided input related to systems engineering processes and documentation that was included in the final FPF ADM signed in April 2012.
- DASD(SE) reviewed the MIDS PPP and met with the program office during FY 2012 to adjudicate and resolve OSD comments, ensuring that system design protects critical program information and that supply chain risks are mitigated.
- DASD(SE) initiated meetings with the MIDS JTRS program to develop an acceptable resolution to the processor margin requirement and the parts obsolescence issues.
- DASD(SE) performed four quarterly Defense Acquisition Executive Summary assessments on the MIDS JTRS performance and production to support OSD leadership and staff oversight.

Measurable Performance Criteria

- **Reliability** – MIDS JTRS has a reliability requirement of 220 mean flight hours between operational mission failure (MFHBOMF) (terminal) and 25 MFHBOMF (system). MIDS JTRS has exceeded its MFHBOMF reliability requirements with 675 MFHBOMF (terminal) and 27 MFHBOMF (system), respectively.
- **Software** – The first MIDS JTRS Link 16–capable terminal is configured with a core software version integrated into supporting operating environment software as Integrated Builds. Integrated Build 1.7.4 includes corrections required to address deficiencies identified in the IOT&E. These fixes in this build were retested in the verification of corrected deficiencies event and implemented into the current production radios.
- **Manufacturing** – There were initial production throughput delays in the delivery of MIDS JTRS terminals from ViaSat and DLS due to manufacturing test issues. Environmental stress screening testing and acceptance test procedure testing prior to release to the Government led to the program's meeting customer delivery requirements.
- **Integration** – The MIDS JTRS has been successfully integrated and tested with the F/A-18E/F, the Air Force's E-8C (Joint Surveillance Target Attack Radar System (JSTARS)), the RC-135 (Rivet Joint) and is planned for integration testing in the EC-130H (Compass Call) and E/A-18G.

Conclusion: The MIDS program is in FPF and is producing MIDS JTRS terminals to meet current customer Link 16 and TACAN requirements.

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APPENDIX A

Department of the Army
Systems Engineering Self-Assessment

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DEPARTMENT OF THE ARMY
ASSISTANT SECRETARY OF THE ARMY FOR ACQUISITION, LOGISTICS AND TECHNOLOGY
(ASA (ALT))

U.S. Army Report to the DASD-SE in support of the FY12 Annual Report to Congress Regarding the Implementation of the Weapon Systems Acquisition Reform Act

Advancing the State of Systems Engineering for the Army

ASA (ALT) Office of the Chief Systems Engineer

02/25/2013

Service Assessment Summary:

The Army, in order to improve the execution of systems engineering across the acquisition community, provisionally established the Office of the Chief Systems Engineer (OCSE) in 2011. Since that time significant strides have been made in advancing the state of Army systems engineering and improving system-of-system integration. OCSE serves as the only organization within ASA (ALT) headquarters to provide analytical support to the ASA (ALT) leadership on critical Systems of Systems (SoS) trade-space issues. The OCSE also conducts studies, establishes vision, designs baselines, and maintains vigilance of affordability, interoperability, and relevance. OCSE also serves as the Chief Information Officer (CIO) for the ASA (ALT), and as the ASA (ALT) CIO. OCSE leads ASA (ALT) transformation to deliver timely, trusted, and shared information, and to create an environment that empowers the acquisition community through an unsurpassed agile, collaborative, productive, lean, and trusted information enterprise.

In Fiscal Year 2012 (FY12) the Army made solid gains in growing its ability to provide strategic systems engineering guidance and assistance across its acquisition enterprise, and to produce strategic level systems engineering documents to align Service system architectures. These advances help the Army make significant strides towards realizing its vision of interoperable, cyber-hardened, system of systems with open architectures and lower life cycle costs.

The mission of ASA (ALT) OCSE is to provide the Army's leadership and materiel developers with the necessary system-of-systems analysis, defining engineering and architectural products to manage and shape the Army's materiel portfolio; to ensure systems engineering discipline across the materiel developer community throughout the acquisition life cycle; and to grow the systems engineering capability within the Army through education, engineering policy, guidelines, and adoption of best industry practices.

Over the past year ASA (ALT) OCSE has focused on the following initiatives:

- Delivering strategic-level System of Systems Engineering and architectural analysis for current and future force capabilities
- Continuing the implementation of the Common Operating Environment through orchestration, validation, and verification
- Fostering the environment for information transparency and collaboration for all architectural and engineering data
- Establishing engineering policy, guides, best practices templates, and metrics to insure SoS discipline across ASA (ALT)
- Improving the SE documentation review process to decrease the time to review and improve the quality by strict adherence to OSD and Army policy and guidance
- Conducting program reviews to ensure compliance with established policy guidance, architectures and standards
- Shaping SoS engineering organizational structure and processes across the Program Executive Offices (PEOs) to ensure consistency in implementation of Systems Engineering rigor
- Promoting education and a personnel development model to cultivate the System of Systems Engineering capability across the ASA (ALT) and the Army
- Orchestrating the domain management of its portfolio of existing Information Technology (IT) systems
- Identification of science and technology opportunities that will enhance the SoS capability

The Army identified the following areas of notable improvements within the implementation of systems engineering and are discussed in detail in Section 1.5:

(1) Implementation of the Systems Engineering Plan policy aligned with OSD SEP policy

(2) Improved synchronization with multiple business and warfighting decision forums

(3) Increased breadth and scope of the Army Systems Engineering workforce through forum attendance, formal training and experience, rotational assignments, etc.

The Army has also identified three areas to focus on improvement in FY13:

(1) Develop and deliver a Development Planning methodology and core capability to the Army, that will use a select set of common tools and best practices, which can be tailored to specific programs needs, to inform the Joint Capabilities Integration and Development System (JCIDS) requirements process, improve Analysis of Alternatives (AoAs), identify early cost and risk factors, and insert appropriate Systems Engineering rigor prior to Milestone A.

(2) Develop a bench of Army Systems Engineering cadre with the proper mix of knowledge and expertise in hard engineering skills, cross engineering disciplines, DoD acquisition processes, and appropriate soft skills that enable them to manage risk and complexity and provide Acquisition Leadership with sound, independent and actionable engineering advice.

(3) Identify common SE methodologies, processes, products, and best practices, as well as systems engineering tools that can leverage common data sets, in order to improve the effectiveness and efficiency of our acquisition processes. Identify common metrics that are useful in measuring and predicting program performance and outcomes.

Systems Engineering Activities

1.0 Progress and Plans for Improved Service Systems Engineering Capability

1.1 Service-Level Systems Engineering Strategy:

The ASA (ALT) System Engineering strategy uses overarching objectives to align with the vision of the Army Campaign Plan and the ASA (ALT) Strategic goals. The outcomes that the Office of the Chief Systems Engineer is working to establish is an overall reduction in acquisition risk by implementing standardized systems engineering processes to reduce the cost of program acquisition, along with the life cycle cost of systems. OCSE will put in place a standardized systems engineering model that consist of using SE subject matter experts in the areas of planning, engineering, architecting, analyzing, and reviewing system capabilities across the PEO community. Additionally, innovative SE concepts, toolset, best practices, and collaborative forums will be used to improve the cycle time required for program documentation reviews supporting key leadership engagement opportunities such as the Army System Acquisition Review Council, the Capabilities Portfolio Review, and associated Defense and Army Overarching Product Team reviews. As Army operations continue to be based on the ability of the Commander to lead and direct supporting and subordinate entities to achieve a common purpose using

mission orders, OCSE is using reference architectures for Transport Systems, Applications, and Senor Services as those mission orders that will inform program how they will outfit formations to ensure the programs are nested within the Army and Joint / Coalition / Interagency architecture construct. The ability for the Army's technologically advanced systems, when integrated seamlessly to ensure full interoperability, will not only allow for the US Army to maintain our technological superiority over our adversaries, but will provide greater Warfighting ability as fully integrated and interoperable systems are a decisive combat multiplier. OCSE's extended team of engineering subject matter experts located in PEOs, RDECs, and Programs across the Acquisition community will use peer reviews of a system's design and architecture to ensure compatibility, interoperability, and consistency across multiple systems and formations; this will build a bench of trained Systems of Systems Engineers that can be leveraged across the community. These reviews will identify informed trades between cost, schedule, and performance objectives in the earliest stages of development and acquisition, and will enable informed decisions by senior leaders. Using developmental and rotational assignments, OCSE is working to grow the breadth and scope of Army Program Systems Engineers supporting PMs, PEOs, and the AAE. The oversight of lower-level ACAT programs is delegated to PEO level. The Army Systems Engineering Forum (ASEF) is being used as an avenue to identify the PEOs' best practices and share them across the community. ASA (ALT) provides a degree of oversight through enforcement and review of standardized Systems Engineering Plans (SEPs) and Program Protection Plans (PPPs). ASA (ALT) is also seeking the means to use hard data to measure the performance and health of individual programs and Army acquisition at-large. A key challenge is identifying the proper metrics and leading indicators that can foretell program outcomes. To expedite identification of key performance indicators, ASA (ALT) is considering establishment of new policy to facilitate the routine collection of a variety of data sets/points from individual programs. That data would be recorded and analyzed along with program progress and outcomes, with a goal of determining which sets of data are predictive of program success. If successful, that type of data could also be used to assist in evaluating, on a timely basis, whether Service-wide performance in acquisition is improving or declining. It could also be used to help identify correlations between specific initiatives or process changes and their impact on program outcomes.

The overarching objectives of the Army's SE efforts are to enable better acquisition outcomes and achieve the ASAALT vision – a "highly efficient, effective, agile organization responsible for acquiring, developing, delivering, supporting and sustaining the most capable affordable systems and services for our Soldiers:

- Enabling our Soldiers to dominate the battlespace, safely and securely
- Enabling our Soldiers to achieve first look, first strike advantage with unprecedented speed and accuracy"

The complexity of our modern systems makes a strong SE capability particularly important to ensure we build the right systems and we design them correctly, with minimal rework. We will apply our systems engineering efforts to ensure the best value for the Warfighter as we support the ASA (ALT) strategic goal and Army Campaign Plan objective of equipping the Army for the 21st Century.

To achieve these outcomes, the Army Acquisition Systems Engineering community will emphasize the following focus areas and objectives:

- **Early systems engineering** and a disciplined approach to acquisition that begins even before the formal start of a program. We will continually seek to improve our understanding of requirements and technology, and refine our designs as early as possible. Our intent is to obtain a higher level of knowledge at key decision points, and reduce uncertainty before commitment

to a specific program path. This will promote program stability, reduce the risk of costly design changes, avoid missteps and re-work, and represents one of our best means to reduce the potential for unexpected cost and schedule growth.

- Establish a **Development Planning** capability. To instill greater rigor in our processes of starting new programs, making major product improvements, and assessing options in system of system combinations and trades, we will provide the Army with a Development Planning (DP) capability. Our DP efforts will establish methodologies and select common tools that can be tailored to the particular situation, allow for evaluation of a broad scope of alternative concepts, and enable better Analysis of Alternatives (AoAs). Development Planning will facilitate a collaborative process to make informed trades, and assist in rational and accurate costing to help ensure that warfighting needs are met while achieving the best value for the dollars invested. The results will help ensure we choose the right programs and set them on a viable path to success. Development Planning will facilitate informed leadership decisions for individual programs and across portfolios, even before concepts enter the formal acquisition process.
- Improve our **visibility and traceability of requirements** across the system of systems; we will continue our efforts to develop an integrated requirements framework to enable development, management, and traceability of requirements in one environment. Requirements will be traced through the hierarchy and linked to architectural data and authoritative references, enabling more effective analysis to determine required system functionality and identification of gaps in architectures. We intend to utilize this framework to identify and reduce duplicative requirements, and provide traceability to Warfighter needs and operational utility.
- **Early identification and management of risk** by the use of appropriate tools and methodologies to aggressively seek and identify risk elements - in technology, manufacturability, integration, software, and other trouble-prone areas. Once identified, we will promptly take steps to mitigate those risks. As a program progresses, we will assist, advise, and provide guidance to PMs to validate progress of their risk mitigation plans. At every phase, our work will enable well-informed decisions with a full understanding of the implications of the risk factors.
- **Identification of cost drivers** to ensure that developed cost estimates will identify the characteristics that contribute significantly to cost. We will not only identify the initial acquisition cost drivers, but also costs incurred throughout the life cycle, such as fuel. A clear identification and understanding of cost drivers will provide opportunities for informed decisions based on evaluation of cost versus benefits. We will seek the early identification of those cost drivers; while early cost information is less refined, it also has potential for the greatest impact on lifecycle costs.
- **Improved reliability** by emphasizing to all Program Offices the use of Reliability, Availability, and Maintainability (RAM) best practices and tools, collecting necessary metrics, and tapping into the Army's Reliability Competency Centers to effectively execute the reliability programs. We will make use of the Reliability Improvement Working Group to perform assessments of reliability efforts and share lessons learned across the Acquisition community. At the program level, we will perform early assessments of reliability requirements; use reliability growth planning curves to plan and track reliability, and use reliability contract language during solicitation and contract execution.
- **Implementation of Common Operational Environment (COE), ** an OCSE sponsored, AAE directed initiative that will be guided by the development of integrated System Engineering Plans (iSEP), which will provide computing environment leaders the ability to continue with implementation. COE iSEPs establish an approach to achieve an approved set of computing technologies and standards for a variety of Computing Environments across the Army.

- **Value Engineering** (VE) methodology will be used to improve value and reduce cost. We will seek opportunities to apply VE and meet the OSD and Army value savings goal.
- **Modeling & Simulation (M&S)** to support program and leader decision making. The SE Community will identify appropriate M&S tools and applications for use across the phases of acquisition to evaluate concepts, understand cost, reduce uncertainty, and predict performance. This included improving our understanding of, and predicting, network performance. Included in these efforts is development of continuously available authoritative network models, data, representative architectures and metrics to support test and evaluation, training, and mission rehearsal. This initiative will establish a common environment of shared network conditions that can be used to establish a low-overhead testing environment. All of these capabilities must be developed to operate in the live, virtual and constructive training environment using the actual Mission Command information systems themselves, allowing the soldier to become intimately familiar with all aspects of those systems and how to adapt those systems to different scenarios.
- **Reference Architecture products** will provide a level of system of systems engineering guidance that will allow systems, concept, and formation architectural products to be developed across Army portfolios. We will develop the guidance and products required to provide direction to our programs and ensure architectural compatibility and consistency.
- **Reduce time to produce** systems engineering **products**. As a measure to meet schedules, reduce cycle time, and reduce risk in our systems, we will strive to reduce the amount of time to deliver our systems engineering products. A measure under consideration is to reduce the time to approve ACAT I SEPs, with a goal of reducing the number of days by 1/3, and to improve the product by reducing the number of OSD critical comments to 10% of the average FY12 rate.
- **Gain control of data rights.** In concert with OSD guidance, the Army will seek greater control over product data and data rights, so we will change the mindset of how we view this information. We will determine the best means to gain government control of the appropriate information, identify the specific steps and goals that represent a credible and executable way forward, educate the workforce, and execute.
- **Improve configuration management** by standardizing our means to perform configuration management, we will improve our tools to increase the visibility and control the performance of the functional and physical attributes of a system. This will also allow better traceability of changes and decision making as a program progresses.
- **Influence Science & Technology** (S&T) efforts. To maintain our Soldiers' first look and first strike advantages we will identify our technology needs early on and influence our S&T efforts to address our gaps. Our objectives will be to ensure that the needed technology is advanced, successfully transitioned, and integrated into our programs at a pace that meets the planned program schedule.
- Provide quality information to **support informed leadership decisions**. We will provide the right information tailored to the required decisions, at a sufficient level of fidelity, to inform senior leadership decisions. This will not only support critical individual programs decisions from definition and development through production and product improvement, but also support decisions across warfighting portfolios.

To allow us to accomplish our objectives and achieve our desired outcomes, we will work to improve on the following fundamentals/ enablers:

- **Organization.** We will continue to define the essential functions and refine the structure of OCSE, grow the organization, and document a concept plan.

- **Workforce.** Our most important asset is our people, and we will pay particular attention to building the bench. Our selection and training will not only emphasize the hard engineering skills, but also the harnessing of multiple disciplines and employment of the appropriate soft skills necessary for successful systems engineering of large, complex projects.
- **Strategic guidance.** We will develop the necessary strategic guidance to communicate our goals and provide direction to the SE workforce.
- **Collaboration and sharing of best practices.** We will identify the common and systemic issues across the community, formulate proposals, and socialize the potential solutions through forums such as our Army Systems Engineering Forum (ASEF). We will incorporate feedback from the community, publish appropriate guidance and recommendations, and promote the use of identified best practices. We will encourage cross-talk among the PEOs at every opportunity, and seek means to facilitate collaboration and combine efforts to solve problems too large for any one organization.
- Identification of **common systems engineering tools, methodologies, processes, and products**. We will identify common systems engineering tools, methodologies, processes, and products that can promote efficiency in our work across programs and architectures. Where appropriate, we intend to apply these consistently throughout the PMs, PEOs, and RDECs, and across architectures, models and simulation, and configuration management. As we assess our needs, we will identify the available tools, match the right tools to the right application, and implement the best common solution.
- **Information management.** In order to reduce the time and effort required to find key information, relevant documents, and reference material, we will seek to make information easily available and searchable. In developing this capability, we will favor an approach of linking to, rather than replicating, sources of information.
- **Metrics.** We will identify the metrics we want to use across the community. That will not only include what is currently being used, but will identify what we should be measuring in order to assess our systems engineering progress. We will identify the most important and effective metrics that can leverage common data sets, then use them for measurement, tracking, and enforcement.
- **Enforcement at PEO level.** We will increase awareness of the importance of systems engineering, track our progress, and impose discipline in our processes at PEO level.

1.2 Pre-Milestone A and Pre-Milestone B Rigorous Systems Analysis and Systems Engineering Process:

One of the major issues across Department of Defense (DoD) acquisitions is the need to better translate operational needs into the Capability Development Document. Systems Engineering (SE) has been historically focused on the translation of a user's needs into a definition of system specifications using iterative process that result in an evolving system design. SE has traditionally been employed during the Engineering and Manufacturing Development phase more so than in the Materiel Solution Analysis and Technology Development Phases of the DoD Acquisition model. Systems Engineering during Pre-Milestone 'A' phase has not generally been practiced due to the realities of the DoD Acquisition life cycle constraints. Systems engineering is usually conducted by the Program Management office and the Prime Contractor(s). Both of these organizations are not established until after a Milestone B decision has been granted and the PM / Contractor(s) have been established or contracted. The lack of a dedicated SE team during the Materiel Solution Analysis phase has kept the systems engineering professional from assisting in the critical efforts leading up to a Materiel Development Decision. During the Pre-MS 'A' phase critical trades are made to arrive at a preferred

material solution. This effort is primarily led by the Combat Development team supported by experimentation and analysis performed by functional proponent battle laboratories. These teams look for changes in Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) to support Analysis of Alternatives. Following the DOTMLPF analysis the focus switches to developing critical documentation to support an Analysis of Alternatives and a Materiel Development Decision. At this time operational research professional, Users, Operators, and Warfighter communities are considering alternative concepts (solutions), developing concept of operations (CONOPS), setting key performance parameters (KPPs) and system requirements. Systems engineering professionals need to participate in these activities to ensure that proper attention is paid to current and future interfaces, architectural and technical standards, and system testing and verification practices are considered and understood.

ASA (ALT) issued new guidance that the Director, Office of the Chief Systems Engineer (OCSE) shall serve as the overarching management and oversight authority for systems of systems engineering policies and processes for the Army. OCSE will provide guidance and direction during programs' Post-Preliminary Design Review and Post-Critical Design Reviews, SE Working Integrated Product Teams, and will assist PEO/PM representatives to develop and staff their Systems Engineering Plan (SEP). ASA (ALT) reissued policy seeks to ensure that Army acquisition programs comply with the PDUSD (AT&L) SEP Outline, in order to promote standard and efficient SEPs across the Army's portfolio. ASA (ALT) OCSE, in close collaboration with the Office of the Deputy Assistant Secretary of Defense for System Engineering (DASD(SE)), ensured the content of the SEP met the expectations and requirements as described in the SEP Outline for eight (8) of the programs in FY12. This assisted the PEO/PMs with preparation for Army System Acquisition Review Council (ASARC) and Defense Acquisition Board (DAB) acquisition decision reviews.

In FY12 the Architecture and Analysis Team for Force Basing (AATFB) led Army Development Planning efforts and utilized Development Planning and Portfolio Development processes to support System-of-System (SoS) portfolio designs. Their analysis and design work was the foundation for development of the Integrated Base Defense (IBD) SoS portfolio. The PM for Electronic Warfare is using a Development Planning process for the Electronic Warfare Planning and Management Tool (EWPMT). For FY13 ASA (ALT) OCSE plans to initiate a Development Planning (DP) capability that can be utilized across Army acquisition to support new program starts and major product upgrades. The intent is to establish a methodology and identify a set of common tools and best practices that can be tailored to the needs of a specific program or project. Rather than centralizing all capabilities, expertise, and resources for performing DP functions in a single organization, ASA (ALT) intends to rely heavily on assembling tailored teams with the appropriate technical expertise from existing Army organizations. These teams would meet virtually or physically for specified projects and limited periods of time. The work will emphasize close collaboration with the requirements community to inform the JCIDS requirements process. A core team will manage the DP activities, assist in framing initiatives, structuring teams, coordinating efforts, and assess the progress of Army DP activities.

FY 12 PEO / PM efforts

Within the Aviation portfolio, Program Managers (PMs) under PEO Aviation are using Systems Engineering best practices. For example, the Improved Turbine Engine Program (ITEP), led by the Utility Helicopter PMO, is utilizing the latest Defense Acquisition Guidelines and previously approved PEO AVN SEP examples to develop all their acquisition documentation including their SEP. Additionally, the UH program office has conducted extensive trade studies and systems engineering analysis associated with

the development of Pre-Material Development Decision (MDD) documentation for the ITEP. These studies and analysis will be used to validate the effectiveness of the new engine in meeting Army requirements as documented in the Operational Energy (OE) Interface Control Document (ICD). The OE ICD provides an approved documented structured framework which is used for the development of engine performance specifications and platform integration efforts.

As a whole, all of PEO AVN Program Management Offices understand the importance of systems engineering. They stress the continued use of established SE guidelines, practices and procedures throughout our acquisition processes. PEO AVN, working with the AMRDEC SE Division, has established a localized database which contains the latest DAG guidelines and recent approved examples to be utilized by new start programs. They look to share information and lessons learned to maintain commonality and consistency whenever possible. All program offices consistently utilize Configuration Change Boards (CCBs) and controlled configuration databases to maintain configuration control, identify best solutions and ensure best quality engineering practices are utilized for all programs no matter their acquisition phase.

In the Ground Combat System domain, the preponderance of programs are centered around the Abrams and Bradley Engineering Change Proposal (ECP) programs, not traditional milestone programs. PEO GCS developed an Abrams and Bradley ECP Acquisition Decision Memorandum (ADM) requiring milestone type documentation and deliverables at designated program phases. The required systems engineering documentation included the development of the Systems Engineering Plan, Life Cycle Support Plan, Technology Maturity Assessment (TMA)/ Technology Readiness, Spectrum Supportability Risk Assessment (SSRA)/Spectrum Supportability Preliminary Design Review (PDR), Spectrum Supportability Determination, Production Readiness Review (PRR) and Post-Critical Design Review (CDR) Assessment. In the Ground Combat Vehicle (GCV) program, use of pre-planned Knowledge Point reviews with senior leadership allowed for structured and iterative refinement of requirements. A structured requirements management plan allowed for collaboration with the User during the Capabilities Development Documentation (CDD) maturation. PM GCV conducted technical and operational analyses that developed the substantiating rationale for either verification of a given requirement or supporting rationale for changing the requirement. The development of a Whole System Trade Analysis decision support tool allowed for a structured methodology to complete a system level assessment of changes to requirements. Development of the performance specification within a structured requirements management environment helped with implementation of efficiencies. SE-Working-level Integrated Product Teams (WIPTs) allowed for maintaining regular engagement with OSD. The Requirement Compliance Matrix allowed for monthly assessments of contractor's performance against requirements and integration of these findings into the CDD maturation process.

The ranking of the proposed Stryker ECP improvements based on their relative increase to vehicle performance went well. This facilitated the identification and selection of those Size, Weight and Power – Cooling (SWAP-C) improvements that provided the greatest growth potential for Stryker upgrades in the future. In addition, the Work Task Analysis (WTA) process established by the PM Stryker Brigade Combat Team (SBCT) will regularly analyze task requirements relative to all phases of the life-cycle, enabling timely adjustments to personnel task assignments to better support the mission. Also, the Program Decision Board (PDB) process established by PM SBCT provides a twice monthly forum for PM, DPM, PdMs, and Directors to present, analyze and discuss significant matters requiring PM-level decision and direction.

The PEO for Intelligence, Electronic Warfare, and Sensors has several areas of systems engineering practices that are being implemented. The PM for Electronic Warfare (EW) is using development planning process for the Electronic Warfare Planning and Management Tool (EWPMT), a pre-Milestone B ACAT III program in FY12. The AoA was completed in April. The SEP has been written and is being staffed within the PEO for approval. The Multifunction Electronic Warfare (MFEW) system is a Pre-Milestone A program that is still having an AoA conducted. A functional Architecture has been developed. PM Air Survivability Equipment (ASE) is developing the Common Infrared Countermeasures (CIRCM) System, which the Systems Engineering team has conducted two (2) System Requirements Reviews (SRRs), July and August 2012 for the two (2) vendors participating in the CIRCM Technology Demonstration Program. In preparation for the System Requirements Review (SRR), conduct of the SRR, and following the SRR, PM CM System engineering accomplished the following tasks:

- Using the Integrated Product Teams (IPTs) approach, coordinated the entrance criteria with the contractors
- Reviewed and agreed upon the contractor's SRR entrance and exit criteria, formed an Independent Technical Review Board (TRB) to ensure entrance criteria were properly defined and exit criteria were met, and utilized/completed the DoD SRR Program Risk assessment checklist
- Reviewed and agreed upon the contractors SRR agenda
- During the SRR, referred to the DoD SRR Program Risk assessment checklist to ensure entrance criteria were properly and thoroughly addressed
- Following the SRR, ensured all critical Request for Actions (RFAs) were addressed and closed in a timely manner
- Following the SRR, updated the CIRCM Program Risk Assessment and performed a crosswalk of the contractors Prime Items Developmental Specifications (PIDS) to the Government's CIRCM system performance specification.
- Recommended to Product Manager the technical readiness of the contractors to proceed on to the next technical review

The PEO for Missiles and Space is working heavily on the Indirect Fire Protection Capability Increment 2 - Intercept (IFPC Inc 2-I) which is in the pre-Milestone A (MS A) phase. IFPC Inc 2-I is a ground-based weapon system transported by Army common mobile platforms and having an integrated set of capabilities designed to acquire, track, engage, and defeat rockets, artillery, and mortars (RAM) in flight. The IFPC Inc 2-I provides 360-degree protection against RAM with the ability to engage simultaneous threats arriving from different azimuths. The IFPC Inc 2-I consists of Interceptor / Launcher sub-systems, Fire Control Sensor (FCS) sub-systems, and Technical Fire Control Sub-systems to coordinate sensor / interceptor activities for execution of commanded engagement functions. It will integrate into the existing Integrated Air and Missile Defense (IAMD) architecture. IFPC Inc 2-I was selected as a pilot project for Model Based System Engineering (MBSE) in the PEO MS. The PEO MS Chief Engineer's office procured floating licenses for a software product called MagicDraw®, with sufficient licenses to conduct the initial pilot project and provide MBSE across the PEO MS. Due to the interdependencies of the programs having specific requirements within the Air and Missile Defense (AMD) Capability Description Document, the architecture tool will be used for ensuring interfaces are well defined and requirements are traced throughout the architecture. The MBSE team is supporting the IFPC Inc 2-I program as it prepares for MS A. Using an MBSE approach, the team collaboratively decomposed and allocated the functional requirements using Systems Modeling Language (SysML), laying out a methodology that clearly traces requirements to Use Cases and communicates those requirements to the potential bidders. The Test community is part of the pilot team and the Test

Verification Matrix and Specification are integrated in the model. The System Specification and Statement of Work were auto-generated from the model reducing the workload on the Requirements and Test teams. The model and the Dynamic Object-Oriented Requirements System (DOORS®) database are synchronized in a controlled fashion. Strong strides were made in understanding the practice of MBSE in support of the JCIDS process.

IFPC2-I has completed the MS A documents that includes the draft Systems Engineering Plan (SEP) and its supporting documents, the Configuration Management Plan (CMP), the Item Unique Identification (IUID) Plan, and the Risk Management Plan (RMP). MBSE tools were used to create and manage diagrams within these documents so that the plans and the model efforts remain in sync. We intend to be able to auto-generate the TEMP from the model. Two additional primary documents, the Technology Development Strategy (TDS) and Test and Evaluation Strategy (TES), and supporting documents for the TDS (e.g., Cooperative Opportunities, Consideration of Technology Issues, Market Research, and Technical Data Rights Strategy documents) were completed. A document staffing process was created to help track the development and staffing of this acquisition documentation for the MS A review.

During FY12, PEO Soldier stood up the Systems Integration Directorate within the PEO Headquarters. The primary mission of the Directorate is to "facilitate the development of external PEO Soldier capabilities that are fully integrated to meet the Soldier's changing mission requirements based upon the Soldier's operational role". Consisting of three Branches, the directorate integrates Science and Technology, Systems Engineering and Test Synchronization within one office. The directorate also supports internal audits to review the systems engineering practices, systems integration, testing and test synchronization, Soldier surveys, technology developments and quality assurance. Audits are conducted at Program and Product Manager level with their lead systems engineers.

JPEO JTRS transitioned to the Joint Tactical Networking Center on 1 October 2012. The Handheld Manpack Small Form Factor Program has transitioned to PEO Command, Control, Communication, Tactical (C3T) and the Manpack system is post MS C, in limited production and is conducting their Operational Test and Evaluation at the time of this report. The Ground Mobile Radio ACAT1 program transitioned to a new start program called the Mid-Tier Networking Vehicular Radio (MNVR). This new start will be moved forward as a Non-Developmental Item (NDI). The RFP has been released and as such the program is planned for entrance into the Acquisition system Post MS B. The Airborne Maritime/Fixed component of JPEO JTRS is pursuing a similar NDI approach to the MNVR radio and is also considered post MS B. During all phases of these programs, the acquisition organizations adhered to the Systems Analysis and Systems Engineering process as described in the JPEO JTRS Systems Engineering Plan Version 1.01, dated 16 March 2007.

Within PEO Combat Support and Combat Service Support (CS&CSS), the Joint Light Tactical Vehicles (JLTV) Joint Program Office (JPO) utilized the results of collaboration between the US Army Training and Doctrine Command (TRADOC) and the US Marine Corps Combat Development Command (MCCDC) to apply Knowledge Points (KPs) in the Technology Development phase to support deliberate requirements refinement of the CDD and subsequently the System Specification. They implemented a rigorous Systems Engineering approach using the DOORS® requirements management tool and established traceability between source requirements contained within the CDD and the System Specifications. Product Manager (PdM) FSS (Force Sustainment Systems, PM Force Projection) continued support for the Contingency Basing (CB) Development Planning effort and also for the Base Infrastructure (BI) Portfolio Design effort. The support included the areas of systems analysis and

engineering to include requirements analysis, functional decomposition, analysis planning, operational and system architecture development. Early partnering with the TRADOC during the Capability Based Assessment and portfolio design was and continues to be very beneficial. The BI portfolio and reference architecture effort was completed in FY12. Per OSD and ASA (ALT) guidance, PEO CS&CSS is preparing to implement the recently-approved OSD SEP template for all CS&CSS programs that have an upcoming milestone review. The PEO has used their own template for ACAT III programs to this point, but moving to the single template for all programs will establish consistency, particularly for the SEs who review and approve the documents. The new template also focuses on the essential components and information to streamline the document creation, review, and approval. This effort was started in late FY12 and will continue through 1QFY13.

FY 13 PEO / PM efforts

PEO AVN will continue teaming and collaboration efforts to develop structured guidelines and databases with AMRDEC Systems Engineering and PEO Missiles and Space. Additionally, each specific PEO AVN platform will continue their focus on system engineering developments specific to their current acquisition status. A few of their specific examples are as follows:

The Fixed Wing PMO has plans to fully implement DOORS for their requirements management process and expand DOORS capability for use as their full requirements traceability toolset. They are also exploring a Model Based Systems Engineering (MBSE) to use in conjunction with DOORS to help expedite requirements management and more easily enable standardization across their PMO. PEO AVN is taking action to make more use of the DoD Architectural Framework (DoDAF) process and DOORS to better coordinate program and technical issues and resolutions among their users, developers and stakeholders. PM Utility Helicopter has recently formed a Futures IPT. The purpose of this team is to provide dedicated Systems Engineering personnel to conduct system level analysis, evaluations and studies of emerging requirements and issues. The Futures team will utilize established SE best practices to analyze impacts of new requirements on the UH-60 platform and develop initial program concepts, acquisition strategies, integrated schedules, risk assessments and budgetary estimates for these emerging requirements. The team will then develop and provide documented analyses which will be utilized by PM leadership to make informed decisions and to provide improved visibility into future program resourcing requirements.

PEO Ground Combat Systems has developed improved risk management tools to allow for the ability to manage issues and opportunities as well as risk. This tool is available for use across all PEO GCS programs. The PEO GCS SEP development portal site is now fully operational and will be used for all new SEPs and their associated activities. In particular, a SEP template, supporting job aids, and SOPs (such as Requirements Management and Risk Management) have been developed that will be used to improve the overall SE process. PEO GCS will continue to look for integration of MS B documentation content across multiple MS B documents to ensure consistency, synchronization and opportunities for efficiencies in developing these documents that often require the same information. The PEO will develop a more formalized process for Logistics to influence the design phase early in the life cycle. The PEO will also complete a Cost Benefit Analysis on several program options to establish which approach provides the greatest payoff in performance and growth potential for the given cost constraints.

For PM Aircraft Survivability Equipment (ASE), the technology readiness level (TRL) 6 is a requirement for exiting the Technology Demonstration (TD) Phase as well the entrance criteria for Engineering Manufacturing and Demonstration (EMD) phase, Milestone (MS) B. PdM Countermeasures

(CM) system engineering, in coordination with Deputy Assistant Secretary of the Army, Research and Technology (DASA(R&T)) and the Assistant Secretary of Defense for Research and Engineering (ASD(R&E) have established a Technical Readiness Assessment (TRA) plan. This includes a schedule of maturity testing events to mature each contractors identified Critical Technology Enablers (CTEs) to a TRL 6 prior to MS B.

PEO MS and the IFPC Inc 2-I MBSE team will be working with the MagicDraw® vendor and the Architecture and Systems Engineering communities of interest to determine best practices in managing the tools and interfaces and measuring the process. They also plan to ramp-up efforts to provide SysML and Unified Profile for Department of Defense Architecture Framework training to the PEO MS SE workforce, to contribute to "Building the SE Bench". Technical Evaluation training will be provided for the IFPC Inc 2-I competing contracts that will be awarded to develop prototypes for a "fly off" to demonstrate technology maturity and support Milestone B. Standing up a System Integration Lab will include hardware/software/modeling and simulation to support contracting efforts (including source selection) and the Material Development Phase.

The Technical Directorate organizational entity of the Joint Tactical Networking Center (JTNC) provides Service Acquisition Executives, DoD CIO, and Services risk reduction support, when requested, in the form of joint tactical networking waveform conformance verification and validation. This assessment function directly supports a key tenet of the JTNC mission: "… provide secure Joint Tactical Networking applications, capable of operating in a variety of hardware transport solutions, for PoRs and commercial radios …". Designation of Joint Tactical Networking-capable Software Defined Radios (SDRs) "Compliant or Certified" is defined below.

- "Compliance" can be used as a prerequisite for participation in a Service-level network integration and evaluation test event for SDRs executing, at a minimum, one of the following waveforms: SRW, WNW, MUOS, and JTRS Link-16. This designation could represent Government verification of basic performance and interoperability with other SDRs executing SRW, WNW, MUOS, and JTRS Link-16 and provides the Services a risk assessment based upon performance, interoperability and waveform conformance testing.

- "Certification" can be used as a prerequisite for procurement by the DoD and other agencies of SDRs executing, at a minimum, one of the following: SRW, WNW, MUOS, and JTRS Link-16. This designation could represent Government verification of adherence to government standards for security, interoperability, waveform performance, and code portability.

1.3 Reliability, Availability, Maintainability, and Sustainability as an Integral Part of Design and Development

One of the key things Army is emphasizing in this area is the need for all Army Program Offices to utilize Reliability, Availability, and Maintainability (RAM) best practices, tools, collect necessary metrics and tapping into the Army's Reliability competency centers to effectively execute the reliability programs

To improve reliability for materiel systems, the Army's Office of the Chief Systems Engineer (OCSE) has initiated a senior level Reliability Improvement Working Group consisting of Training & Doctrine Command (TRADOC), Army Evaluation Center (AEC), Army Materiel Systems Analysis Activity (AMSAA), Program Executive Office (PEO), and Research, Development, and Engineering Centers

(RDECs) to evaluate five (5) recent systems with reliability concerns. The team is focused on: 1) Performing detailed assessment of RAM efforts throughout the acquisition life cycle for the programs identified; 2) Collecting Lessons Learned; 3)Determining systemic root causes for the reliability issues; 4) Coordinating support for the necessary gaps; and 5)Recommending solutions to leadership.

The Army is committed to enhancing RAM in the acquisition process by implementing and revising policy to include Army Materiel Systems Reliability, Availability, and Maintainability regulation (AR 702-3). This regulation incorporates design for R&M, reliability planning methods and reporting requirements timed to key acquisition activities to monitor reliability growth, early Engineering and Manufacturing Development (EMD) reliability test threshold, early engineering-based reliability program reviews, and operational requirements development. AR 702-3 is in its final draft. It is scheduled for worldwide staffing in March 2013 and final publication by the end of CY 2013.

A consequence of Acquisition Reform in the mid 1990s was the fragmentation of the reliability, availability, and maintainability (RAM) community across the Army. The Army is energizing the RAM community by establishing Senior Level forum for Army R&M managers to meet at least annually. The first forum was held Aug 2012 with Aviation & Missile Research, Development and Engineering Center (AMRDEC), Communication & Electronics Research, Development and Engineering Center (CERDEC), Armament Research, Development and Engineering Center (ARDEC), Tank & Automotive Research, Development and Engineering Center (TARDEC), Army Logistics Leadership Center, AMSAA, AEC, ASA (ALT) OSCE, ASA (ALT) AP&L, and OSD (SE). The objectives of the meeting were to identify the Army R&M managers, improve communication between organizations, enable collaboration, identify R&M resource constraints (personnel, training, analysis tools), and discuss implications of Army & OSD R&M policy to include drafting of AR 702-3 and OSD DTM 11-003. To continually improve weapon system reliability, the Army has several other venues to discuss policy, reliability and maintainability tools, acquisition language, training / workforce development, and recruitment. These venues include:

1) Army R&D Centers, AEC, and AMSAA holding reliability workshops such as the reliability and maintainability technical interchange hosted by TARDEC.

2) AMSAA and AEC under the joint-partnership of the Center for Reliability Growth (CRG) conducted reliability training classes across the Army and DoD. Training emphasizes the latest reliability policies, tools, advancements, and lessons learned across DoD and industry and their implementation under the guidance of OSD DTM 11-003 and the ASA (ALT) Reliability Policy. The classes include hands-on exercises using the AMSAA Reliability Scorecard and reliability growth planning and assessment methodologies. The training also provides attendees an opportunity to bring their lessons learned and potential reliability pitfalls to a larger forum for discussion, immediate feedback, and guidance. FY12 training included: TARDEC; ARDEC; Joint Light Tactical Vehicle Program Office; PEO Intelligence Electronic Warfare and Sensors; and PEO Command Control Communications-Tactical. In addition to the Army specific training, the CRG has conducted sessions for the following DoD organizations: Director, Operational Test and Evaluation; Deputy Assistant Secretary of Defense for Developmental Test and Evaluation; Joint Project Manager for Protection; the Air Force Operational Test and Evaluation Command; Commander Operational Test & Evaluation Force; the Armament Directorate at Eglin Air Force Base; the Navy Multiband Terminal Program Office; PEO Subs; and the Submarine Integration Program Office.

3) Society of Reliability Engineers-Huntsville Chapter sponsored reliability, maintainability, and conditioned maintenance workshop that had participation across the Army, industry and academia, reliability and maintainability systems engineering technical community.

Several Army reliability and maintainability organizations are recognized within the technical community for their expertise. For instance, AMSAA continues to be recognized as the leader in reliability growth modeling, and AMSAA and AEC have partnered to form the Army's Center for Reliability Growth (CRG). The CRG works towards improving reliability by providing policy, guidance, standards, methods, tools, and training. Specifically in FY12, the CRG:

1) Developed an approach for applying condition based maintenance data from actual fielded systems to enhance current systems' Operational Mode Summary/Mission Profile (OMS/MP) values. The OMS/MP values drive many programmatic and test decisions. Enhanced OMS/MPs will promote test and acquisition efficiencies.

2) Provided cost and risk assessment tools for use in analysis of alternatives (AoA). Use of appropriate tools that exists today can provide managers with a more complete understanding of the impact of reliability on the technical, schedule, and cost risks for their programs. The CRG and the Center for Army Acquisition and Materiel lessons Learned (CAAMLL) are strongly engaged to make this happen.

3) Emphasized early influence on design through the use of Design for Reliability (DfR). Early use of DfR tools, such as modeling and simulation (M&S) and physics of failure, influences efficient acquisition. Utilizing DfR tools early in system design can optimize the reliability of the system without a significant increase to design costs. The initial investment in these tools can save significant cost and schedule during testing and production and sustainment.

4) Developed a software specific reliability scorecard and expanded the use of the general version. Both scorecards use a structured engineering and analytical approach to identify weak performers and risk early in program development (even before any test data is available) and can be used throughout the life-cycle of the system.

5) Continued development of advanced reliability methodologies. The advanced methodologies are influenced by lessons learned and the evolving acquisition process. The model framework allows for test efficiencies by developing reliability estimates using current test data, supplemented with other information sources such as historical data, M&S, and component/subsystem data.

6) Continued the distribution of reliability models across the DoD and major defense contractors. Over 500 model requests have been processed.

7) Developed reliability contract language designed to help Program Managers step through key contract elements for reliability. The language ensures that the Program Manager gets the information they need and establishes the framework for the reliability program.

AMRDEC provides reliability expertise to multiple government agencies, such as, support to the Missile Defense Agency developing R&M policy and lessons learned. AMRDEC, AEC, and AMSAA are key members in the joint services reliability and maintainability team with OSD SE in shaping reliability and

maintainability policy throughout the acquisition life cycle. As part of this effort, a Defense Acquisition Guide is under development to address reliability and maintainability Analysis, Planning, Tracking, and Reporting for Major Defense Acquisition Programs. The Army's plan is to continue improving the existing workforce through reliability and maintainability mentoring, partnering with academia, working closely with Department of Energy National Labs and Joint Services, and through specialized DAU training.

The Army PEOs have integrated R&M principles into major development/acquisition programs.

1) PEO Aviation has established practices to assess and implement RAM corrective actions which generate cost avoidance. The Program Manager Aviation Systems completed a reliability improvement project with a cost avoidance of $1.6M in life cycle cost. The Utility Helicopters Project Office (UHPO) H-60M has monthly fleet management reliability and sustainment IPTs which examine "Top Cost" driver from multiple data sources. Value Engineering is performed utilizing multi-disciplined teams that analyze the failures and develop alternatives. A business case is developed to pursue funding. The project lead develops an IPT that includes the OEM, and then the part is qualified and fielded.

2) The PM for Aviation Systems, for the Mobile Tower System (MOTS) is requiring RAM data to be collected into a database for analysis. This data will be analyzed and a scoring matrix will be developed for future RAM info. RAM will be addressed thoroughly during the development of the requirement package for the MOTS Full Rate Production contract. A MOTS Risk Management Plan is in development. Risks and mitigation plans are presented by the contractor at PMRs and are monitored by the MOTS Team at bi-weekly meetings.

3) Additionally, PEO Ammunition's Excalibur Ib program implemented a RAM program IAW DoD Instruction 5000.02 and Directive-Type Memorandum (DTM) 11-003. The Excalibur Ib system reliability model accounts for the expected operational life of the Excalibur projectile which includes 18 years of controlled storage, 2 years of uncontrolled storage, cannon launch and flight operations. The model was used to predict both storage and operational reliability. Additionally, the Excalibur Ib Reliability Growth Curve was generated by the Excalibur Reliability Working Group. Primary considerations of the reliability growth curve are the initial value and reliability drop when item transitions from development to large scale production. Currently, Excalibur Ib is tracking to the reliability growth curve after more than 20 flights.

4) The PEO Missiles and Space continues to integrate RAM practices into all managed programs. Indirect Fire Protection Capability Program is incorporating RAM into all required Milestone A documentation. This includes RAM-C, System Engineering Plans, Test Evaluation Strategy, and contractual language. All project office managed programs have an ongoing RAM program that appropriately corresponds to the weapons system's life cycle phase. The project offices apply a tailored set of contract language for RAM based on the weapons system's acquisition phase, whether development or production. All project office programs have an ongoing Failure Reporting, Analysis, and Corrective Action System (FRACAS) to include in their Contractor Logistics Support contracts.

5) The Army continues to institutionalize the culture of innovation and continuous improvement of Design for Lean Six Sigma (DFLSS) to assure reliability engineering is an integrated approach to design, systems, and supportability engineering. For example, ARDEC & PEO-Ammunition have

successfully developed/taught/applied the DFLSS approach to several projects (e.g., Development of Design for Reliability Process for Common Controller, Establishing & Integrating Software Reliability Best Practices into Army Software Acquisition Programs, etc) to improve reliability, cost, schedule, and risk for the armaments and munitions.

6) PEO Ground Combat Systems initiated an effort to install 300 data loggers on deployed Stryker vehicles that will collect a variety of vehicle performance data to provide a basis for developing improved diagnostics and prognostics. The monthly Stryker Fleet Level Management - Senior Resource Acquisition Board is a joint PM and contractor IPT that examines Stryker readiness drivers through the use of a formula based on parts consumption, cost of the part, cost to repair the part, criticality of the part, time it takes to replace the part, time it takes to repair the part, to focus PM resources on highest pay-back activities. Improvements vary from parts re-design, augmented training, improved publications, and addition of special tools.

7) Also, PEO Ground Combat Systems has experienced RAM performance challenges on the Paladin Integrated Management (PIM) program due to Force Protection and Survivability requirement changes directed by the December 2011 Capability Production Document (CPD) and the underbelly kit memo from the Defense Acquisition Executive (DAE) in August 2012. In order to improve RAM performance the program used a reliability contract incentive to keep the enterprise focused on quality and reliability while managing the modifications necessary to meet the CPD and DAE memo requirements. The contract contains a minimum reliability threshold requirement for the contractor to meet as well as an objective, or desired reliability requirement. The incentive is scored at defined program milestones. The incentive is earned on an increasing linear scale, where the incentive earned increases as the reliability performance achieved is closer to the objective requirement.

8) PM Ground Combat Vehicle has implemented RAM practices IAW OSD Sample Reliability Language for DOD Acquisitions and emphasizes design for reliability (DfR) best practices as well as specific software reliability scope. Knowledge Point reviews have been implemented with Army leadership, and GCV has refined the RAM requirements to a more practical and feasible requirement set for MS-B, based on detailed analysis of Bradley M2A3 reliability performance data and the early analysis conducted by their two competitive TD contractors. The GVC RAM-C Report is in progress and will be documented in the GCV TEMP, SEP and Life Cycle Support Plan for MS-B. Drafts of these documents will begin staffing in December of 2012. PM GCV keeps primary RAM stakeholders apprised of RAM issues and activities in a monthly RAM WIPT Telecon, as a sub-group to the GCV T&E WIPT. PM GCV RAM personnel dialog at least weekly with the contractor RAM personnel to assure RAM design influences are being incorporated into the system architecture.

9) Under the ECP Improvement contract, plans are to require the prime contractor to continue to follow and implement the Stryker Systems Engineering Plan throughout the execution of the program. This will also require that the contractor meet all the performance requirements defined in the Stryker performance specification to include RAM. PM SBCT incorporated a Contract Deliverables Requirements List (CDRL) to formalize the Obsolescence Management and Excess Management of parts. This will reduce the warehousing footprint, reduce cost, and improve operation reaction time.

10) The GCV SOWs for both TD and EMD require that RAM be an integral part of the System Engineering process. The TD contractors were briefed at the Start of Work meetings on the Government Reliability Growth Strategy, so they were keenly aware of the reliability goals for compliance with 80% confidence, and would build their TD RAM program such that it would facilitate achievement of those goals in EMD and beyond. RAM requirements have always been and continue to be part of the performance spec. Also, the EMD RFP will also include the EMD early Threshold value for reliability, as required by ASA (ALT). PM-GCV is including the SEP with the RFP and asking the contractors to develop a SEMP based on that SEP.

11) Within PEO CS&CSS, JPO JLTV established a RAM IPT early in the acquisition cycle and maintained the IPT throughout FY12 in developing the RAM program strategy. A close partnership with all stakeholders ensured coordination and communication of program plans and facilitated resolution of concerns across the RAM community. The IPT helped to inform the requirements development process and provided valuable input into reducing the CDD reliability requirement to an achievable value that was in line with what was demonstrated during the TD phase. The IPT ensured the statement of work included RAM best practices and the incorporation of lessons learned. The IPT further helped in the refinement of the JLTV reliability growth plan which resulted in acceptance from the RAM community and ultimately OSD. Input from the RAM IPT was used to feed development of the JLTV Reliability, Availability, Maintainability–Cost (RAM-C) report, which received OSD recognition and is being used as a template for other programs entering the Acquisition cycle. PdM Bridging has incorporated a mandatory requirement for Reliability Scorecard in both Bridge Erection Boat and Joint Assault Bridge for EMD phases.

The US Army Materiel Command is exploring a concept, in cooperation with ASA (ALT), RDECOM, and AMSAA, called “Invest for Reliability”. The intent of this effort is to validate the feasibility of developing a program which would provide seed money to “forward fund” total ownership cost improvement initiatives, the majority of proceeds going to general budgetary relief, and a portion of the proceeds used for reinvesting in the program.

The Army will continue to improve the R&M system requirements generation process via technical interchange and policy/regulations with the Materiel Developer, Independent Tester/Evaluator, and User. The TRADOC (User) role is critical to the success of system acquisition in ensure viable /attainable system requirements. The R&M workforce stability and growth may be constrained by future budgets; however, the Army will evaluate its workforce structure to ensure critical R&M requirements are met.

The Army process to assess the strength of the current R&M workforce is multi-fold: 1) Define core competencies of an Army civilian R&M engineer; and 2) Survey PEOs, RDECs, AMSAA, AEC, and TRADOC for current Army civilian R&M strength and competencies levels. The Army will continue the R&M civilian workforce analysis by having R&M Managers: 1) Evaluate and determine R&M civilian personnel requirements (strength & competencies) by ACAT programs; 2) Evaluate system issues versus R&M personnel requirements; and 3) Perform gap analysis and path forward.

The Army has recognized the R&M engineering shortfall and the need to retain, recruit, and train R&M engineers. The Army continues to pursue consortiums with universities that have R&M focused curriculums in order to gain access to the universities’ top reliability and maintainability engineering graduates, while competing with industry. For example, AMRDEC joined consortiums with

University of Tennessee-Knoxville and Auburn University in Alabama to evaluate/recruit potential R&M engineers. The University of Alabama Huntsville has recently added a master's degree in reliability engineering to meet demand of the Huntsville technical community including the Army. In addition to partnership with other universities, ARDEC has teamed up with the Naval Postgraduate School (NPS) on the distance learning program for system engineering focused reliability engineering. Several reliability engineers have successfully received the MS degree from the NPS.

In 2012, the DoD, with Army as the lead organization, graduated the first Specialty Engineering Education & Training (SE2T) pilot class in Huntsville, Alabama. Those graduates are pursuing a one (1) year masters program from Auburn University. The program is two (2) years and provides extensive reliability and maintainability training for new engineers. The second SE2T class started in Aug 2012, with the Army and Missile Defense Agency (MDA) enrolling students. This program is being integrated throughout the Army and in the future through DoD.

The Army currently has RAM engineers who are actually coded as logistics acquisition employees rather than SE. The Army includes introductory RAM classes in the Career Program (CP) 16 (engineering) as recommended training for all engineers in the Army regardless of acquisition or non-acquisition coding. The Army CP will consider re-coding the RAM engineers from logistics to SE occupational series. This will entail becoming certified in the SE acquisition career field with a timeline of 24 months.

1.4 – Systems Engineering Requirements During the JCIDS Process and in Contract Requirements for each MDAP

ASA (ALT) Office of the Chief Systems Engineer (OCSE) sponsored the formulation of an Integrated Requirements Framework (IRF) to enable collaborative development and management of System of Systems (SoS) requirements across the entire Army community. The hierarchy, built upon IBM's Dynamic Object-Oriented Requirements System (DOORS) toolset, is based upon the current TRADOC and ASA (ALT) organizational structures. This hierarchy facilitates a particular requirements developer (i.e. TRADOC Capability Manager (TCM), Program Manager (PM)) to maintain control over their requirements data, yet build traceability to other requirements or information within the environment. The Army IRF was populated with approved requirements documentation pertinent to the COE Computing Environments (CEs), which will enable thorough traceability analysis as CE requirements are decomposed by the Program Executive Office (PEO) teams, in accordance with the COE Directive signed by ASA (ALT) on 20 December 2011. The Army IRF structure allows the Army Capstone Concept document, Army Operational Concept document, Army Functional Concepts documents, Required Capabilities, Capability Based Assessments (CBAs), JCIDS Operational Requirements, and System Performance Specifications to be integrated into one environment. Processes and governance surrounding the Army IRF will be solidified during FY13 to support TRADOC in the development of JCIDS documents that address System of Systems engineering requirements.

Across the PEOs standard language has been developed for inserting SE requirements into weapon systems' contracts. That is currently implemented at the product center level, based on their unique requirements and specific needs.

All contract development efforts within PEO AVN have a section that addresses specific system engineering tasks such as metrics reporting, technical reviews, configuration management baselines,

requirements development and traceability, risk assessment and SE documents development. Systems engineering principles are applied in varying measures and methods depending on lifecycle of the program, scope, level of effort, etc. The following are the specific examples provided by PEO AVN for incorporating system engineering requirements into contracting requirements:

The Tactical Terminal Control System (TTCS) is currently working on a development item with the Aviation and Missile Command (AMCOM) Prototype Integration Facility. TTCS Analysis of Alternatives (AoA) is a textbook example of taking system requirements and constraints inputs through the system engineering process to a design prototype output. It included every aspect of engineering, logistics and Soldiers' needs from concept to implementation. It will greatly increase RAM for the TTCS.

Program Manager for Cargo Helicopters incorporates systems engineering requirements into Cargo contract requirement packages (CRPs). The CH-47F Performance Specification is the foundation for all development efforts, establishing aircraft level performance requirements. Additionally, each development effort is required to follow a structured systems engineering process, flowing down performance requirements into lower level detail requirements. Each contractor is required to conduct system requirements reviews, design reviews, technical interchange reviews, safety of flight reviews, and test readiness reviews, among others, to ensure system design satisfies requirements. The CH-47F performance specification includes RAM requirements to ensure RAM is addressed in system design. Additionally, Cargo CRPs include requirements for Level of Repair Analyses (LORA), Maintenance Allocation Chart (MAC), Spares Analysis, and O&S Cost Modeling. Additionally, PM Cargo has continued to work with the prime contractors to strengthen the requirements across all of our contracts in the areas of configuration management and obsolescence. TopVue integrated data environment has been integrated into our contract CDRLs as the delivery point. This yields a single repository for program information and data making the systems engineering process more efficient through a single source of information with the latest documentation.

The Gray Eagle program has several concurrent contracts (System Development & Demonstration (SDD), Engineering Service, and Performance Based Logistics (PBL)) which each include systems engineering and RAM requirements. Specific examples are below:

1) System Development & Demonstration (SDD) Contract:
    - Reliability & Maintainability (R&M) Allocations: Allocation of System requirements to each subsystem.
2) Performance Based Logistics (PBL) Contract:
    - The contractor is monetarily incentivized for fielded assets to show reliability performance, regarding the Ground Control Equipment (GCE) subsystem, above its threshold requirement.
3) Sub-Engineering Service Memorandum (SESM): Non-recurring effort to generate these recurring process improvements.
    - Reliability Block Diagrams (RBDs): Purpose is to show concise visual shorthand of the various series-parallel block combinations or paths that result in system success. It's a tool used to model the reliability of complex system design based on network relationships, system redundancies, and reliability predictions.
    - Feed Failure Review and Corrective Action System (FRACAS) field data into Failure Modes, Effects, and Criticality Analysis (FMECA) analytical data to increase precision.
    - FRACAS and Failure Review Board (FRB) will include hardware & software (HW/SW) failures rather than just hardware alone.

- Establish Relex (analysis software) as the Central database repository for all failures/issues, both HW/SW, serving as a location for delineating each subsystem failures, frequency, root causes, corrective actions, fix effectiveness, etc. This will allow a filtering capability (i.e. Mission Critical, Flight Safety ~ "single point failures", Long Lead, Cost Drivers, Fix Effectiveness, etc.) so the PM Office can identify and target priority trouble spots to make better decisions in allocating its resources considering the standard program office schedule demands and cost constraints.

The Utility Helicopter Program Office H-60M Multi-Year 8 contract incorporated an R&M IPT and a Failure Reporting, Analysis and Corrective Action System (FRACAS) RAM requirement. The Multi-year 8 contract also includes dedicated effort to manage obsolescence on the UH-60M platform. The UHPO is actively working to maintain real-time dynamic interchange of requirements documentation via DOORS database with its OEM.

For FY12, even though it was not a Project Director (PD) COMSEC contract, PD COMSEC working with the rest of the Army team (CIO G6, CERDEC, and CSLA) provided input to the NSA PM for improvements in the Key Management Infrastructure (KMI) program, including RAM improvements. These suggested changes were observed over numerous test events and hand on experience.

WIN-T Inc 3 ensured that numerous System Engineering tasks were included in the Statement of Work (SOW) for the Follow on EMD contract, to be awarded in FY13. This included description of system engineering processes for configuration management, Software development criteria, and requirements traceability. It also included significant tasks for RAM analysis, including FMECA, Condition-Based Maintenance Plus (CBM+) and Supply Chain Management.

PM NV/RSTA and subordinate organizations placed language into the TPQ-53 (Enhanced EQ-36) Counterfire Radar Full Rate Production contract RFP for submission of contactor systems engineering in the areas of SE management plan and traceability. This ensured several CDRLs for contractor SE deliverables, including traceability and technical reviews were in the proposal. This effort was identified as a factor which may have led to the program being recognized as one of the top five DoD programs for SE in FY12.

PM DCGS-A use of allowed current standards and Data Item Descriptions (DIDs) as found on Acquisition Streamlining and Standardization Information System (ASSIST) for contract performance and daily Government work. This is based upon the International Electrical and Electronics Engineers (IEEE) adoption of ISO 12207 series of standards and the Information Processing Standards for Computers (IPSC) series of data items for information technology. Hardware is predominately Commercial Off-The-Shelf) COTS and the standard RAM associated with pure commodity COTS (home and office use), not as weapon, aircraft or automotive system parameters.

The PEO Missiles and Space Chief Engineer is the standards executive for Contracts Requirements Packages (CRPs) PEO MS-wide. All CRPs are reviewed and approved by the Chief Engineer, ensuring compliance to SE and RAM requirements. The PEO MS project offices apply a tailored set of contract language for SE requirements, including RAM, based on the weapons system's acquisition phase, whether in development or production.

Under PEO Missiles and Space, the Sentinel program SE requirements are built into all contracts, Statements of Work (SOW), and the Sentinel System Performance Specification. For STINGER, SE

requirements, including RAM and program review entrance/exit criteria, have been built into the SOWs for the STINGER Proximity Fuse and for STINGER Foreign Military Sales (FMS) production. For IFPC Inc 2-I, the system Specification identifies RAM requirements, along with the rest of the system performance requirements. The SOW has an entire section dedicated to RAM program to include Reliability Growth. In the IAMD PO, detailed Entry/Exit Criteria for the Army IAMD Critical Design Review (CDR) were defined by IAMD SE (in accordance with the Defense Acquisition Guidebook (DAG)), negotiated with both prime contractors (i.e., Northrop Grumman and Raytheon), and agreed-to by all stakeholders prior to the review. The SOWs required that both prime contractors support the IAMD Interface Control Working Group (ICWG) and its sub-Working Groups to mature the Plug and Fight (P&F) B-Kit to A-Kit Interface Control Document (ICD) and the IBCS-External ICD. The IAMD Program has implemented DoD Earned Value Management (EVM) requirements on applicable contracts, subcontracts, and other agreements as prescribed in DoDI 5000.02, the DAG, and the Earned Value Management Implementation Guide (EVMIG). SE is integrated into the EVMS by including all systems engineering tasks, all Contractor Data Requirements List (CDRL) deliverables, and all technical reviews in the schedule and work packages. Reviews are not considered complete until exit criteria are met. The use of percent complete is discouraged and measurable objectives are used to determine task completion. Technical Performance Measures are agreed to by the government and prime contractors and integrated into the EVMS to ensure linkage between engineering and cost considerations in program management decisions. The SOWs required both IAMD PO prime contractors conduct component-level CDRs prior to the IAMD system-level CDR. These "feeder" reviews proved invaluable as this data acting as "building blocks" in helping lay the foundation for the overall Army IAMD System of Systems (SoS) review. Detailed IAMD SoS RAM contract requirements have been appropriately defined; fulfillment by the contractors of their RAM requirements will result in all IAMD CDD requirements for RAM being successfully met. Furthermore, the SOWs required that both prime contractors implement a Reliability Development/Growth Test (RDGT) program.

In the Joint Attack Munitions Systems Project Office (JAMS PO), the Joint Air to Ground Missile (JAGM) request for proposal (RFP) included requirements for the contractor to develop and implement a Systems Engineering Management Plan (SEMP) for all SE requirements, including RAM, as follows: use the DOORS® requirements management program to develop and maintain requirements decomposition, allocation, flow-down rationale, and traceability of specification requirements; conduct technical reviews in accordance with specified entry and exit criteria; integrate Technical Performance Measures with the risk management program; develop and implement a reliability program plan to ensure that RAM is incorporated into all aspects of product design and that the design includes specific features that enhance the ease of performing maintenance; develop reliability models, predictions, and supporting data to demonstrate specification reliability requirements; and conduct reliability analyses and tests including fault tree analysis; failure modes, effects, and criticality analysis; and environmental stress screening/highly accelerated stress screening. The JAGM program also implemented a risk management program, led by the Government with contractor participation.

JPEO-CBD programs incorporate many systems engineering requirements into their contracts. These include: support to technical reviews including briefings and supporting documentation; technical related documentation, such as Corrosion Prevention and Control Plan, and technical baselines; Configuration Management; and Risk Management.

The Joint Tactical Networking Center generated a MUOS E2E Capability Test Strategy document completed by MUOS RIL and NED in conjunction with PMW-146 and HMS. The E2E Strategy outlines the number, type, location, and timing of test assets and the targeted software builds, as well as the core

E2E functionality for evaluation during the risk reduction periods. The E2E Test Strategy will be used to formulate contracting requirements passed down to the vendors hired by the government to support this initiative.

JLTV's EMD contract includes specific RAM requirements in the PD and SOW. The JPO derived the RAM requirements directly from the user's CDD requirements. These requirements include reliability (MMBHMF and MMBEFF), Operational Availability, maintenance ratio, mean time to repair, and maximum time to repair. The PD reliability requirement accounts for an 80% confidence interval and includes a 10% degradation factor between Developmental Test (DT) and Operational Test (OT) to ensure the contractor's hardware and software are robust enough to meet user's requirements with high statistical confidence in an OT environment. This contractual language includes requirements for implementation of a formal RAM program. The Bridging team is often the first within PEO CS&CSS to find ways to incorporate SE activities into contracts. Some examples of "firsts" are the requirement to deliver early "developmental drawings" at PDR and CDR, the requirement for contractors to complete a reliability scorecard self-assessment to assist AMSAA in completing their assessment, and incorporating both Government- and contractor-format TDPs into a contract as options.

1.5 Service-Specific Identified Area(s) of Progress and Improvement

<u>FY12 FOCUS AREA</u> – Establishing Processes and Tools to help address our SoS Integration challenge

ASA (ALT) OCSE under the direction of the AAE in FY 12 updated the Common Operating Environment (COE) Implementation plan to ensure clarity and consistency; this provides guidance to government and industry partners in order to standardize end-user environments and software development kits. It also established streamlined enterprise software development processes that rely on common, pre-certified, reusable software components and deployment strategies that give users direct access to new capabilities. OCSE appointed COE Computing Environment (CE) leads for six CEs, including the Data Center/Cloud/Generating Force, Command Post, Mobile/Handheld, Mounted, Real-Time/Safety-Critical/Embedded, and Sensors. The CE leads have developed CE Execution Plans for each of their respective CEs, including details for CE scope, requirements, ecosystem development, cost, schedule and risk. CE Working Groups (WG) have also been established for each CE. Control Point Specifications for each interface between the CEs have been drafted and will be completed in FY13. The CEs have also completed their initial integrated System Engineering Plans, Resource Management Plans, Life Cycle Management Plans, Configuration Management Plans, and Integrated Master Schedules. These will be refined in FY13.

ASA (ALT) has completed the COE integrated System Engineering Plan v1.0 which includes details for COE program requirements, technical staffing and organizational planning, technical baseline management, technical review planning, and integration of SE with overall program management. OCSE has drafted the Army Common Operating Environment (COE) Policy to replace the Army Software Blocking Policy, to be completed in FY13. The Army COE Policy codifies the COE governance and the roles and responsibilities required to align COE Baselines with the ARFORGEN fielding cycles. As codified, the COE Baseline infrastructures are updated every two years. The Army COE Policy describes how the COE Baseline process aligns with the SE "V" mapping, which includes Requirements Analysis, Architecture Trades/Analysis, SoS Engineering, SoS Implementation, SoS Integration-Lab/Field, Fielding/Support, and Sustainment.

ASA (ALT) has defined a COE Technical Roadmap that provides a mapping the COE Baselines v1.0 through v4.0 over the FY12 through FY18 timeframe, with objectives for Network Transport, Hardware/Devices, Software Development Infrastructure (including Operating System, Software Development Kits, and Background Services), Cross-Cutting Capabilities, and End-User Applications. Complimentary to the technical roadmap, ASA (ALT) has defined an Integrated Master Schedule for COE Baselines v1.0 through v3.0 to coordinate ARFORGEN, POMs, NIE Planning/Execution, I2E/AIC, and COE Governance activities and reviews. For COE governance, ASA (ALT) has chartered the Technical Advisory Board (TAB) which has been executing and coordinating between the CE WGs and the System of System (SoS) General Officer Steering Committee. The TAB has approved six Cross-Cutting Capabilities in order to implement common operational capabilities across the CEs, including Assured Position, Navigation, and Time (PNT), Common Overlay, Common Authentication, Information Assurance (IA) - Public Key Infrastructure (PKI), Database Synchronization, and Single Geospatial Foundation.

Per the Common Operating Environment (COE) Directive for Program Executive Offices (PEOs), signed by the ASA (ALT) on 20 December 2011, the Platform Integration & Analysis (PIA) Integrated Product Team (IPT) was initiated to ensure that Size, Weight and Power–Cost (SWaP-C) platform constraints are adequately addressed, applicable standards are adhered to, and Computing Environment (CE) hardware selections is performed through a collaborative process between the CE leads, PEOs, and Product Managers (PM). The PIA-IPT assists in developing new policies, processes, and tools and coordinates them across Programs of Record (POR) to ensure integration constraints, issues for platform and CE-supportable solutions, and all remaining issues are properly vetted and adjudicated.

The ASA (ALT) Office of the Chief System Engineer (OCSE), Architecture Analysis Directorate (A&AD) produced the first version of the Integrated Architecture Framework (IAF) for the Common Operating Environment (COE) community. The IAF was evolved through the OCSE Applications and Services Integrated Product Team (IPT). IAF products support key Army decisions such as the G 3/5/7 Agile process, Unit Set Fielding, Army Interoperability Certification, and Capability Set Fielding. The IAF hosts information on Cross Cutting Capabilities (CCC), Software Development Infrastructures (SDI), and Computing Environment (CE) architectures and enables OCSE to synchronize efforts, enable analysis & trades, and deliver timely relevant information to decision makers.

The Army has adopted the network integration "Agile Process" resulting in the ability to effectively assess and acquire solutions for the network. This process provides a holistic and integrated approach for the acquisition, testing, evaluation, and fielding of capability solutions across the Army's range of operations. The Agile Process has created efficiencies through the minimization of steps, tasks, work, and problems that arise as a result of rapidly changing requirements due to speed of war, pace of information technology development, and changes in the Army Force Structure. The seven-phased Agile Process is an effort to procure critical capabilities more rapidly, while ensuring technical maturity and integration, and reducing the integration burden from deployed units and Soldiers.

The Agile Process consists of seven phases grouped in three basic areas. Phases 0 and I focus on identifying requirements and potential solutions. These phases are continuous in nature and react to external changes from ongoing operations, advances in information technology and traditional analysis the Army conducts to modernize the force for the future. Phases II through V of the Agile Process focus on assessing potential solutions in both a laboratory and operational environment. Candidate systems are prepared through architectural development, systems integration and Soldier training prior to executing the Network Integration Evaluation. These phases are time-driven, on an approximately 120-day cycle, based on the capacity of operational units in the Brigade Modernization Command. The final

phase, VI, consists of HQDA applying analysis to TRADOC's DOTMLPF report at the conclusion of a Network Integration Evaluation. HQDA collectively aligns requirements, programmatic, and funding COAs to implement NIE recommendations in concert with capability set fielding and Army Force Generation (ARFORGEN) alignment. While the phases imply a linear Network development approach, all are collaborative in nature and continuously inform each phase. Each phase will be refined over time as the Army matures the process to accelerate technology procurement.

On 12 April 2012, the ASA (ALT)/Army Acquisition Executive (AAE) approved and signed the Charter for Force Basing. The Director of the ASA (ALT) Office of the Chief Systems Engineer (OCSE) serves as the Executive Agent (EA), reporting to the ASA (ALT) Deputy for Acquisition and Systems Management (DASM). OCSE produces reference architectures (RA) in the functional areas of Integrated Base Defense (IBD), Communications and Computing Infrastructure (CCI), and Base Infrastructure (BI) to inform the annual Army Weapon System Review (WSR) and Program Objective Memorandum (POM) submission. OCSE leads the Program Executive Offices (PEO); the Research, Development and Engineering Command (RDECOM); Army Capabilities Integration Center (ARCIC) and the Army Staff (ARSTAF) in Force Basing reference architecture and corresponding portfolio production for Semi-fixed Sites (base camps) in OCONUS and Installations (Fixed Sites) and Mobile Operations in CONUS and OCONUS. In FY12, OCSE successfully delivered the OCONUS FY15 IBD RA to the Army WSR, instituted the first Integrated WSR (I-WSR) for IBD and produced RAs for CONUS IBD and OCONUS CCI and BI for the FY13 WSR and POM submission.

ASA (ALT) OCSE has reinitialized the Army Systems Engineering Forum (ASEF) which serves as a venue to socialize key System-of-Systems Engineering (SoSE) and Systems Engineering concepts and strategies across the Program Executive Offices' (PEO) Chief Systems Engineers, the Chief Software Architects, key members of the Army software community, and as well as RDECOM Chief Systems Engineers. The forum is held every month alternating between live session and virtual session (DCO). The SE communities has been engaged to address the challenges the Army is encountering on topics such as reliability assurance, Army Integrated Requirements Framework (IRF), Simulation and Emulation in Support of Operational Networks: "ALWAYS ON", Model-Base SE Metrics, Structure, tools and methodologies related to Architecture, Army Product Data & Open Standard Architecture. Corresponding Workgroup/Intergraded Product Team (WG/IPT) has been established to conduct deep dive analysis and proposed way ahead. Findings are reported up to the group for adoption.

During the Army Systems Engineering Forum, ASA (ALT) Office of the Chief Systems Engineer (OCSE) reviewed a handbook being developed that is intended to provide awareness to the Army's SE communities of its initiatives and related work products (template), focusing on Common Operating Environment (COE), Architecture review, Modeling and Simulation (M&S), Program Protection and Systems Engineering plans reviews. This handbook was to institutionalize OCSE's 5 core tenets: Orchestration - Coordinate and synchronize SE activities and initiatives, as well as promote transparency and knowledge management throughout PEOs & RDECs; Facilitation - Ensure the development of products with a set discipline and engineering rigor across multiple domains and PEOs; Coordination - Support Army position at ASARC, DAB, ITAB & WSR; Program Support - Ensure PMs have the engineering rigor in executing their programs; Mission Assurance - Ensure compliancy of policies & guidance and workforce development. Upon review and discussion with Systems Engineering community, the consensus was for OCSE to move from a consolidated single document, to an interactive web service hosted on the OCSE Systems Engineering portal.

OCSE has identified to the Army's Modeling and Simulation General Officer Steering Committee that the continuous flow of authoritative Network data, designs, and performance metrics from Concept to Development, to Test and Evaluation, to Training and Mission Rehearsal is missing. There is a critical need for an authoritative Persistent Integrated Environment for Analysis, Research, Design, Test, Evaluation, Training and Experimentation on Operational Networks. ASA (ALT) OCSE has established an initiative for a persistent integrated environment in support of analysis, research, design, test, evaluation, training, and experimentation on Operational Networks, "Always On". This environment will build on a set of capabilities that has been developed over the past 15 years by a partnership activity between the acquisition, testing, and combat development communities. The intent is to take already developed building blocks and integrate them into a persistent networked environment using common interfaces and metrics. The use of existing organizations' core competencies across domains to establish and orchestrate the capability, will lead to efficiencies across acquisition lifecycle. The plan is to start with the current core Joint Network Emulation (JNE) capability demonstrated at the most recent NIE and evolve it over time through an incremental build process, with each build "rolled out" at Field Test events such as the Network Integration Evaluations (NIE). The "Always On" effort is consistent with the Army's Test and Evaluation Enterprise Strategic Plan 2013 and the Army's Agile Capabilities Life Cycle Process Standard Operating Procedure.

In FY12 the Army pursued the development of and implementation of Vehicular Integration for C4ISR/EW Interoperability (VICTORY) and Future Airborne Capability Environment (FACETM). VICTORY is an architecture and a standard set of specifications that facilitate interoperability and reduced platform integration risk. VICTORY designs use a common digital data bus and shared resources such as displays and processors. VICTORY specifies interfaces for data exchange and control between many classes of components over an embedded network and provides for services such as time and location distribution. FACETM establishes a standard common operating environment to support portable capability applications across Department of Defense (DoD) avionics systems. It is a partitioned architecture that provides separation between safety critical and non-safety critical applications through software partitioning, enabling a non-safety critical applications to be modified and/or updated without affecting the safety critical applications, therefore minimizing the time required for integration, test and airworthiness certification. Both VICTORY and FACETM provide improved system engineering standards that can reduce the total time programs of record require to design, implement, deliver, test, and field new, enhanced, and/or additional capabilities to the Warfighter. Implementation of both VICTORY and FACETM in Acquisition programs is ongoing. Initial versions of both standards have been released.

During FY-12 the content and scope of the VICTORY Standard was expanded through the publishing of an enhanced Architecture (A1) and Specifications (Versions 1.2 & 1.3). A reusable software reference library was established containing more than 250K source lines of code. This library contains both application interface code that can be used to assist developers in implementation of the VICTORY Standard and Verification Toolkits that can be used to test component compliance. Significant progress has been made in the harmonization and synchronization of VICTORY with the COE effort. VICTORY is recognized as a foundational capability for several of the COE Computing Environments and is part of the overall COE 2.0 TV-1. Many platform programs have made plans to implement the VICTORY standards including Abrams, Bradley, GCV, Stryker and JLTV. Similarly several mission equipment programs are incorporating VICTORY including Electronic Warfare (EW) systems (e.g. Pursuit & Exploit [P&E]), sensor systems, and the successor hardware and software programs to FBCB2 including the modular Family of Computer Systems (mFoCS) and Joint Battle Command – Platform (JBC-P). A VICTORY Management Directive was signed formally establishing a management structure for the

Standards Body and overall initiative. A formal VICTORY Process Document and a Configuration Management Plan were approved.

Army Value Engineering (VE) efforts continue to be an integral part of Army-managed defense system cost management dynamics across the enterprise life cycle. Critical to VE program success will be the new emphasis in the Operations and Support (O&S) phase, as this is the area that generally has the most program life cycle costs, with a great potential for positive cost reduction efforts.

The Army is moving forward with plans to consolidate its Value Engineering (VE) project tracking system, known as the Value Engineering Management System (VEMS), with the Army's primary process improvement tracking tool, called PowerSteering. This consolidation should result in a cost savings by eliminating the hosting cost for the old system and allowing for greater visibility of VE projects.

FY12 FOCUS AREA – Better linkages between SoS Efforts and Business Decision Forums

The 1st iteration of the Agile Process is coming to fruition with the fielding of Capability Set (CS) 13. The System of Systems Integration (SoSI) Directorate is coordinating the synchronized fielding of the capability set with new equipment training scheduled to begin in October for the 3d Brigade, 10th Mountain Division at Fort Drum, NY and the 4th Brigade, 10th Mountain Division, Fort Polk, LA. Product Director, Synchronized Fielding has taken the results of previous Network Integration Events (NIE) and has coordinated the integration of a fully integrated and vetted network package (CS 13) into the Mine Resistant Ambush Protected (MRAP) All Terrain Vehicles (ATV) which are being delivered from the Space and Naval Warfare (SPAWAR) Systems Center Atlantic in Charleston, SC. Vehicle deliveries will continue on a staggered schedule over the next few months and simultaneous safety release and network verification testing has been initiated at Aberdeen Proving Ground, MD."

A key business decision forum in the Army is the Army Business Council (ABC), formerly the Business System Information Technologies (BSIT) Enterprise Guidance Board. This board is chaired by the Chief Management Office, and the Vice Chief of Staff Army is the vice chair. The ABC follows the BSIT strategy as described in the in the Business Systems Information Technology 2012 Annual Report on Business Transformation. "The BSIT strategy serves as the Army's roadmap for executing enterprise architecture using enterprise perspectives about our portfolio of solutions and our business processes. While not a classic systems engineering activity, the Business Systems Information Technology (BSIT) strategy is a living document that is evolving in response to changes in emerging missions, capabilities and technology. Through this strategy, the Army is engaged in the review a number of high-priority business process capability improvement opportunities and is applying standard Business Process Management and Re-engineering methods in evaluating and increasing value returns across its processes and systems. It is the framework for mapping and improving the Army components of the 15 Department of Defense (DoD) Business Enterprise Architecture End-to-End (E2E) processes. Process mapping enables the Army to better understand how work gets done and identifies cross-domain dependencies. The BSIT strategy serves as the Army's roadmap for executing our enterprise architecture using enterprise perspectives about our portfolio of solutions and our business processes. It is the foundation from which Army Business Systems Information Technology will progress in the years to come. The BSIT strategy leverages the capabilities and business process improvement opportunities offered by the Army's four Enterprise Resource Planning (ERP) programs currently under development or in fielding. The four ERP systems support logistics, military personnel and pay, and financial management activities. These ERP systems and other business systems enable the Army to train, organize and equip Soldiers under the aegis of the Army Force Generation (ARFORGEN) process and

provide the foundation necessary to obtain an unqualified audit opinion." The Army Acquisition Executive is a core voting member of the ABC. ASA (ALT) participates in the 3 Star Review Group and the 1-2 Star Working Group. In FY 12 these groups were instrumental in obtaining ABC approval for several enterprise business systems implementations, such as Enterprise Email and Enterprise Content Management Activities. In addition, ASA (ALT) has reviewed requirement documents and has recommended several engineering changes to ensure compliance the Common Operating Environment (COE) Data Center/Cloud computing environment.

ASA (ALT) Office of the Chief Systems Engineer (OCSE) continues to participate in the Capability Set Management Board (CSMB), a key senior leader decision forum to guide the goals, objectives and activities of related Capability Set (CS) segments. Within the mission space of the CSMB, OCSE led parts of the Network Design Cell (NDC) effort, which yielded a reference transport design for three Infantry Brigade Combat Teams (IBCTs) for fielding in FY13. OCSE was a key lead on the CS14 Stryker Brigade Combat Team (SBCT) NDC. OCSE assisted in fielding radios through Size, Weight, and Power – Cooling (SWaP-C) analysis on Stryker, Bradley and Abrams. With TRADOC, Army G-3/5/7 and the NDC, OCSE maintained and refined the Network Basis of Issue Feeder Data for BCT formations. OCSE worked closely with ASA (ALT) System of Systems Integration (SoSI) to provide input into the Network Integration Exercise (NIE) architecture development process. OCSE worked with TRADOC Architecture and Integration Management Division (AIMD) to develop an Army-wide strategy for storing, manipulating, and managing architecture data by leveraging the Army Capability-based Architecture Development and Integration Environment (ArCADIE) repository.

Additionally, ASA (ALT) continues to support the LandWarNet (LWN) Mission Command (MC) decision forums, led by Army G-3/5/7 LWN Division via the Capability Set Management Board (CSMB) and the LandWarNet 1-2 Star General Officer Steering Committee (GOSC). ASA (ALT) coordinated across the Headquarter elements and key Program Executive Offices (PEO) and Program Managers (PM) to ensure integrated solutions are fielded to the Soldier. ASA (ALT) collaborated across the Army Staff (ARSTAF) and with the LWN GOSC on Common Operating Environments (COE), Network Operations (NetOps), Force Basing and Operations/Intelligence convergence initiatives. A systematic process was implemented to vet ASA (ALT) capabilities across the Headquarters staff as part of the preparation process for the LWN decision forums. This process was inclusive of key PEO and PM stakeholders and facilitated coordination across disparate functional elements.

ASA (ALT) continues the Network Operations (NetOps) IPT which is co-chaired by the ASA (ALT) Office of Chief System Engineer (OCSE) and the Army G-6/Chief Information Officer (CIO). In coordination with TRADOC and the CIO/G6, ASA (ALT) implemented an annual process to develop architecture products that inform specific integration initiatives to improve Network Operations (NetOps) capability on the battlefield, while consolidating and converging NetOps products and functions to make them more user friendly to the Warfighter. The strategy was endorsed by the Vice Chief of Staff of the Army (VCSA) during the 9 June 2012 Mission Capability (MC) Capability Portfolio Review (CPR) and executed by directive from the ASA (ALT)/Army Acquisition Executive (AAE) in August 2012. Program Executive Office (PEO) Command, Control, and Communications – Tactical (C3T) has been assigned Trail Boss responsibilities to ensure that execution of these integration initiatives are coordinated across participating Program Managers (PMs) and PEOs, and that new integration initiatives are coordinated through key stakeholders and correspond to VCSA strategic guidance, as well as coordinated through the Army Staff (ARSTAF).

The Strategic Management System (SMS) is the Army's approved and supported online system for measuring strategic performance and tracking progress toward achieving our goals. SMS will continue to be the ASA (ALT) management tool for these purposes and our primary backdrop for measuring progress toward strategic goals. OCSE will have Systems Engineering objectives that will translate the narrative of the ASA (ALT) strategic plan into executable, measurable tasks and metrics within SMS to allow performance tracking and measurement.

FY12 FOCUS AREA – Building the SE Bench through Human Capital Development

ASA (ALT) Office of the Chief Systems Engineer (OCSE) initiated the OCSE Systems Engineering Developmental Assignment Program (SEDAP), which offers exceptionally talented government-service systems engineers in the Program Executive Offices (PEOs) and the Army Research, Development and Engineering Centers (ARDECs) the opportunity to serve 12-month career development assignments in OCSE. The OCSE Architecture & Analysis Directorate (A&AD) sponsored four Developmental Assignees (DAs) in FY12 to the great benefit of OCSE and the DA parent organizations. DAs served in the mission critical positions of Future Technologies Officer, Chief Engineer, Chief of Force Basing, and Platform Integration & Analysis Lead. The OCSE SEDAP provided significant benefits to DA parent organizations, as DAs gained valuable experience and knowledge of ASA (ALT) processes, procedures and policies, which they could apply in future enterprise-level projects on behalf of their parent organizations. Costs of the SEDAP were borne by parent organizations. The OCSE SEDAP will continue in FY13.

PEO Ammo PMs have filled key SE leadership positions, including testing and logistics positions. PEO Ammo SE community has a close relationship with the ARDEC SE, which allows the PMs to utilize ARDEC SE talent not only for project personnel but for succession planning as well. In concert with Army objectives in SE, PEO Ammo employs comprehensive Individual Development Plans for all individuals in the Army Acquisition Corps, and makes use of training and educational opportunities for our employees (current and new). All SE staff in PEO Ammo are SPRDE certified Level III through DAU and the PEO supports developmental assignments for all employees.

PEO AVN Systems Engineering Structure has an established Chief Engineer within each Product Office that monitors and mentors all product development efforts. Each product development team is staffed with a product lead engineer (senior) and a mid-level engineer to manage and coordinate all design and development efforts. The product team lead assigns and mentors a mid-level engineer to appropriate subsystems for daily managing as a training technique to develop their careers and talents in acquisition and technical management. This strategy of succession creates a leadership and management capability that delivers and sustains business practices within the product office. PEO AVN continues to grow the Systems Engineering expertise across all Program Offices. Each platform emphasizes SE training and development to continue core SE principle, process and procedures development. Systems engineering plays a pivotal role in the development, production and sustainment phases of all PEO AVN products. PEO AVN also relies on AMRDEC System Engineering to provide systems engineering expertise and training. PEO AVN has approximately 25 senior systems engineers that are matrixed to various product offices to improvement and implement integrated systems engineering requirements. PEO AVN Systems Engineers also are required to obtain and maintain DAU Level III Systems Planning, Research, Development & Engineering (SPRD&E) qualifications.

PEO C3T, and PM WIN-T Inc 3 has a large number of System Engineers who are SMEs in areas of transmission technology, including radios, antennas and software based transmission waveforms, as well as NetOPs planning and management tools and Network Design. These engineers are experts in

their fields, as well as certified in Army acquisition process. We continue to hire experienced personnel. We are focusing on hiring more junior personnel to ensure transition planning for the future of the organization.

PEO Ground Combat System acquires most SE personnel by matrix support from RDECs who are brought in for their unique expertise and SE Backgrounds. PEO GCS will continue to work with the RDECs to improve the knowledge and skills of the SE workforce through training, SPRDE certification process, and conferences. The PEO GCS SE workforce is a blend of relatively new engineers with only a few years experience and senior engineers with years of experience on multiple ground vehicle programs. PEO GCS is constantly mentoring younger engineers to replace the experienced talent base being lost due to attrition. All PMOs within PEO GCS have dedicated SE resources. Additionally, PM SBCT conducted a Work Task Analysis to identify the skill sets necessary to transition from Production to Sustainment. The WTA also identified the skill sets necessary to continue development of the ECP Improvements. This effort identified key personnel with the required skill sets that need to be retained to execute the program. PM Stryker established a Stryker Life Cycle Sustainment Plan (LCSP) IPT incorporating PM SBCT, PEO GCS, ILSC, TARDEC, DLA, ACC and contractor members to develop a comprehensive plan that not only addresses the Stryker transition to Sustainment in FY 16, but will provide a baseline living document that will record the comprehensive (all disciplines) Stryker support strategy as it evolves over time.

Systems Engineers supporting PEO MS are matrix employees from the Aviation and Missiles Research, Development and Engineering Center (AMRDEC). The PEO MS provides the skill sets required and the AMRDEC "Builds the Bench" appropriately. All SE workforce new hires are required to achieve the Defense Acquisition University's Systems Planning, Research, Development and Engineering Level III certification within a reasonable time period. Progress towards certification is part of each employee's performance objectives. SE management allows employees flexibility in work schedules to ensure that training requirements and completion of daily work assignments are both given appropriate priority. The Chief Engineer's office has worked with experts from AMRDEC and academia in order to expand the SE sphere of knowledge and experience, and to assist SEs in promoting the practice of SE in the PEO MS. The Chief Engineer's office has conducted training sessions to educate PO personnel on SE methodology for Systems Engineering Planning, Program Protection Engineering, Conducting Technical Evaluations, Technical Data Rights, Models-Based Systems Engineering (MBSE), MagicDraw®, and SysML. The Chief Engineer's staff conducted Army Strategic Software improvement program workgroup meetings to ensure software personnel are aware of new policies/changes, tools and lessons learned. The Chief Engineer is also planning additional training in FY13 for the project offices in Systems Engineering Planning, Program Protection Engineering, Risk Management Planning, and MBSE. The Chief Engineer plans to offer periodic courses on the MBSE experience focusing on system engineers and simulation engineers for Real Time Innovation Data Distribution Services training at both the general engineering level and the implementation level and IAMD Simulation Framework (ISF) training at both the general engineering level and the implementation level. The Chief Engineer office is collaborating with SMDC, the AMRDEC, the ERDC, and other RDEC's in S&T transition to improve systems maturity and integration during the S&T phase to reduce program risk.

In FY12, PM Soldier Warrior stood up Product Director Soldier Integration. PD SI is charged with facilitating Soldier Systems Integration by implementing two major tenets: ANSI-649-B based Configuration Management approach and treating the Soldier and Squad as integrated systems, or platforms as is done in the combat vehicle and aviation communities. PD SI conducts a general approach to improve cross-product communications, collaboration and situational awareness in future

product development, evaluate and introduce tools to visualize the "system", and create collaborative venues for design and decisions. For FY13, PEO Soldier intends to host a quarterly Systems Engineering IPT. The IPT is tasked to Communicate across PMs current status of Systems Engineering issues and projects, garner collaboration, and collaboratively determine path forward to address prioritized SE issues i.e.; integration, configuration management, baseline development, etc. Also, participation in the Army Systems Engineering Forum (ASEF) has produced valuable resources and potential ideas for SE projects that will be introduced and potentially adopted by the SE IPT.

PEO STRI uses multiple methods to recruit, educate and train new and mid level engineers in an effort to build the bench in support of systems engineering. PEO STRI recruited the best and brightest new engineers in FY 12 through a highly competitive program called the Acquisition Academy. PEO STRI recruited 5 new engineers from a field of over 250 applicants and provided those candidates with an intensive 11 week program that exposed them not only to the Systems Engineering process but also to other disciplines within the Acquisition Process. The Acquisition Academy is a continuation of a program begun in 2008. The Acquisition Academy program has recruited close to 30 high performing new engineering graduates to the PEO STRI team within the last three years. The Acquisition Academy is experiencing a 98% retention rate. PEO STRI recruited mid level engineers in FY 12 by utilizing the Expedited Hiring Authority for Acquisition (EHAA). This program carefully screens mid-level engineers by using highly qualifying criteria to ensure that PEO STRI recruits only the top candidates from industry and other Government Agencies. The highly qualifying criteria assesses the candidate's degree, years of experience and specific experience in engineering and the training and simulation domain to recruit top talent at the mid career level.

To educate and train the PEO STRI Systems Engineering workforce, PEO STRI uses a variety of resources offered by DoD, Academia, Industry and Industry Associations. PEO STRI takes full advantage of the Acquisition Courses offered by the Defense Acquisition University in the area of Systems Planning, Research Development and Engineering (SPRDE). Our workforce consistently leads the ASA (ALT) community in SPRDE certification. The PEO also takes advantage of Army leadership courses through the Army Management Staff College's Civilian Education System program. Our engineering workforce is engaged in these courses at all levels. PEO STRI is engaged with universities and other industry associations to educate our workforce. These include the Software Engineering Institute at Carnegie Mellon University, the National Defense Industry Association (NDIA), the National Training and Simulations Association, and the International Council on Systems Engineering. Our workforce attends training courses sponsored by each of these institutions. This combination of recruiting, education and training through engagement with Government and industry provides significant momentum toward creating a bench that will be able to take over as senior leaders of our organization.

The JPEO-CBD Chief Systems Engineer chairs a JPEO-CBD Systems Engineering forum each month. This is an opportunity for engineers across the enterprise to discuss new policy and guidance; special considerations for CBD programs; and lessons learned. Also during FY12, several System Engineering related information briefings and training sessions were offered to the JPEO-CBD engineers across the enterprise; topics included: Configuration Management, Risk Management, Rights in Technical Data, Integrated Master Schedules, and Requirements Traceability Matrices. Planned Systems Engineering related training topics for FY13 includes: Architecture; Requirements and Functional Analysis; Reliability, Availability, and Maintainability; Integrated Master Schedules; and Corrosion Prevention and Control.

Within PEO CS&CSS, many employees are pursuing engineering Master's and even doctorate degrees. Employees have a requirement to complete 80 hours of outside training every 2 years and are encouraged to pursue additional training in the engineering field that supports their job function. PdM Bridging actively engages younger engineers through the summer hire, SCEP, and co-op programs. In FY12 one Bridging's co-ops successfully converted to a full time intern on the Bridging team. Bridging also has an active mentoring program where more experienced engineers share their experiences with younger/less experienced engineers resulting in greater SE knowledge on the team.

2.0 Army Systems Engineering Workforce

2.1 Workforce Development Initiatives

The SPRDE and Program Systems Engineering (PSE) requirements were identified in the FY08 National Defense Authorization Act (NDAA) Section 852 (i.e. number of SE and PSE resources required and funding requested).

Section 852 of the NDAA for FY08, Public Law Number 110-181, directed the establishment of the Defense Acquisition Workforce Development Fund (DAWDF). This fund permits the Department of Defense to train and develop, recruit and hire, and retain its Acquisition workforce. The U.S. Army Acquisition Support Center is responsible for identifying and overseeing the Army's Section 852 initiatives.

In Apr 2009, the Secretary of Defense (SECDEF) directed the growth of 20,000 defense acquisition workforce positions by FY15. The department-wide Grow the Workforce Taskforce was established to lead and integrate program requirements and execution of Secretary of Defense's Grow the Acquisition Workforce Directive. The DoD (Carter-Hale Numbers) allocated 1,885 new hire growth positions to Army Acquisition, funded with Section 852 funds. The SPRDE community hired the following via Section 852:

1) FY09 – 14 SE allocated intern positions; 14 SE interns hired (one intern departed early); 11 allocated SE journeyman positions; nine SE journeymen hired (three journeyman departed early). No PSE allocated intern positions; no PSE interns hired; no allocated PSE journeyman positions; no PSE journeymen hired

2) FY10 – 20 SE allocated intern positions; 22 SE interns hired (one intern departed early); no allocated SE journeyman positions; 13 SE journeymen hired (three journeyman departed early). No PSE allocated intern positions; no PSE Interns hired; no allocated PSE journeyman positions; no PSE journeymen hired

3) FY11 – Six SE allocated intern positions; three SE interns hired; no allocated SE journeyman positions; 15 SE journeymen hired; no PSE allocated intern positions; no PSE interns hired; 22 allocated PSE journeyman positions; no PSE journeymen hired.

4) FY12 – Seven SE allocated intern positions; two SE interns hired; no allocated SE journeyman positions; no SE journeymen hired. no PSE allocated intern positions; no PSE interns hired; two allocated PSE journeyman positions; two PSE journeymen hired

5) For FY13-15, the SPRDE Community has been allocated the following growth, via Section 852: FY13 – five SE interns, no PSE interns; no SE journeymen, no PSE journeymen

Training: The PEOs use multiple methods to recruit, educate and train new and mid-level engineers in an effort to build the bench in support of systems engineering. To educate and train the systems engineering workforce, the PEOs and other organizations use a variety of resources offered by DoD, academia, industry and industry associations. PEOs take full advantage of the acquisition courses offered by the Defense Acquisition University in the area of SPRDE. In FY12, USAASC provided the SE community approximately $2.6M from the DAWDF for various types of Acquisition forums, operational experiences, rotational assignments, leadership training, recruitment, and job fairs.

Specific actions taken by the CP-16 Functional Chief's Representative (FRC) and the Army Materiel Command's (AMC) Research, Development, and Engineering Command (RDECOM) to develop an enhanced systems engineering workforce are:

1) Continued partnership with the Naval Post Graduate School with funding under Section 852 for a Master of Science in Systems Engineering degree. As of spring 2012 the first class of 15 graduated. Currently 45 RDECOM engineers are working towards their degree completion with the second class of 22 scheduled to graduate in the spring of 2013.

2) The RDECOM completed Research Task (RT) 29 with the Systems Engineering Research Center (SERC). This RT created a Systems Engineering Advanced course that was disseminated to the RDECOM workforce in four times throughout FY12. The effort established courseware that can now be used by all RDECs and local universities that are part of the SERC to continue to broaden the systems engineering talent.

3) The RDECOM continued efforts within the systems engineering IPT across the command which expanded to include project management focus as well as updating the corporate processes for planning and executing the systems engineering discipline. This effort looks at skills, tools and methods, and includes application of these efforts on command S&T and engineering programs to ensure we develop and mature them across the command.

4) Finally, RDECOM set up an online forum infrastructure for sharing of systems engineering best practices. The RDECOM Systems Engineering Process Asset Library (SE PAL) is a SharePoint hosted site that allows anyone within RDECOM to view SE/PM Policy, templates, best practice examples, and identify multiple training opportunities.

The primary means used to assess the strength of the SE workforce is the Strategic Workforce Assessment Report. The Army continues to analyze/assess the strength of the SE acquisition workforce by identifying mission critical occupations, forecasting MCOs, analyzing and conducting root cause analysis and developing strategies to close the MCO gaps. The Strategic workforce assessment and gap analysis is expected to be completed by the end of FY15.

The Army is currently undergoing a comprehensive Civilian Workforce Transformation process for all civilian employees. The Army SE workforce is included in this effort and focus is being given to the mission critical occupations first. During this effort each occupational series is being evaluated for required competencies, surveys of the workforce and supervisors are being conducted and a database is being built to enable the Army to close the gaps identified during this process. While this process is

ongoing we have a risk of losing many skilled personnel due to the need to reduce the workforce (manpower/budget cuts) (junior personnel at risk because of the time in service; senior personnel at risk because of the VERA/VSIP).

An Army-level view of SE workforce requirements is currently being collected by a workforce analysis/competency analysis conducted by the Army G-1 (CP). In general gaps identified (though not validated) have included writing skills, briefing skills, as well as other "soft skills" and multifunctional analytical ability. There are limited technical skill gaps identified, however the competency gaps have not been validated for all series included in the SE Workforce so this may change. One technical gap that has come to light is cyber skills for computer, electrical and electronic engineers. This is an emerging skill area.

There is a team of stakeholders across the DoD acquisition community working specifically on defining requirements for Key Leadership Positions (KLPs). The Army Director for Acquisition Career Management (DACM) Office is a member of this team. Once the team results are finalized and OSD guidance documented, the Army DACM Office will provide details to the Army Acquisition community to articulate implementation and path ahead for all KLPs. Program Lead, Systems Engineer is identified as a KLP. KLPs require a significant level of authority commensurate with the responsibility and accountability for acquisition program success. The selection of qualified personnel to fill KLPs is essential for both the organization and the individuals filling these highly demanding positions; detailed competencies and experiences will be required. To aid in evaluating and selecting the best qualified KLP candidates, the team has discussed five factors to assist supervisors in selecting personnel to fill KLP vacancies. They include: education; experience; cross functional competencies; tenure; and currency. Currently, KLPs must have the following qualifications: Defense Acquisition Corps Membership, Level III Certification and a Tenure Agreement. This new effort is evolving, and the Army DACM Office will remain involved and proactive with path ahead once finalized.

2.2 Additional Authorities or Resources Needed

As of 31 Dec 10, the Secretary of the Army has put on hold all acquisition civilian conversion (in-sourcing) efforts on hold until further notice. The Army does not require any additional authorities to support management of the acquisition workforce. Trades will be made among internal Army sources to resource any shortfalls that affect systems engineering. The FY13-15 requirements have not yet been identified. USAASC will solicit the field for input later this year.

2.3 SE Workforce Positions in the Army as Reported by USAASC

During FY12, the total acquisition workforce assigned to SPRDE positions decreased from 10,071 in FY11 to 9,812 in FY12. The primary reasons contributing to this decrease were continued personnel losses associated with Base Realignment and Closure Commission (BRAC) workforce moves, Voluntary Separation Incentive Pay and Voluntary Early Retirement Authority, and other types of attrition. A couple of notable BRAC related moves were the closure of Fort Monmouth, New Jersey to Aberdeen Proving Ground, MD and the move of Army Material Command Headquarters to Redstone Arsenal, Alabama from Fort Belvoir, Virginia.

Additionally, target hiring levels for civilian acquisition workforce personnel in the SPRDE career fields of Systems Engineering and Program Systems Engineer have been reduced due to budgetary uncertainty. Military positions coded SPRDE are expected to remain steady.

Table 1. Department of the Army SE Workforce

Total Number of Civilian and Military Acquisition-Coded SPRDE-SE/PSE Personnel				
Fiscal Year	**Year Ending**	**US Army**		
FY05	30-Sep-05	11,138		
FY06	30-Sep-06	11,964		
FY07	30-Sep-07	11,050		
FY08	30-Sep-08	10,769		
FY09	30-Sep-09	10,208		
FY10	30-Sep-10	10,647		
FY11	30-Sep-11	10,071		
FY12	30-Sep-12	9,812		
Fiscal Year	**Year Ending**	**US Army**		
Planned Growth as Reported In:		**FY10**	**FY11**	**FY12**
FY13	30-Sep-13	208	11	17
FY14	30-Sep-14	220	11	11
FY15	30-Sep-15	125	0	4
FY16	30-Sep-16		0	0
FY17	30-Sep-17			0
FY18	30-Sep-18			0
Planned End-State Total Number of Civilian and Military Acquisition-Coded SPRDE-SE/PSE				
Fiscal Year	**Year Ending**	**US Army**		
FY16	30-Sep-16	9,844		
FY17	30-Sep-17	9,844		
FY18	30-Sep-18	9,844		

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APPENDIX B

Department of the Navy
Systems Engineering Self-Assessment

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DEPARTMENT OF NAVY

Systems Engineering
FY12 Annual Self-Assessment Report

29 November 2012

Prepared by the Office of the Assistant Secretary of the Navy

(Research, Development and Acquisition)

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EXECUTIVE SUMMARY

The Department of Defense Deputy Assistant Director for Systems Engineering (DASD (SE)) is required to submit an annual report to Congress on the activities pursuant to subsections (a) and (b) of Public law 111-23 section 139. DASD (SE) tasked ASN (RDA) to develop the Naval Systems Engineering (SE) portion of this annual report. This document responds to the DASD (SE) request.

Specifically, this report identifies progress made and plans for improved SE capability to include: 1) Service-Level (Department of the Navy (DON)) SE Strategy, 2) Pre-Milestone A and Pre-Milestone B rigorous systems analysis and SE process, 3) reliability, availability, maintainability, and sustainability as an integral part of design and development, 4) SE requirements during the JCIDS process and in contract for each Major Defense Acquisition Program, 5) provision of evidence of progress against the FY12 areas for improvement identified in the FY11 self-assessment, and 6) identification of plans for addressing FY13 priority areas to improve SE and development planning capability of the DON.

Additionally, this report assesses the SE workforce to include 1) a listing of workforce development initiatives where progress has been made in FY12 and plans for improvement in FY13, 2) identification of additional authorities or resources needed to meet the experience and technical expertise of SE in DON, and 3) a complete listing of Systems Planning, Research Development and Engineering (SPRDE)-coded military and government personnel.

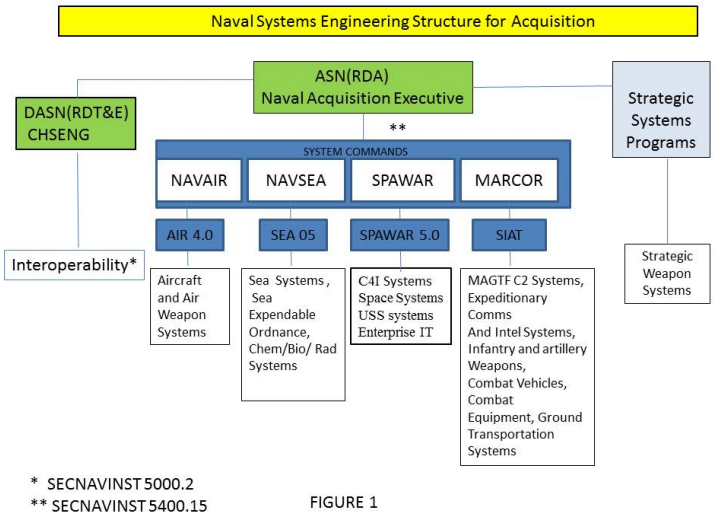
1.0 Progress and Plans for Improved Service Systems Engineering Capability

1.1 Service-Level Systems Engineering Strategy

- The strategy to increase Naval Systems Engineering (SE) capability focuses on the integration and standardization of SE processes to enhance mission effectiveness and reduce SE costs thereby improving mission assurance, reliability and maintainability (R&M), agility, and
  Interoperability of system of systems (SoS).

1.1.1 **Overarching Systems Engineering Organization**

Figure 1 illustrates the Naval Systems Engineering Organization, and the delegation of technical responsibility.



* SECNAVINST 5000.2
** SECNAVINST 5400.15

FIGURE 1

The Systems Command (SYSCOM) Commanders, Program Executive Officers (PEOs), and Direct Reporting Program Managers (DRPMs) are accountable for the specific responsibilities listed in the policy *Department of the Navy (DON) Research and Development, Acquisition Associated Life Cycle Management, and Logistic Responsibilities and Accountability,*[1] including administration of assigned acquisition programs, and reporting directly to the Naval Acquisition Executive (NAE) for such programs. In accordance with this policy, the SYSCOM Commanders exercise independent Technical Authority (TA) over all programs within their cognizance. PEOs and DRPMs work with the SYSCOMs to ensure that SYSCOM technical authority processes are an integral part of their program execution. The SYSCOMS provide the technical personnel to support the PEO's acquisition program, populate the program Integrated Product Teams, write the Statements of Work (SOW) for contract Request for Proposal (RFP), oversee test and evaluation (T&E) from component testing (CT) thru developmental testing (DT), review engineering change notices, support the development of logistics data for sustainment, and develop initial Fleet training on the systems.

[1] SECNAVINST 5400.15

As defined, TA is the authority, responsibility, and accountability to establish, monitor, and approve technical standards, tools and processes in conformance with higher authority policy, requirements, architectures and standards and is an inherently governmental function. The TA chain of command[2] is the SYSCOM Commander as the Warranting Officer (WO), the Deputy Warranting Officers (DWO) assigned by the SYSCOM Commander, and Technical Warrant Holders (TWH) assigned by the SYSCOM Commander.

As stated in SECNAVINST 5400.15C, the SE activities in DON report to ASN RDA for acquisition via their SYSCOM leadership. The SYSCOM commanders report to the Chief of Naval Operations (CNO) and the Commandant of the Marine Corps (CMC) as reporting senior. Among the responsibilities of the SYSCOM Commanders, are local implementation and execution of core policies and processes, which include SE. DASN (RDT&E), on behalf of ASN RDA, establishes DON-wide SE policy and tools to ensure consistency and rigor in the Department's SE activities. Specifically, there are points of engagement/intersection where policy (ASN RDA/DASN (RDT&E)) and execution of policy (SYSCOMS) meet:

a) The Naval SE Stakeholder Group (SESG) was established under DASN RDT&E and membership is comprised of the senior leadership in the SYSCOMs for the purpose of shared awareness of SE challenges and solutions, and process improvements.

b) The SE Competency Group (SECG), comprised of SE and human resource practitioners across the DON, focuses on the SE workforce to include SE workforce training and development.

The Navy believes this organization provides the balance and continuity of materiel acquisition and life-cycle sustainment between the civilian and military communities intended by the Goldwater-Nichols Act and the Weapon Systems Acquisition Reform Act (WSARA), and has furthered the implementation of SE policies into practice with no limitations.

TA's are identified by technical domain on the Naval Systems Engineering Resources Center (NSERC) website located at https://nserc.navy.mil. This location is used to promote cross-SYSCOM identification of the appropriate TA for the review of Naval Air Systems Command (NAVAIR), Space and Warfare Systems Command (SPAWAR), Marine Corp Systems Command (MARCORSYSCOM), and Naval Sea Systems Command (NAVSEA) assigned systems and to help identify and resolve risks associated with the procurement and acquisition of naval systems.

Technical oversight of ACAT I and ACAT II programs is accomplished by a combination of DASN (RDT&E) CHSENG and the SYSCOM TA. Technical oversight of ACAT III and IV programs is accomplished by the SYSCOM TA structure. Two distinct types of TA are normally needed to support ACAT programs at all levels; one type is embedded in the Program Office as the Chief System Engineer, the second type, the TWH, is providing deep technical expertise to

[2] VS-JI-22A

all appropriate programs. In this manner, the Navy is able to provide both technical knowledge and oversight over programs at all ACAT levels.

The SYSCOMS SE organizations (AIR 4.0, SEA 05, SPAWAR 5.0, SIAT) are responsible for providing the engineering and scientific expertise, knowledge, and technical authority necessary to design, build, maintain, repair, modernize, certify, and dispose of naval assets. Frequently, the SYSCOMS SE organizations embed SE personnel into PEOs as a Chief Engineer (CHENG) or Assistant PEO to provide consistent and timely support for acquisition programs.

1.1.2 Improving SE

Standardization and Integration of SE Processes

The standardization of SE processes, policy development and issuance, standards development, training and education identification and implementation, and tools development and execution across the Naval SYSCOMs is accomplished through the SESG. The SESG is in the final compilation of the revision to the Naval Systems Engineering Guide (NSEG) and the System Engineering Technical Review Handbook (SETRH) that will baseline the above listed initiatives and efforts underway across all Naval SYSCOMs. Several working groups such as Systems Safety, Integration & Interoperability (I&I), Human Systems Integration (HSI), R&M, Ship/Facility, and Air/Ship Integration focus on standardization and integration of processes to reduce the cost of executing processes.

The Navy established a Naval Deputy Standards Officer (NDSO). The SESG Standards Working Group (SWG) recommended re-establishing SE guidance provided in MIL-STD 499 and MIL-STD 1521. Acting on that recommendation, the Defense Standardization Council (DSC) chartered the working group to engage non-governmental standards organizations to identify and adapt commercial standards, where applicable, to DoD processes.

The NSERC contains tools to support the SE processes such as requirements management, architecture development process, risk management and reliability analyses. Active use of this site is increasing every year with system engineers (SEs) and Program Offices establishing share sites on NSERC. This website is supporting a continuous process improvement and communications between engineering TAs and programs.

Mission Assurance

The Navy has initiated a Mission Assurance (MA) engineering construct, lead by NAVSEA, to support PMs and lead SEs to more comprehensively address the many critical specialty engineering area standards, processes, and risk identification procedures related to their platforms and systems in an affordable manner. MA considers, but is not limited to, the critical specialty engineering area constructs of, safety, HSI, reliability and maintainability, supportability, software usability, commonality, and interoperability. The MA construct will establish the trade-off space analysis between critical specialty engineering areas for a program and deliver a MA strategy to be documented in the Systems Engineering Plan (SEP). The proposed MA strategy will positively impact the ability and affordability for a program to

address the critical specialty engineering analyses and risk identification processes required by DoD and DON for these areas. The MA strategy will be developed and vetted by the appropriate TAs and Program Authorities (PAs) to support a program's ability to ensure risk is fully identified and appropriate mitigation strategies are planned and reviewed during Systems Engineering Technical Reviews (SETRs) and Milestone Reviews (MRs). This comprehensive approach ensures aspects and capability of the system or platform needed to support the fleet's ability to meet mission requirements. It is envisioned that MA strategy will begin as early as Milestone A of an acquisition program and be re-evaluated and updated through the lifecycle of the system.

SoS

The naval SE community continued to develop and assist in defining several capability-based roadmaps such as Maritime Ballistic Missile Defense, Undersea Dominance and Maritime Domain Awareness. The purpose of these roadmaps is to define the path for obtaining Information Dominance (ID). These roadmaps offer alignment of capabilities to systems acquisition and functionality useful for both fiscal and engineering decisions. To support the execution of the ID Roadmaps, a mission level SoS design perspective is needed because the platform-centric approach that is described in the naval acquisition process increases operational risk by failing to deliver information from the source to the end user.

The Navy is developing an Executable Architecture and Requirements Model [ExARM] data set, tools and process to enable ID SoS engineering. The ExARM process development is being led by SPAWAR. The Navy will develop technical baselines, target architecture, capability phasing plans, and derived specification and implementation profiles for program-of-record (PoR) systems. The SPAWAR CHENG has adopted a top-down SoS approach to define mission trade space.

The ExARM data set is being developed using the Department of Defense Architecture Framework (DODAF) 2.0, which supports re-use of collected data in other naval architectures, and thereby reduces potential costs associated with procurement. Naval MAs are described in the *Naval Required Operational Capability / Projected Operational Environment* guidance[3]. ID is described by specific information flow chains within fourteen mission threads illustrated by DoDAF 2.0 Operational Views (OV6c). Information Exchange Requirements (IERs) are derived from the mission threads. IERs are mapped to systems on platforms / bases to define technical baselines for as-is and as-programmed architectures. A target architecture for the FY 2018 timeframe is also being developed that will include network Cloud services.

Because of the enormous scope of the Navy ID SoSs, manually ensuring the data remains consistent and analyzing the impacts of changes to capabilities is intractable. However, vendors are developing automated tools that can link and propagate changes across many mission level capabilities and implementation profiles across the entire SoS. The ExARM process is being enabled by a System of System Architecture [SoSA] data base that links all the DODAF artifacts associated with the operational and system data and an Executable Architecture Management

[3] OPNAVINST C3501

System [ExARMS] that ingests the architecture data along with other required inputs, performs simulations, and then outputs results in a stakeholder friendly presentation layer. SPAWAR has demonstrated a prototype of the SoSA-ExARMS toolset and is now building the toolset and collecting the architecture data needed to achieve an initial capability that will cover the Navy's highest priority mission areas and 80% of the systems in the ID SoS. The Navy will have the initial capability to use ExARM to address naval issues in 2013.

SoS Interoperability

The concepts and fundamentals of technical and certification authority are being fully used to strengthen the fielding of interoperable SoS aboard naval platforms and among naval forces. The complex interfaces between Command, Control, Communications, Computers and Intelligence (C4I) and weapon systems require both SoS processes and ME personnel to execute them. The Navy has developed processes, checklist criteria, and has conducted SoS testing. A SPAWAR end-to-end testing capability linking geographically distant testing labs is being utilized. The Naval Warfare Centers have established ME competencies and populated them with engineers focused on SoS/platform integration and interoperability.
Additionally, ASN (RDA) funded SoS Interoperability initiatives in three areas in FY 12:

- Capability Solution Management: Develop Integrated Capability Packages (ICPs) that document the doctrine, organization, training, materiel, leadership, personnel, facility (DOTLMPF) "solution set" for a given Fleet mission priority. This work focused on mission analysis and SoS engineering and related it to budget data expected within the current Future Years Defense Program (FYDP).

- Integrated Capability Framework: The Integrated Capability Framework (ICF) provides a common, overarching framework designed to support and integrate Interoperability and Integration activities conducted across naval communities. The result is improved mission performance in projected operational environments. A guidebook describing this process has been drafted.

- Capability Acquisition Management: This tasking produced a set of suggested changes to existing Navy Gate Reviews and Systems Engineering Technical Reviews (SETRs). The purpose of this work is to insure I&I criteria are addressed throughout the acquisition decision processes thereby improving our delivery of mission based capabilities.

As a result of the influence these initiatives have had on the SE workforce, most of the Navy's System Engineering Plans (SEPs) for acquisition programs are considering system engineering from a SoS perspective. The SEPs are identifying that the Major Defense Acquisition Program (MDAP) is part of a larger SoS, that their requirements development process must include members of the larger system of systems community to ensure interoperability and cohesion between these systems, and that verification and validation (V&V) of system performance must involve the larger SoS.

In FY 13, the Navy will consolidate SoS architecture processes into a single guidebook that harmonizes SoS engineering. The Naval SETR Guidebook will be revised to include the I&I SETR criteria. Gate Review templates will also be revised.

Open System Architecture

Several key DoN Open System Architecture (OSA) activities occurred in FY 12:

- NAVAIR participated in the Future Airborne Capability Environment (FACE) working group with Industry, Academia, The Open Group and other Government Offices. In FY 12, FACE established its first FACE Standard, Edition 1.0.

- The Marine Corps published *Cloud Computing Strategy*.

- PEO C4I published its OA Compliance Rule Set for use across the PEO C4I portfolio.

In FY 13, the Naval OA Enterprise Team will publish an Open System Architecture Strategy (OSAS) that harmonizes the myriad of OA strategies in DoN. Additionally, the Naval OA Enterprise Team is developing metrics to assess the institutionalization of OA.

SE Processes

In FY 12, the Navy drafted additional chapters covering software assurance processes in the *Guidebook for Acquisition of Naval Software Reliant Systems.* The guidebook will be published in FY 13.

Agility

Considerable work still needs to be completed to define Agile SE practices within the defense acquisition process. Small ACAT programs respond better to Agile SE than large, complex ACAT programs. Software-intensive programs respond well because software design is more modular and incremental capability is easier to add.

MARCORSYSCOM has instituted an aggressive Agile Software education and implementation activity. Software intensive programs have successfully implemented Agile approach. MARCORSYSCOM will continue to expand the Agile educational training program building upon early success.

For FY 13, the Navy will continue to work with OSD, the National Defense Industrial Association (NDIA) and the Defense Acquisition University (DAU) to align SE processes with Agile acquisition.

1.2 Pre-Milestone A and Pre- Milestone B Rigorous System Analysis and SE Process

DASN (RDT&E), NAVSEA and NAVAIR are actively participating in the OSD AT&L rewrite of the Defense Acquisition Guide (DAG) Chapter 4 along with the OSD AT&L Development

Planning Working Group (DPWG). By informing these working groups of current naval mission level architecture development processes, OSD guidance for Pre-MS A acquisition now includes a separate and distinct concept engineering analysis activity between completion of the Analysis of Alternatives (AoA) and MS A entry into the Technology Development phase. This effort has served to re-establish the importance of the Alternate Systems Review (ASR) and the associated SETR evaluation criteria checklist which is currently being updated.

The Marine Air Ground Task Force (MAGTF) Integration War Room provides leadership and management direction to analyze both requirements and the programs/systems at the individual level, the larger family, and at SoS. The SE and requirements community collaborate to trace war fighting operational functions to individual system capabilities. This effort began in FY12 and is in the process of evaluating the Command and Control (C2) functions. Once complete the other functional areas will be analyzed and traced. In FY 13, the Navy will continue participation in the DAG revision and will describe its process for adding rigorous SE analysis to Pre-MS A acquisition processes for consideration by the DAG team.
Additional plans for FY 13 include:

- Share lessons learned across the SYSCOMs on the early development of DoDAF products in support of Pre-Milestone A analysis
- Develop products and processes to ensure development of a capability/mission-based technical baseline from Materiel Development Decision (MDD) to Milestone A in support of developmental planning.
- Support acquisition decisions by defining and making traceable SoS interdependencies, define Government trade space to be worked and align material solution(s) with DOTLPF changes required.
- Draft guidance and policy needed to execute the rigorous system analysis approach for Pre-Milestone A.
- Re-organization will occur at SPAWAR and NAVAIR to create organizational entities that specifically support ME

1.3 Reliability, availability, maintainability, and sustainability as an integral part of design and development

In FY 12, the Navy drafted a policy to incorporate USD(AT&L)'s memorandum *Reliability Analysis, Planning, Tracking, and Reporting*[4] into all levels of ACAT programs. The process is tailorable to different ACAT levels and discusses the use of testing to verify reliability predictions throughout the acquisition lifecycle.

As a result of FY 11 efforts, the naval SYSCOMS have started to improve R&M engineering skills.

- NAVAIRSYSCOM Research and Engineering Group (AIR-4.0), SE Department (AIR-4.1), R&M Division (AIR-4.1.10) ensures naval aviation systems are reliable and

[4] USD (AT&L) Directive Type Memorandum 11-003 of 21 March 2011

maintainable through the application of proven R&M engineering processes. AIR-4.1.10 is responsible for providing the people, technical knowledge, and processes required to support the planning and execution of a product's life cycle R&M program plan. The AIR-4.1.10 R&M engineering processes are governed by our Standard Work Packages (SWP). The SWPs codify engineering best practices and processes for R&M tasks and activities across the product's life cycle; define the skills, resources, and sequence of steps needed to complete a tasking/process; ensure process consistency across the division; and can be updated to account for lessons learned, new practices, and new policies. In order to comply with the Directive Type Memorandum (DTM) DTM-11-003 two new SWPs are being developed: Reliability, Availability, Maintainability, and Cost (RAM-C) Rationale Report SWP and Reliability Growth Development and Management SWP. The NAVAIR Command Staffing tool, coupled with discussions with the PMAs and PEOs regarding the standard work as addressed in the SWPs, is used to determine R&M workload demand for each PMA/PEO.

- NAVSEA has established an R&M Community of Practice and Infrastructure Working Group. The working group held a NAVSEA enterprise-wide workshop to identify gaps, and align R&M and SE policy, guidance, standards, and to identify NAVSEA's capacity and capability to meet DTM-11-003. The R&M working group focus is to identify what NAVSEA needs to do to fully support the reliability engineering and reliability growth requirements. An R&M workforce capability and capacity survey was sent out to the engineering and program communities. Analysis of the survey confirmed a need to re-invigorate the R&M engineering workforce across NAVSEA. As a result, an effort is underway in several of the NAVSEA Warfare Centers to: 1) develop and deploy R&M training for the NAVSEA workforce and, 2) Establish R&M workforce improvement strategies to support NAVSEA programs to fully address DoD requirements. Overarching R&M policy for NAVSEA is under development. R&M engineering and TA reviews of NAVSEA SEPs, RAM-Cs and Test and Evaluation Master Plans (TEMPs) are being done to ensure compliance with DoD and DON requirements. The Office of the CHENG, SE policy lead supports Programs in SEWIPTs and TEWIPTs. R&M SWP and a NAVSEA technical publication is in development. These products will codify R&M engineering best practices and processes for R&M tasks and activities across the product's life cycle.

- During FY12, MARCORSYSCOM (DC SIAT) initiated a cross functional IPT to improve operation and maintenance of military systems with managed risk. An enabler is improving equipment reliability, availability, maintainability, and sustainability. The initial task was to assess workforce knowledge and execution of RAM-S and in-service engineering. The data identified pockets of excellence, as well as gaps in knowledge and execution. This information formed the basis for FY13 efforts. Planned FY13 activities include RAM-S process mapping, policy development and training and criteria to select in-service engineering activities. All Marine Corps ground programs document RAM-S planning in the program SEP.

In FY13, the Navy's SESG R&M working group will coalesce all of the individual SYSCOM efforts to identify standard skills and develop common structures and capability. The products

from internal SYSCOM and cross-SYSCOM efforts will identify the classroom training and hands-on experience required for an R&M practitioner to be "qualified" to autonomously execute the efforts associated with the specific standardized work packages (SSWP). Each R&M practitioner will be mapped against each SSWP to identify training and experience gaps across the division. These gaps will be compiled to identify and prioritize the training necessary to maintain a capable and proficient R&M workforce.

1.4 SE Requirements During the JCIDS Process and in Contract Requirements for Each MDAP

In FY 12, the Navy's efforts towards improving SE requirements have been focused on the SoS engineering processes that help to define requirements from the mission level perspective, thus providing an operational perspective to performance requirements that allows the Navy to obtain the right requirements. The Navy will continue to pursue this path in FY 13 to support developmental planning so that the right requirements are defined as early as possible in the JCIDS process.

- The Naval Open Architecture Enterprise Team (NOAET) published an updated version of the OA Contract Guidebook for Program Managers for DoD-wide applicability, for use by all Services.

- The Naval Human System Integration (HSI)Working Group drafted HSI language for contracting and source selection. A guidebook was developed and the guidebook is being reviewed by Navy leadership. It is anticipated that a signed guidebook will be posted on the main page of the NSERC website.

As an example of the value of using TA to support the JCIDS process, SPAWAR's independent systems technical reviews conducted in the past year yielded valuable validation of programs technical risk assessments and discovery and implementation of risk and cost avoidance opportunities. During the SETR process, TWHs improved awareness and implementation of HSI practices, facilitated improvement of software engineering practices, and improved insight into systems safety.

The Navy anticipates that the additional mission-level system engineering analysis that is being accomplished prior to Milestone A on major acquisition programs will lead to better defined requirements for the acquisition programs. The DoDAF architectures, because of the DoDAF 2.0 format, provide executable data that can be imported into modeling programs to help ensure the requirements are defined sufficiently. Additionally, the DoDAF software tools provide traceability between operational requirements and system requirements which helps to verify that operation requirements are being met, and that the performance requirements have been allocated to the right system. The mission threads that are developed in DoDAF during the early system engineering efforts provide input into the test scenario development for testing. The DoDAF architectures also provide the operational perspective needed to develop a TEMP that will verify the system will meet the operational need.

In FY 13, the NSEG will contain information on the development of DoDAF architectures from a mission level perspective and it will explain to the SE workforce the value of developing these architectures as early in the acquisition cycle as possible so that they can be used to improve SE requirements during the JCIDS process.

1.5 Service-Specific Identified Area(s) of Progress and Improvement

MARCORSYSCOM

In an effort to better inform the requirements and acquisition community, MARCORSYSCOM has developed the Framework for Assessing Cost and Technology (FACT) tool. This set of integrated decision support tools, used by acquisition teams, evaluates Total Life Cycle management and assess designs against performance, cost, RM&A, and schedule. FACT will continue to mature to support Modeling and Simulation (M&S) support to SE in order to enable rapid trade space and alternatives analysis to support USMC combat vehicles throughout the acquisition lifecycle.

MARCORSYSCOM DC, SIAT provided liaison representative(s) to the CD&I Requirements Community, to better understand the requirements generation process and support requirements transition to the material developer at MCSC. Through an assigned requirements transition lead, additional engineering studies are performed to analyze alternatives and evaluate the results through Alternative Systems Reviews leading to rigorous system engineering technical reviews and repeatable processes. Future efforts include the development of M&S capabilities, to analyze requirements for feasibility and eventual trade studies.

MARCORSYSCOM has established a responsible organization for HSI within the SE Directorate. This organization also operates an on-base facility known as the Gruntworks Squad Integration Facility (GSIF) in order to conduct HSI with Marines and equipment worn as well as integration of combat equipped Marines in vehicle and aircraft platforms. The HSI organization and programs within MARCORSYSCOM use the Naval Surface Warfare Center Dahlgren Division (NSWCDD) for additional HSI support as required. HSI planning and application is conducted within the program offices across all seven domains of HSI. The continued use of PM Marine Expeditionary Rifle Squad (PM MERS) that treats the Marine and his equipment as a system has significant SE capability to improve Marine infantry capability. Education, training and knowledge of resources continues to be a fundamental factor in system engineering documentation and procedures and is strengthened by MARCORSYSCOM personnel currently enrolled in HSI Masters and Certificate Programs with the Naval Postgraduate School (NPS).

NAVAIRSYSCOM

NAVAIR is in the first phase of development of the Systems Architecture Development Process (SADP) which will enhance Naval Enterprise Capabilities (NEC) through the development of architecture design training using the NSERC tools to support the SE architecture development process. NAVAIR has commenced phase III of populating its TA data base which includes Airworthiness certification, Aviation certification and Technology Readiness Assessment (TRA) processes and has expanded the data base to include MARCORSYSCOM.

NAVAIR established the Systems Engineering Development & Implementation Center (SEDIC) in 2009 to provide a focused resource for SE improvement within NAVAIR Programs. One of

the first SEDIC initiatives was to re-write and re-design the existing SETR checklist content and associated tool set. To date, the SEDIC has completed and released new Menu-Driven SETR Checklists that span the reviews associated with System Requirements, Technology Development, System Architecture, Technology Demonstration, and Engineering & Manufacturing Development (EMD). In FY 12, the SEDIC developed a guidance document for Pre-Milestone A activities associated with Material Solution Analysis (MSA). The SEDIC developed and, in FY 12, deployed a Checklist Manager (CLM) environment that enables the SEs and Subject Matter Experts (SMEs) to address multiple reviews within the same management environment. The advanced capabilities enable tailoring decisions to be improved from one program to the next, user friendly updates, e-mail-able content, and collection of final databases. Within the first eight weeks of deployment, 227 requests for downloads of the CLM have been accomplished, and 114 have occurred in the last week, reflecting an increased usage among the systems engineers at NAVAIR. A full support environment was also implemented, with over 82 minutes of computer based training available at the NSERC.

The Menu-Driven SETR checklists are designed to be easily tailorable for all programs regardless of ACAT level. Designed to take advantage of the Competency Aligned Organization at NAVAIR, the checklists are maintained to address the latest relevant content typically required by the NAVAIR technical authorities composing the Technical Review Board (TRB) during SETR events. The checklists implement a user-friendly tool containing filter/sort and navigational aids to assist users in quickly reviewing, tailoring, and scoring the checklists. In FY 12, NAVAIR was a member of the Capability Acquisition Management (CAM) team that developed SETR criteria for I&I. The CAM team organized their SETR criteria so that it can be absorbed into the NAVAIR SETR database. In addition, the Menu-Driven SETR Checklists automatically generate a series of tailoring and scoring reports to assist in the SETR event preparation & execution process. This new tool was designed for systems engineers by systems engineers to assist the Assistant Program Manager System Engineers (APMSE) in assessing their program's design maturity. Resources are available on the NSERC web site.

SPAWARSYSCOM

In FY12, the CNO directed that SPAWAR become the single Information Technology (IT) TA to unify TA for all new and legacy IT/Information Systems and networks, afloat and ashore, and to develop a plan to do so. SPAWAR engaged each of the naval SYSCOMS and is defining roles and responsibilities and establishing certification standards through which existing systems and networks will be certified and consolidating network architecture authority under SPAWAR.

In one example of its emergent TA responsibilities, SPAWAR now provides IT TA insight and approval for IT resource purchases across the Navy in accordance with designated cost thresholds as directed by the CNO.

In FY 13, SPAWAR will continue to define and develop the SE approach, tools, certification process and governance framework required to execute Single IT TA responsibility. A System of Systems Engineering and Integration (SoSE&I) approach is being implemented for establishing and governing the Navy's IT enterprise architecture in response to the challenges presented by the Navy's ID vision.

As the technical experts for naval C4I systems, SPAWAR developed the processes and support infrastructure to certify C4I systems in support of the Naval Warfare System Certification Policy (NWSCP). These certifications will serve as a critical component of C4I delivery to the fleet by identifying and mitigating the operational impacts of degraded system performance.

NAVSEASYSCOM

NAVSEA is actively participating in the OSD AT&L rewrite of the DAG and is supporting the OSD AT&L Work Development Planning (WDP) and the Defense Standards Working Groups (WSWG). Further, NAVSEA is supporting System Safety and Acquisition Safety leads at OSD and ASN level to establish clear linkage for System Safety risk analyses and review process in SE processes. This effort includes participation on Mil-Std 882 joint service teams, engagement with OPNAV Safety Afloat policy development and Naval Safety Center Mishap response activities. This collaboration between SE policy leads and Safety leads ensures Safety risk is identified early and throughout the system design and development and ensures Safety risk is not just transferred to the operational community without a management strategy. NAVSEA is working closely with NAVAIR, SPAWAR, MARCORSYCOM and NAVFAC program systems engineers and SE policy leads. NAVSEA internal focus are for SE improvement is on governance processes, SETR criteria and includes ongoing efforts to ensure cross referencing across TA, SE, Test and Sustainment policy bases, and Program planning documents. This effort is focused on translating best practices into standard work packages for TA to ensure programs fully supported in their SE effort.

1.5.1 Status of FY 12 Planned Areas for Improvement Actions

- **Planned Action**: Develop an integrated framework to enable Interoperability and Integration activities. I&I activities being conducted at all of the SYSCOMs for multiple sponsors are being evaluated to determine best practices and the means to integrate the output. A framework is needed to integrate the processes, facilities, workforce capabilities, and Fleet needs to support integrated acquisition, design and test. Guidance will be issued third quarter of FY 12.

  Status: An Integrated Capability Framework Guideline (ICFG) has been drafted and made available on the NSERC website. Rather than issuing a separate document from the Mission Level System of Systems Engineering Guidebook, the two guidebooks will be combined in FY 13.

- **Planned Action:** Actively engage the SYSCOM TAs in all phases of the acquisition process, including early developmental planning. The SYSCOM TA structure has been fully established, PEOs have been encouraged to use this structure to support programs. TAs have been approaching PEOs to explain their ability to support the program's SE needs. DASN (RDT&E) CHSENG will use the SYSCOM TA structure in all of its technical tasking. The TA structure has been posted on the NSERC website so that the PEO can search for a TA by name or specialty.

Status: The TA structure has been posted on the NSERC website under the TA tab.

- **Planned Action:** Continue improving guidance and best practices for R&M. The establishment of the SYSCOM R&M working groups will support the complete integration of R&M into all SE products that support acquisition. A draft joint DON R&M and T&E policy to implement the R&M DTM-11-003 at all ACAT levels will be developed in 4th quarter FY 12.

  Status: A DoD DTM-11-003 Implementation Guide is in preliminary coordination. A draft joint DON R&M and T&E policy to implement the R&M DTM-11-003 at all ACAT levels is being developed and will be consistent with the aforementioned DoD guide. It will also provide guidance for naval implementation of the draft direction to include R&M data in the Defense Acquisition Executives System (DAES) reporting system per DTM-11-003. An update to the ASN(RDA) Dashboard is necessary to implement this new DAES requirement. A new R&M engineering page in the ASN(RDA)Dashboard will be recommended to provide the PM an opportunity to identify program efforts in this high visibility area.
  The DTM-11-003 related DAES Functional Data Description is also in preliminary coordination. The joint DON R&M and T&E policy draft and the recommendation for a new R&M engineering page for Dashboard will be finalized as the DoD documents are formally coordinated and issued.

  Planned Action: Integrate SETR evaluation criteria with the other system engineering processes. The NSEG is being revised by the SESG to link processes. Estimated completion date of this revised guide is 31 Dec 2012.

  Status: The SETR evaluation criteria are being integrated with other system engineering processes. The completion of the revision to the NSEG has been delayed until 31 July 2013.

- **Planned Action:** Document the I&I governance process that allows the Fleet to use SYSCOM SEs in conjunction with Fleet experts to analyze current gaps in I&I effectiveness. A policy memorandum will be released in the fourth quarter of FY 12.

  Status: The I&I governance process for current I&I gaps has been documented. A draft policy is undergoing coordination with OPNAV.

- **Planned Action:** Continue developing guidance and processes that support SoS design and procurement. SPAWAR is actively engaging in a SoS process in FY 12 supported by guidance developed by DASN (RDT&E) CHSENG. Lessons learned from SPAWAR's application of a SoS engineering process in pre-Milestone A development planning will be consolidated into additional SoS guidance and DASN (RDT&E) CHSENG's guidance will be revised in 4th quarter FY 12.

Status: SPAWAR is developing the ExARM process described in section 1.1.2 of this report. The process is still under development and lessons learned will be available in FY 13. Incorporation of the ExARM process and lessons learned will be incorporated into FY 14 Naval guidance.

2.0 Systems Engineering Workforce

2.1 Workforce Development Initiatives

DON workforce development strategy has centered on training, education, and certifications. This includes many employees taking college level classes towards degrees, and those enrolled in Master's degree programs at various colleges and universities. DASN (RDT&E) conducts yearly leadership development for the SE workforce through the Executive Leadership Development Program (ELDP) and also selects senior engineers to attend a nine month Fellowship for a program sponsored by the MITRE Corporation. Further, DoN has developed SE training that is tailored to specific domains and product areas to improve knowledge, skills and abilities of workforce members using specific SE concepts and processes. Specifically, in FY 12 NPS developed a certificate curriculum for HSI that is available on- site and through distance learning and a distance learning curriculum for a Master's Degree in SE with a System Development focus that includes courses in capability engineering, system integration and systems architecting.
DON work force development includes hiring the proper expertise and participating in the Navy Acquisition Intern Program (NAIP) and the SMART (Science, Mathematics and Research for Transformation) program. Program candidates routinely transition to DON positions to perform SE for acquisition, RDT&E, and system support.

The SE Competency Modeling Team (SECMT) benchmarked five models. The team extracted best practices to develop SE requirements for Knowledge, Skills and Abilities (KSA's) from the following sources:

- SE Workforce Development NUWC: selected by the team as DoD/DoN/NAVSEA/SYSCOM best practice
- INCOSE: International SE Industry Standard
- MITRE: US private sector SE Industry Standard
- SPRDE Learning Objectives
- DAU

The SECMT developed definitions for SE skill level and work experience. Definitions can be found in Table 1, below.

SE Experience Level	Definition	Work Experience	Education	Additional Training Req.
SE-1 ENTRY LEVEL	Able to understand the key issues and their implications. They are able to ask relevant and constructive questions on the subject. This level requires an understanding of the Systems Engineering role within the enterprise.	0-3 years of work experience	B.S. in Engineering	preferred/required defined in FY13
SE-2 JOURNEY LEVEL	Displays an understanding of the subject but may require minimal guidance and with proper training and opportunity will be able to provide guidance and advice to others.	3-6 years of work experience	preferred/required defined in FY13	preferred/required defined in FY13
SE-3 EXPERT LEVEL	Contains extensive and substantial practical experience and applied knowledge of the subject.	6+ years of work experience	preferred/required defined in FY13	preferred/required defined in FY13

Table 1: Naval SE Competency Descriptions

The best practice Competency Models were combined in a spreadsheet matrix and divided into Benchmarks that mapped to three naval SE experience levels. See Table 2.

Model	Experience Levels	Naval SE Experience Level
INCOSE	AWARENESS	SE-1 ENTRY LEVEL
MITRE	Foundational Behaviors	SE-1 ENTRY LEVEL
SE Workforce Development NUWC	ND-2 Entry Level	SE-1 ENTRY LEVEL
MITRE	Intermediate Behaviors	SE-2 JOURNEY LEVEL
SE Workforce Development NUWC	ND-3 Intermediate Level	SE-2 JOURNEY LEVEL
SE Workforce Development NUWC	ND-4 Journey Level	SE-2 JOURNEY LEVEL
INCOSE	SUPERVISED PRACTITIONER	SE-2 JOURNEY LEVEL
INCOSE	PRACTITIONER	SE-2 JOURNEY LEVEL
INCOSE	EXPERT	SE-3 EXPERT LEVEL
MITRE	Expert Behaviors	SE-3 EXPERT LEVEL
SE Workforce Development NUWC	ND-5 Expert Level	SE-3 EXPERT LEVEL
SE Workforce Development NUWC	ND-6 Executive Level	SE-3 EXPERT LEVEL

Table 2 Naval SE Experience Level Benchmarks

Over 2600 KSA's are being mapped to 31 Competencies and navy SE experience levels as illustrated in Table 3. A complete list of Education and Training requirements and mapping of all KSAs to competencies is planned to be completed in FY 13.

COMPETENCIES	SE-1 ENTRY LEVEL	SE-2 JOURNEY LEVEL	SE-3 EXPERT LEVEL	Grand Total
1.0 TECHNICAL BASIS FOR COST	2	5	3	10
2.0 MODELING & SIMULATION	39	60	36	135
3.0 SAFETY ASSURANCE	35	44	41	120
4.0 STAKEHOLDER REQUIREMENTS DEFINITION	20	57	42	119
5.0 REQUIREMENTS ANALYSIS	33	23	24	80
6.0 ARCHITECTURE DESIGN	26	51	33	110
7.0 IMPLEMENTATION	8	27	15	50
8.0 INTEGRATION	20	43	25	88
9.0 VERIFICATION	19	37	25	81
10.0 VALIDATION	8	32	23	63
11.0 TRANSITION	9	27	14	50
12.0 SYSTEM ASSURANCE	14	28	19	61
13.0 RAM	17	36	15	68
14.0 DECISION ANALYSIS	14	32	24	70
15.0 TECHNICAL PLANNING	11	32	13	56
16.0 TECHNICAL ASSESSMENT	8	22	19	49
17.0 CONFIGURATION MANAGEMENT	13	26	13	52
18.0 REQUIREMENTS MANAGEMENT	12	31	22	65
19.0 RISK MANAGEMENT	18	37	24	79
20.0 TECHNICAL DATA MANAGEMENT		2	7	9
21.0 INTERFACE MANAGEMENT	14	20	10	44
22.0 SOFTWARE ENGINEERING	5	8	6	19
23.0 ACQUISITION	29	51	31	111
24.0 SYSTEMS ENGINEERING LEADERSHIP	66	87	114	267
25.0 SYSTEM OF SYSTEMS	10	16	6	32
26.0 COMMUNICATIONS	38	40	44	122
27.0 PROBLEM SOLVING	12	25	25	62
28.0 STRATEGIC THINKING	14	27	35	76
29.0 PROFESSIONAL ETHICS	73	67	93	233
(blank)				
30.0 SYSTEMS THINKING	13	10	2	25
31.0 INDIVIDUAL AND INTERPERSONAL CHARACTERISTICS	38	71	67	176
0.0 Category Pending/Unresolved	7	10	2	19
Grand Total	645	1084	872	2601

Table 3: SE Competencies Mapped to SE Experience Level

For FY13, DON will participate in the Pathways program, which replaces earlier student programs, for recruiting and hiring students and recent graduates. DON will continue targeted training by expanding into Cyber Engineering classes and offer rotational assignments to current employees for career broadening assignments. Additionally, in FY13, a non-resident Master's degree program with a Systems Development focus will be offered at NPS Department of SE.

DASN (RDT&E)'s on-going development of SE competencies supplements DAU SE training. The DON SE Competency Development Models (CDM) is being validated through the NSERC to help guide employee's career development.

The DON I&I efforts have worked to develop Mission Area System Engineers (MASEs) that are trained in the technical curriculum normally found in a SE competency combined with an in-depth understanding of the operational issues surrounding the 22 missions the DON must execute. The MASE is a senior SE with expertise in engineering discipline through engineering products (e.g. architectures, requirements trees, and system design documents), Gate and SETR reviews, as well as expert knowledge across the Doctrine, Organization, Training, Material, Leadership, Personnel, Facilities (DOTMLPF) associated with a given naval mission.
The MASE support the acquisition process by:

- Developing mission-level architectures for assigned mission areas if no similar architecture exists in the DoN Enterprise Architecture exists. The mission level architectures will support the PEOs in the development of platform, system, and node architectures by providing sufficient information to rapidly develop DoDAF Operational View (OVs) and Systems View (SVs) at the platform or system level.
- Reviewing program-level architectures with other architectures for congruency. This review will support the PEOs by identifying potential interoperability misconceptions early enough in acquisition development to make corrections that do not significantly impact cost and schedule.
- Establishing maintenance, operations, and configuration management processes for mission-level integrated architectures for their assigned MA's. The intent is to make the mission level architectures re-useable by all PEOs and DoD stakeholders to prevent re-work and duplication of effort. Therefore, the information in those architectures must be accurate, up to date, and correctly interpreted by all users.
- Establishing effective working relationships with the appropriate Navy and Marine Corps Requirements/ Resource sponsors and Operational agents for their assigned mission area. The MASEs should be trusted partners in the development of operational concepts and alternative solutions to capability gaps. The MASEs should support the PEO by explaining the content, intent, and extent of a mission to the PEO.
- Evaluating the mission-thread performance for assigned mission areas through the Integrated Capability Framework (ICF) Process.

The MASE workforce will provide mission based technical continuity across the "as is", "as programmed" and "to be" capability for each mission area. The DON has developed mission

level SE training curriculum and is reviewing current organizational structures to better reinforce the importance of the MASE roles in the acquisition process.

The expertise of the MASE engineering workforce across the navy SYSCOMs was applied in three primary areas in FY 12. The goal of this work was to build on previously developed technical products and extend foundational acquisition processes, at the mission level. The three focused efforts are:

- Mission thread Architecture Development
- Analysis of the effectiveness of kill chains[5] in a mission area
- Developing guidance for the application of an ICF

The NAIP has a variety of career field Internships available.

- Financial Management Analyst
- Contract Specialist
- Logistics Management Specialist
- Operations Research Analyst
- SPRDE

Interns receive formal professional education and training at DAU. DAU is a DoD accredited corporate university that focuses on long-term career development for our professional AT&L workforce. Professional development is a critical component of the NAIP. Interns have the opportunity to work with world-class professionals and receive outstanding mentoring, as well as professional education and training. This is a 36-month full-time paid position in which successful applicants are placed in an immediate career path to manage people, programs, and technologies critical to our national defense.

Interns are responsible for maintaining satisfactory performance levels in all aspects of work performance, and can look forward to aggressive, merit-based promotions. Promotions normally occur at one-year intervals coupled with guaranteed full-time placement at the host command after successfully complete the Intern program.

DAWIA SPRDE Interns work with and are mentored by world-class engineering professionals within the DoD. Responsibilities include management and oversight of research, design, and development of leading edge defense technologies, and encompass the full spectrum of supporting activities across the system lifecycle. Interns may also participate in planning and executing transfers of current and future surface ships, submarines, boats, and defense technologies to foreign militaries.
Approximately 150 DAWIA SPRDE Interns participated in the Navy Acquisition Development Program (NADP) Annual Symposium 2012.

[5] A kill chain is the sequence of tasks that put a weapon on a target

The DAWIA SPRDE Program System Engineer (PSE) career field will be discontinued starting in FY14. The PSE career field was intended for DoN Acquisition Professionals candidates or incumbent GS 14/15 - 05/06 or senior seeking career as Program Lead Systems Engineer.

DON is working collaboratively with OSD to develop Common Cross Functional Key Leadership Position (KLP) requirements. KLPs positions considered are those listed in AT&L memorandum of August 25, 2010. Definitions for Specific KLP Requirements defining Attributes and Demonstrated Experience Beyond Level III are being developed based on the OPM-established leadership competencies. In FY13, DoN will provide OSD draft version of navy SE Competency Model (SECM) KSA matrix. DON will share experience gained from KSAs to SE competencies.

In FY13, as organizational changes are phased in, focus areas will include alignment of the workforce to support the SoS construct and defining and designing the environment to support the work force to provide the strongest possible support to the fleet.

SE Competency FY13 goals include:

1. Development of an effective operating model that supports the SoS construct;
2. Development of the people, processes, and tools that support the SoS operating model; and
3. Validation of a SE Competency Model

2.2 Additional Authorities or Resources Needed

The President's budget is sufficient to support planned programs. SE becomes more critical in a fiscally constrained environment. Training demand to increase the knowledge and skills of the workforce continues to challenge the budget.

2.3 Department of the Navy SE Workforce

Total Number of Civilian and Military Acquisition-SPRDE-SE/PSE Personnel				
Fiscal Year	**Year Ending**	**US Navy**		
FY05	30-Sep-05	16,886		
FY06	30-Sep-06	16,688		
FY07	30-Sep-07	16,804		
FY08	30-Sep-08	16,576		
FY09	30-Sep-09	18,085		
FY10	30-Sep-10	19,270		
FY11	30-Sep-11	19,325		
FY12	30-Sep-12	19,498		
Planned Growth in Civilian and Military Acquisition-Coded SPRDE SE & PSE				
Fiscal Year	**Year Ending**	**US Navy**		
As Reported In:		**FY10**	**FY11**	**FY12**
FY13	30-Sep-13	225	160	329
FY14	30-Sep-14	88	94	60
FY15	30-Sep-15	164	79	158
FY16	30-Sep-16		35	98
FY17	30-Sep-17			66
FY18	30-Sep-18			8
Planned End-State Total Number of Civilian and Military Acquisition-Coded SPRDE SE & PSE				
Fiscal Year	**Year Ending**	**US Navy**		
FY16	30-Sep-16	20,703		
FY17	30-Sep-17	20,393		
FY18	30-Sep-18	20,402		

Table 4: Department of the Navy SE Workforce

APPENDIX C

Department of the Air Force
Systems Engineering Self-Assessment

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Headquarters United States Air Force

Department of Defense Systems Engineering FY 2012 Annual Report

Prepared by the Office of the Assistant Secretary of the Air Force (Acquisition)
Total Hours for Preparation: 250

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Washington DC 20330-1060

27 November 2012

Air Force FY2012 Systems Engineering Self-Service Assessments

1.0 Progress and Plans for Improved Service Systems Engineering Capability

1.1 Service-Level Systems Engineering Strategy

The Air Force made several significant revisions to its strategy to improve systems engineering (SE), involving both organizational and policy changes. The office of the Assistant Secretary of the Air Force (Acquisition) re-structured its systems engineering policy into the overall Acquisition policy office to integrate policy development. The Air Force Deputy Assistance Secretary for Science, Technology and Engineering (SAF/AQR) experienced organizational and process changes. Air Force Materiel Command (AFMC) re-structured from 12 centers to 5 centers, consolidating center staff functions and reassigned many senior level Systems Engineering experts to program offices.

The Air Force prepared and coordinated a streamlined SE policy, aligning it with the Defense Acquisition Guidebook (DAG) guidance on systems engineering. Life Cycle SE policy (AFI 63-1201) was merged with Integrated Life Cycle Management policy (a revised AFI 63-101). The resulting policy will clearly define the roles and responsibilities of the Program Executive Office (PEO), Program Manager (PM), and Lead Systems Engineers (LSEs) when implemented. Compliant with the USD (AT&L) key leadership policy, the LSE is the senior engineer/technical authority responsible for ensuring implementation and execution of life cycle SE for Air Force acquisition programs. The Air Force is placing greater reliance on the SE guidance in the DAG as well as Air Force pamphlets and guidebooks to capture best practices and lessons learned.

SAF/AQR is the Air Force Senior Functional for SE, the Air Force Science and Technology (S&T) Program Executive, and Functional Manager for Scientists and Engineers (S&Es). SAF/AQR is the Air Force technical lead for technology transition, SE, and Development Planning. SAF/AQR provides technical advice to the Air Force Service Acquisition Executive (SAE) in support of pre-acquisition investment decisions, and conducts acquisition reviews of PEO programs to support Acquisition Strategy Panels, Air Force Review Boards, milestone reviews, portfolio reviews, and configuration steering boards.

SAF/AQR leads efforts to continuously improve SE capabilities that meet future Air Force requirements. SAF/AQR works with a coalition of Air Force senior leaders [PEO, Headquarter Air Force Capability and Functional Directorates, AFMC, Air Force Space Command (AFSPC), etc.] to facilitate its roles and responsibilities as the engineering technical authority for Air Force programs and functional manager of Air Force scientists and engineers. They advocate, oversee and ensure future strategies are in place to: 1) better organize, train, and equip the Air Force SE workforce; 2) support evidence-based decision making—drive efficiencies with reportable SE metrics, standardization requirements, and the right analytical tools; and 3) strengthen technical management of SE tenants such as system designs and integration, human system integration (HSI), modeling

and simulation (M&S), reliability and maintainability (R&M) across the life cycle of acquisition programs.

AFSPC, relying on Space and Missile Systems Center (SMC) for much of its SE expertise, increased its headquarters staffing with civilian engineers to augment the requirements generation and mission architecting processes. SMC reorganized its Engineering Directorate to add a GG-15 Lead Systems Engineer to focus more on: 1) detailed technical aspects of Program Executive Officer Space (PEO Space) SE; 2) pervasive technology on-ramp; 3) industrial base health; and 4) certifying entry and exit criteria of major design reviews. SMC also elevated its Mission Assurance Division to GG-15 level with added focus on system acquisition.

The AFMC re-structure to 5-Center construct was formally announced in November 2011 as a major part of AFMC's response to a Department of Defense challenge to find efficiencies. By reducing and consolidating overhead, the command enhanced its support to the warfighter. The new organizational structure reduced overhead, increased SE expertise with direct support to programs, improved lines of communication, as well as produced significant effectiveness and efficiencies by standardizing SE processes/tools. Additionally, resources at the Air Force Center for Systems Engineering (CSE) were realigned to better support program office implementation of DoD SE policy and guidance.

During the initial operational capability (IOC) roll out of Air Force Life Cycle Management Center (AFLCMC), the center developed and published 19 standardized SE process guides. These guides supplement DoD and USAF policy. Where appropriate, the AFLCMC SE process guides include tailored processes for ACAT Level II and below. Each guide contains a process definition, purpose and scope, process description, and a process audit description. These standard processes are established to improve efficiency, consistency of interface, and communication by clarifying roles and responsibilities.

A Milestone Decision Program Execution Toolkit (PET) has been instituted as the standard AFLCMC process for obtaining milestone decisions. The PET provides standardized templates for Milestone Decision Briefs, Acquisition Decision Memorandums, and Should Cost for each ACAT Level. These templates provide a communication tool for the PM to provide consistent and standardized content to the PEO at decision briefs. For example, technology maturity is required to be assessed and briefed to the PEO as well as the status of SE planning.

The AFLCMC Senior Acquisition Team (SAT) initiative is a panel of senior-level advisors that provides functional expert counsel at specific acquisition program decision briefings. The SAT panel assists AFPEOs and program teams in formulating effective program acquisition and milestone strategies. It instills consistency and efficiency across AFLCMC programs by sharing knowledge, best practices, and lessons learned. This ensures the Chair/MDA has the best possible advice needed to make high quality acquisition and strategy decisions. To make the most efficient use of resources, ACAT I programs are supported with SES and GS-15 engineers, while the SAT is made up of GS-

15s and GS-14s for ACAT II and III programs. The SAT initiative supports early identification and management of technology, engineering and manufacturing risks and that those risks are characterized for decision makers at program reviews prior to commitment of resources.

All AFLCMC units conduct an annual self-inspection on their life cycle SE. SE practices determined critical to compliance with statutory and regulatory requirements are inspected using a checklist. The results of this inspection and substantiating documentation is recorded and made available for independent review. Non-compliances are reported to PEO/PM leadership and recovery plans are tracked to completion. This continuous validation process ensures program implementation of SE meets Air Force standards.

Additionally, AFMC took several steps to improve SE over the past year. These include: issuing a change to AFMC Instruction (AFMCI) 63-1201, *Implementing OSS&E and Life Cycle Systems Engineering*, conducting three SE Unit Compliance Inspections (UCIs), drafting updated policy to clarify the requirements for SE plans especially in the sustainment phase, and placing an increased emphasis on SE strategic planning.

The Air Force FY13 SE strategy is to fully implement both the Air Force STEM Workforce Strategic Roadmap and the Air Force Systems Engineering Strategic Plan. These plans support the development of life cycle SE that promises to provide better war fighting systems in less time and cost with less risk in support of transparent acquisition decision making by the Air Force Service Acquisition Executive (SAE). Working directly with the PEOs, SMC, and AFMC, the Air Force top priorities for improving SE capabilities (people, policy and processes) are to:

1. Increase technical expertise in STEM: a) define a competent SE in terms of experience, training, education and mentoring, etc, and identify where/how Air Force SE inventory is lacking; b) assess the state of SE's career development and offer possible improvements; and c) establish functional training and education requirements for technical expert track.

2. Drive efficiency through tailored/flexible standardization of policy, processes, practices, tools, training and metrics: a) focus technical activities (software, R&M, configuration management) supporting SE and ensure specialty areas are adequately planned for, resourced, and integrated into SE strategy; b) integrate sustainment considerations into SE strategy; c) continue to engage in SE forums to actively promote collaboration across all applicable functional areas and external support entities.

3. Support Air Force SAE transparent decision making: a) ensure early identification and management of technology, engineering and manufacturing risks and that those risks are characterized for decision makers at program reviews prior to commitment of resources; b) ensure all engineering authorities are at the appropriate grade level, are members of the integrated life cycle governance structure and process an equal vote to other functional leads on policy and program decisions; c) establish a pool of

independent subject matter experts (SMEs) to support PM and MDA during technical reviews and provide an overall assessment of design maturity and a summary of the system-level results;

1.2 Pre-Milestone A and Pre-Milestone B Rigorous Systems Analysis and Systems Engineering Process:

As stated in our 2011 report, *"Development Planning products identify technical and technology feasibility, operational, and programmatic issues associated with concepts for prospective materiel solutions. In so doing, they enable integrated risk assessments to technically inform pre-acquisition and S&T investment decisions."* Concepts (prospective materiel solutions) increase in technical maturity as they advance through the early SE process to implementation analysis. Following the Materiel Development Decision (MDD), the sponsor and the acquisition community continue operational, technical, and programmatic analyses during the Materiel Solution Analysis phase. The Analysis of Alternatives (AoA) Study Team, generally led by the sponsor, is charged to address critical areas including operational and employment concepts; threats and scenarios; technologies and alternatives; effectiveness; life cycle cost; and risk. The AoA report provides an integrated assessment of the concepts along with relative "ranking" in each of the analytical areas and it serves as the basis for the sponsor's selection of a preferred system concept to be brought forward to the Milestone A decision.

In FY 2012, the Air Force matured its efforts to better align planning for S&T, technology transition, and development Capability Collaboration Teams (CCTs), as established in draft AFI 61-101, Management of Science and Technology, were formed to work through Major Command (MAJCOM) capability needs and identify potential materiel solutions and the S&T necessary to develop these capabilities. MAJCOMs, Centers, and the Air Force Research Laboratory (AFRL) participated in CCTs as required to conduct SE decompositions to determine if S&T is required to address Center technology needs.

CCTs yield a set of vetted and prioritized MAJCOM S&T needs based on an examination of critical technologies required for ongoing or prospective materiel solutions. Following S&T needs identification the CCTs identify and vet potential S&T solutions mapped to MAJCOM capability needs by mission area. Recommended S&T solutions may become internally managed AFRL S&T projects, or may be proposed as candidate Advanced Technology Demonstrations, Flagship Capability Concepts, or Joint Capability Technology Demonstrations. For each approved candidate, a transition planning Integrated Product Team (IPT) develops and coordinates a Technology Transition Plan.

AFSPC implemented several FY12 initiatives to strengthen developmental planning. These include the SMC SEP Development Guide (SSDG), the operational acceptance process, space mission decision support, and a hosted payload strategy.

To help SMC programs conduct SE planning per the OSD Outline, SMC published the SSDG. The SSDG provided a repeatable process for SEP reviews as well as for

maintaining SEP currency and relevance. The SSDG significantly decreased staffing time; it provided a framework for OSD to easily compare SMC SEPs per OSD guidance. Additionally, SMC programs now have a proven process for developing accurate and timely SEPs.

To resolve apparent systemic difficulties arising late in the operational acceptance process, SMC conducted a value stream mapping event to document "as is" and "to be" operational acceptance process architecture. AFSPC/A3 conducted a rapid improvement event in parallel with the SMC effort. Both of these efforts emphasized the importance of establishing operational acceptance criteria during capability DP. To synergize such efforts, AFSPC included the operational acceptance process as a topic for AFSPC Frontier Focus, a leadership exercise where the Command's brightest professionals focus their efforts on assigned topics. Frontier Focus confirmed the results of both the SMC and AFSPC/A3 exercises, which are expected to propel AFSPC/CC to effect the necessary cultural changes to promote operational acceptance process discipline.

To better employ space capabilities in the current launch-constrained environment, AFSPC collaborated with the National Reconnaissance Office and NASA to develop a disciplined process to assess and trade launch manifest alternatives. This provided senior decision makers better schedule and risk confidence assessments to set the launch manifest for national security space missions. This improvement enabled DoD to launch more missions and avoid costly delays. Launch opportunities increased 25% in FY12.

SMC also stood up a Hosted Payload Program Office within the DP Directorate. This office promoted resilience and affordability. Per SMC/CC directions, all capability analyses of alternatives are required to consider hosted payload strategies within the materiel solution set.

Air Force S&T activities are supported and informed by the following development planning efforts: 1) S&T communities identify technology maturity, as well as opportunities (e.g., the "art of the possible") to inform the formulation and consideration of candidate concepts; 2) development planning communities identify technology needs and technical risk areas of candidate concepts to inform S&T planning; and 3) the Air Force conducts the necessary development planning activities to transition Advanced Technology Demonstrations, Flagship Capability Concepts, and Air Force-led Joint Capability Technology Demonstrations into acquisition programs.

The results of early SE and DP activities directly supported the capability development planning portions of the Air Force Strategic Planning System. Over the past several years, the Air Force developed Core Function Master Plans (CFMPs) that align strategy, operating concepts, and capabilities for each of the Air Force's 12 Service Core Functions over a 20-year horizon. The DP community specifically supported the CFMPs by developing capability roadmaps that identify potential materiel solutions and S&T needs to solve documented capability gaps. These capability development roadmaps are integral to planning the future of the Air Force.

In FY 2013, the Air Force will improve DP activities to provide the analytical underpinnings necessary to make sound acquisition decisions. The Air Force DP Governance Structure is taking an active role in developing a common understanding of DP across the Air Force. Best practices will be identified and communicated to ensure DP activities are conducted and resources are leveraged effectively and efficiently. One specific initiative is to investigate the use of cost and capability assessments to assist operational users in establishing affordable requirements by evaluating the cost of various increments of capability.

During FY12, the Air Force undertook a Capabilities Based Assessment (CBA) of Analysis and Assessment (A&A) activities supporting Life Cycle Management. A&A capabilities include M&S data, people, organizational, and analytical methodologies and tools. The CBA is an effort to examine current analytic capabilities and assess the adequacy of processes, tools and environments in providing adequate, timely and relevant information to support key life cycle decision making. The results of the CBA will be used to support enterprise A&A resource allocation and strategic planning. Initial CBA results will be available in FY13.

As noted in section 1.1., the re-write of AFI 63-101 fully integrates SE into the overall Acquisition and Sustainment life cycle management process, which includes Materiel Solution Analysis and Technology Development. The revised AFI places repeated emphasis on the need to initiate SE and all other program management activities as early in the life cycle as possible. The AFI also requires that the LSE be appointed at the same time as the program manager in order to ensure the earliest possible initiation of program technical planning. The AFI focuses PEOs, PMs, and LSEs on the mandatory elements of SE and other Acquisition activities. In addition, in FY2013 AQ will continue to work with Air Force/A5 to enhance early SE support to the JCIDS process (see section 1.4.).

The Air Force continued its FY11 Modeling & Simulation (M&S) efforts being conducted by an Air Force IPT. This team was established to support ongoing Deputy Assistant Secretary of Defense for Systems Engineering [DASD(SE)] efforts to position Modeling, Simulation, and Analysis (MS&A) as a consistent and trusted tool within the SE domain to support acquisition. A new Air Force governance structure established Life Cycle Management as one of three pillars of M&S, along with Analytics and Operations/Test/Training.

In FY12, this IPT was recognized throughout Headquarters Air Force (HAF), AFMC and OSD for leadership and innovation in improving M&S in acquisition. The team provided invaluable contributions by ensuring Air Force M&S governance addressed Vice Chief of Staff of the Air Force (VCSAF) guidance and stakeholders concerns. The IPT accomplishments include: 1) authoring language ensuring M&S addressed LCM considerations and defined all implementation tasks; 2) updating AFI 63-101 to establish policy to plan and implement M&S considerations to support Air Force programs; 3) developing governance for LCM using the integrated life cycle management (ILCM) Executive Forum and existing organizations and processes; 4) submitting research and development (R&D) recommendations to National M&S Coalition used to develop

national agenda fostering M&S adoption; and 5) obtaining senior Air Force M&S leaders' support and working with multiple organizations to obtain FY13 funding.

SAF/AQR refocused its Product Support Reviews (PSRs) with increased emphasis on complementing PEO/PM efforts to build in quality much earlier in the acquisition life cycle through early program engagement and specialty area (technical areas which support systems engineering) improvements. For example, the Air Force supported pre-program efforts of the Eagle Passive/Active Warning & Survivability System (EPAWSS) program management office (PMO). This included helping the PMO understand the needed content in Concept Characterization and Technical Descriptions (CCTDs), assist in defining and documenting viable options that became the options in the AOA, and review the documentation and technical approach. The Air Force also provided early SE assistance for Spacefence, Global Positioning System (GPS), and F-22 Raptor Increment 3.2 B PMOs. These programs received pre-SEP preparation and independent Technology Readiness Assessment guidance that supported execution of rapid assessments identifying timelines required for meeting upcoming MS-B requirements without causing delays.

The Air Force addressed lagging specialty areas by focusing efforts to improve policy, process, and people concerns. Efforts are focused on specialty areas such as acquisition intelligence, corrosion prevention, open systems design, and R&M. In the R&M specialty area, SAF/AQR established links with DASD/SE, the other services, AFMC, and SMC to form a collaborative R&M team of subject matter experts (SMEs) to address: 1) policy changes to be included in the Directive-Type Memorandum (DTM) 11-003 Implementation Guide; 2) processes for developing SMEs to serve as the Air Force conduit to individual programs; and 3) people requirements for standard Air Force R&M training, capacity and capability concerns. Additionally, an R&M SME team helped Global Hawk (GH) PMO respond to an acquisition decision memorandum (ADM) requiring a R&M review be conducted to identify opportunities to improve reliability and sustainability.

AFLCMC/ Engineering & Analysis (XZ) completed the Joint Future Theater Lift technology study with participation from the Army, Navy, and Air Mobility Command. The effort provided a rigorous look at airlift technologies to meet a challenging short-takeoff capability. While the requirements will not be taken forward by the services, the results of the effort will leverage the Capability Based Analysis and future airlift technology strategies.

Additionally, AFRL conducted and documented early SE activities in all major technology demonstration efforts (e.g., precision air drop capability). To lead these activities, AFRL established a LSE position both at its Headquarters and in each of the Technical Directorates.

1.3 Reliability, availability, maintainability, and sustainability as an integral part of design and development:

The Air Force continued collaborative efforts to develop and implement R&M policy and processes. The SAF/AQR R&M service lead directly interfaces with the DASD(SE) R&M engineering focal point, Air Force R&M SMEs, and represents the Air Force at DASD(SE) Service Lead Meetings. Noteworthy activities include:

1. The SAF/AQR service lead and Air Force SME team members worked with DASD(SE) to develop implementation guidance for the Materiel Solution Analysis, Technology Development, and Engineering, Manufacturing, Development acquisition lifecycle phases. Comments were coordinated to the satisfaction of Air Force R&M engineers.

2. The SAF/AQR R&M service lead organized and led an Air Force/Army/Navy R&M SME team in the review of the Global Hawk program in accordance with a June 2011 Nunn-McCurdy Certification ADM action. The SME team developed findings and recommendations based upon a review of technical data and interactions with the program management office, prime vendor, Defense Contract Management Association (DCMA) and maintenance organizations. Review results were presented to the PM, PEO, and DASD(SE) and endorsed at all levels. Lessons learned can be shared with other Air Force Major Defense Acquisition Programs (MDAPs) and are available to the Army and Navy as well.

3. The Air Force Institute of Technology (AFIT) Graduate School, in concert with SAF/AQR, designed two R&M training courses utilizing Defense Acquisition Workforce Development Fund resources. One is a two day course titled "Introduction to Reliability and Reliability Growth." The other is a 4-1/2 day course titled "Reliability and Reliability Growth Foundations." Both courses provide standardized training to R&M practitioners and other program office personnel in critical areas including implementation of DTM 11-003 and planning and executing a reliability growth program. To date, course instruction has been provided to personnel at the following Air Force bases: Eglin, Hanscom, Hill, Los Angeles, and Wright-Patterson. AFSPC, in conjunction with AFIT, is pursuing development in FY13 of a specialized space R&M curriculum. This curriculum will include hands-on training where students will practice generating reliability growth curves and satellite mean mission life predictions.

4. In FY11, the R&M service lead began the development of an R&M attachment to the draft Air Force Instruction (AFI) 62-101, Systems Engineering. However, draft AFI 62-101, intended as a replacement for AFI 63-1201, was terminated in FY12 as a result of the SAF/AQ reorganization. To further support this reorganization, the Air Force incorporated SE police into a revised AFI 63-101, Acquisition and Sustainment Lifecycle Management. The revised policy will be published in FY13.

5. In August 2012, SAF/AQR requested that PEOs identify their top five problematic technical specialty areas. Two PEOs identified R&M as problematic. PEO input assists SAF/AQR in determining future technical focus areas. R&M remains a focus area for SAF/AQR and SAF/AQR has recently hired a GS-14 engineer to specialize and to contribute to R&M management.

In FY13, AFLCMC plans to develop a Reliability Working Group (RWG) to synergize R&M efforts to effectively monitor the health of the AFLCMC by providing oversight of reliability, maintainability and sustainability. Goals and action plans will be developed centering on the core competencies of product support such as Reliability and Maintainability, Sustaining Engineering, and Software Sustainment. Additionally, tools and skills necessary for implementing effective R&M programs and processes will be identified throughout the Air Force portfolio. AFLCMC's overall R&M lead, the AFLCMC/EZP Technical Advisor, provides process oversight for R&M related acquisition activities at Wright-Patterson, Eglin, and Hanscom Air Force Bases.

The AFLCMC RWG offers the opportunity to create an R&M governance structure which can influence Air Force-wide R&M related policy, process, and human capacity concerns and initiatives. The governance structure must be expanded beyond AFLCMC to include the space and sustainment communities.

The RWG will address R&M capacity and capability issues across the Air Force. There is differing business models used to acquire, retain, train, and develop R&M talent. For instance, within AFMC, AFLCMC utilizes designated R&M positions. AFLCMC does some external hiring of R&M talent to support Program Office needs based upon PEO input. The Palace Acquire Intern program is one avenue; Section 852 hires are another. This is a zero sum game however – R&M hires are not placed upon newly created billets, but rather assume vacated billets. Other R&M demand is satisfied via reassignments (e.g. an R&M engineer backfills a billet vacated by a propulsion engineer) as determined by the current needs of the Program Office. AFLCMC has developed training plans for each engineering discipline including R&M and conducts periodic R&M training open to all R&M talent. SAF/AQR is engaged with AFLCMC's effort to complete a competency mapping process to ID R&M engineers and to map R&M competencies to positions. This competency mapping process may be useful to the RWG. The Air Force Sustainment Center (AFSC) uses a different approach. There are no designated R&M positions at AFSC. Rather, R&M tasks are accomplished through participation of the entire engineering and technical staff. This model differs from that of AFLCMC and must be addressed in accomplishing R&M tasks in the logistics realm.

Once established, SAF/AQR as S&E Functional Manager (see paragraph 1.1), will assist the RWG by advocating R&M workforce concerns and initiatives. SAF/AQR uses three avenues to influence and shape the larger Air Force S&E workforce (of which R&M practitioners are a subset):

1. SAF/AQR leads annual S&E development teams (DTs), which convene at the Air Force Personnel Center, to review individual career development plans and provide

their best career development advice (called vectors). The Intermediate DT is comprised of S&E GS-15 and equivalent grades and provides force development guidance to S&E GS-11-14 and equivalent grades. S&E workforce participants are evaluated against one of three career paths; R&M practitioners and other "tech experts" are evaluated in the technical expert path, which emphasizes a competency set including depth in a technical specialty, technical society participation, and advanced education.

2. SAF/AQR chairs the Scientist and Engineer Advisory Council (SEAC), an executive body which influences policy and hiring decisions affecting the entire Air Force S&E workforce. Council members include Air Force Materiel Command, Air Force Space Command, Air Force Test & Evaluation, the Air Force Chief Scientist, and the Acquisition Career Management Division (SAF/AQH).

3. SAF/AQR has a functional link to SAF/AQH. The Chief of AQH has the role of S&E Career Field Manager (CFM), a supporting role to the SAF/AQR S&E FM. This linkage provides a mechanism for SAF/AQR to effect training, education, accessions, etc., when S&E workforce deficiencies are identified.

1.4 Systems Engineering Requirements During the JCIDS Process and in Contract Requirements for each MDAP:

The Air Force codified Development Planning (DP) and its early SE processes and key artifacts in AFI 63-101, *Acquisition and Sustainment Life Cycle Management*, and AFI 63-1201, *Life Cycle Systems Engineering*. Building upon the successes of FY 2011, several DP efforts produced Concept Characterization and Technical Descriptions (CCTDs) for review in preparation for MDDs. Examples of CCTDs developed are Ground-Based Strategic Deterrence, Hard Target Munitions (HTM) and Non-Kinetic Counter Electronics (NKCE).

FY12 DP efforts guided Air Force leadership in producing key deliverables that ensured investment decisions were backed with sound analysis. Multiple CCTDs were integrated, staffed and used as part of the Complete Concept Analysis (CCA) for NKCE. The Long Range Standoff (LRSO) weapon benefitted from the analytical underpinnings of multiple CCTDs that supported ongoing activities during FY 2012. Additionally, the North America Air Domain Awareness (ADA) Surveillance DP effort investigated alternative solutions for persistent aerial surveillance of North America. This DP effort focused on the following conceptual areas of interest: external, internal, regional and event-driven point defenses. All FY 2012 CCTDs were developed and updated for system concepts that satisfy the Integrated Air and Missile Defense ICD in order to support the MDD and the AoA for ADA. System concepts, life cycle cost estimates and planning inputs were provided to AFRL, AFLCMC Mobility Directorate, and Air Mobility Command for future integration of several technologies being developed under the Precision Airdrop Flagship Capability Concept (FCC) to ensure requirements development, acquisition budgets and program plans will dovetail with the technology developments. Trade space analysis and

concept development continued with the F-X capability development for F-22 replacement. Based on earlier results, the scope for the capability was expanded and renamed Air Dominance to account for the broader scope that is platform agnostic.

In FY2012, AFMC continued its efforts focused on implementing Objective 7.2 of the Air Force Systems Engineering Strategic Plan: "Ensure that all technical risks are identified and assessed within the trade space before each Milestone decision as part of the Air Force Program Support Review process." AFI 10-601, *Operational Capability Requirements,* directs the Commanders of Air Force Materiel Command (AFMC/CC) and Air Force Space Command (AFSPC/CC), and the Service Acquisition Executive to certify to the Secretary of the Air Force that space and non-space system requirements: 1) can be translated for evaluation in a source selection in a clear and unambiguous way; 2) are prioritized (if appropriate); and 3) are organized into feasible increments of capability. These requirements appear in Capability Development Documents (CDDs) for ACAT I and non-delegated ACAT II programs. For delegated ACAT II and ACAT III programs and Capability Production Documents (CPDs) as feasible, AFMC/CC attests to the requirements as described in the CDD. The certification or attestation occurs concurrently with presentation of the CDD or CPD to the Air Force Requirements Oversight Council. These actions represent further translation of operational and technical requirements into contract requirements.

In response to the OUSD (AT&L) November 2010 memorandum, *Better Buying Power*, the Air Force continued FY11 efforts of incorporating direction to conduct and review "*systems engineering tradeoff analysis showing how cost varies as major design parameters and time-to-complete are varied"*. As a result, each Center commander has appointed a Center Level Technical Authority (CLTA) who assesses the adherence of program offices to Center-level SE policies, practices, guidance, tools, education and training. The CLTA also assists the PEOs in the appointment of LSEs specifically assigned to each program. The PM will ensure that overall responsibility for SE implementation is assigned to their LSE and is responsible for directing implementation of rigorous SE practices across all program areas.

In FY2013, SAF/AQ and Air Force/A5 will work together to provide increased technical support for Air Force High Performance Teams (HPTs) that conduct JCIDS studies and document development. Early SE support to HPTs enhances technology risk and affordability of system solutions being considered as part of the Doctrine, Organization, Training, materiel, Leadership and Education, Personnel, and Facilities (DOTmLPF) analyses. In addition, the Air Force/A5 HPT initiative will establish and maintain a consistent team membership (to include technical support) throughout the capabilities development activities from pre-MDD to the Milestone B completion of the CDD.

AFLCMC developed and published comprehensive guidance for incorporating engineering requirements with Requests for Proposals (RFPs). The guide assures that all the planning and processes of a SEP are captured in the RFP and in the subsequent executed contract. It also includes reliability analysis, planning, tracking, and reporting guidelines based on the latest OSD direction. This RFP guide provides a checklist for the

different RFP sections and program phases. The guide contains sections on preparing a System Requirements Document (SRD) and Statement of Work template language for the tenets of Systems Engineering, such as Human Systems Integration, Airworthiness, and Technology Readiness. All of this information is based on the latest policy and recent program experience as well as leveraging Air Systems, Armament Systems, and Electronics Systems RFP Guidebooks. The Guidebook also includes a formal review process for engineering to assure the best possible and technically sound RFP is produced. As the SE Standards (discussed below) are completed, the LCMC guidance will incorporate the appropriate use of those standards in contracts.

To engage programs early, Air Force/AFLCMC has institutionalized Multifunctional Independent Review Teams (MIRTs) and Air Force Red Teams that provide independent assessments of acquisition program plans, processes, and activities regarding RFPs and Source Selections. With respect to SE, MIRTs review RFP documentation to ensure that sound SE principles and practices are infused into the source selection and resulting contract. This includes unambiguous and objectively verifiable technical requirements; planning and criteria for executing successful program technical reviews; and assessing the maturity of technologies and manufacturing critical processes.

Air Force participated in OSD-led working group that performed a gap analyses to identify requirements gaps and to make recommendations for standards development. Existing industry and government standards were reviewed for suitability for contract compliance. The recommended path forward was to develop new military standards for SE and Technical Reviews and Audits, using SMC standards SMC-S-001 and SMC-S-021 as starting points. This approach was briefed to the DSC which redirected the effort to investigate the development of industry standards. DSC assigned Air Force the lead, and the Air Force tasked SMC to chair the working group which now is developing an approach to define effective industry System Engineering standard practices that: 1) enable consistent definition of required RFP and contract SE tasks, thus leveling the playing field for competitive proposal evaluation; and 2) provide an improved foundation for PM and SE workforce training. The working group consulted with Nation Defense Industrial Association, Aerospace Industries Association, and relevant non-government standards development organizations (SDO) to ensure DoD objectives are compatible with and supported by industry partners. The working group is now in the process of selecting a non-government SDO such as International Organization for Standardization , Institute of Electrical and Electronics Engineers, TechAmerica, etc., who will partner with the government in the development of an SE standard and a Technical Reviews and Audits standard. The criteria for selection of an SDO are in process of being developed.

Air Force standardization activities in 2012 are a continuation of efforts initiated with DASD (SE) and the other Military Departments in mid-2010 through the Defense Standardization Program and Defense Standardization Council (DSC) to address acquisition performance issues stemming from the loss of SE standard practices. Joint service working groups were formed to assess existing systems engineering technical documentation in the areas of SE, Technical Reviews and Audits, configuration management (CM), Logistics Support Analysis, and Manufacturing.

The Air Force is supporting the configuration management standard working group, under Navy leadership, efforts to define and develop a common DoD-suitable non-Government standard practice. The Air Force is also supporting an Army effort to complete a contract-suitable configuration management military standard for interim use until a non-Government standard is available.

The Air Force also collaborated with Army, Navy, DASD (SE) and DASD (MR) in an effort with TechAmerica to publish a product (logistics) support analysis standard in November 2012 for contract use and in the common effort to update an existing military handbook for guidance to DoD personnel on the product support analysis process and use/tailoring of the standard in early 2013.

Several initiatives were started in FY12 and are continuing in FY13 to improve JCIDS systems engineering support:

1. **Product Support Evaluation**. All JCIDS evaluations are being expanded with gap analysis for product support requirements (such as R&M) which will enhance requirements development through specific inputs for ICDs and CCTDs.

2. **CFMP Affordability Assessments**. Plans are being developed to conduct affordability assessments for the Core Function Master Plans to help the Lead Integrators screen or prioritize future requirements for affordability considerations. The affordability assessments will require a more streamlined version of JCIDS analysis to be conducted to define applicable materiel solutions for the gaps and shortfalls identified in the CFMP. By taking forward a reduced number of requirements into JCIDS, we can improve the quality of each development and reduce risk with false starts.

3. **Lower Fidelity Operations Analysis**. Based on lessons learned from previous JCIDS developments, AFLCMC has begun applying lower fidelity models to directly evaluate concept employments (CONEMPS) and bracket requirements for materiel solutions. The complexity of system of system solutions and networked architectures limits the ability of operators and analysts to conceive and test the full range of applicable concepts, but higher fidelity models would be too impractical and expensive to apply. This effort was constrained by funding for several years and is now underway.

4. **Reaper Capability Planning & Analysis**. A JCIDS project is being planned for FY13 with the Reaper program that will include tradespace analysis, operational analysis and affordability trades to recommend a common architecture to accommodate many future requirements in conjunction with a block upgrade. This is a non-traditional approach to develop a more robust design for the integration of new sensors and weapons that would systematically evaluate options to expand capability and reduce life cycle cost versus evaluating the integration of each requirement separately.

1.5 Area for Improvement Identified in FY 2011: Reliability, Availability and Maintainability (RAM).

DTM-11-003 implementation: This is an SMC ongoing initiative with SAF/AQ and DASD(SE) to accommodate DoD reliability growth guidelines into national security space programs that accounts for the one-shot nature of space missions. This initiative, currently in its infancy, is expected to fully realize the intent of the DoD reliability growth direction.

Global Positioning System (GPS): The Global Positioning System Directorate updated its satellite storage requirements to match what is routinely achieved in the field. Originally GPS storage requirements were 20% humidity, but when the satellite vehicles (SVs) are purged in storage, the humidity levels drop to close to 0%. The reduction in humidity promotes extended satellite storage life.

R&M Improvement: Military Satellite Communication (MILSATCOM) Directorate conducts reliability, availability and maintainability improvements in accordance with the Directorate and individual program SEPs. In addition, MILSATCOM established Product Improvement Working Groups (PIWGs) as the forum for operational users to identify and assess R&M problems, develop corrective actions and implement improvements.

1.6 Area of Progress and Improvement Identified in FY11: Training of acquisition workforce

Systems, Programming, Research, Development, and Engineering-Systems Engineering (SPRDE-SE): Steady state training achieved for the Air Force SPRDE-SE; SE community continues to benefit from additional resources for training made available through the Defense Acquisition Workforce Development Fund (DAWDF). For example, thanks to DAWDF, the Air Force is able to give civilian engineering personnel the same initial skills course opportunity (Air Force Fundamentals of Acquisition Management) that is required for military personnel in engineering career fields. This training includes an introduction to fundamental project management skills applicable to all engineering disciplines.

Specialty Engineering Discipline Training: Based on the recently published Specialty Engineering Disciplines, SMC developed coursework in Quality Assurance, Subcontractor Management, and Manufacturing and Producibility to address gaps in specialty engineering training. DAWDF funding was used in FY12 to continue delivery an Introduction to Developmental Planning course, Technical Readiness Assessment course, and Manufacturing Readiness Assessment course, all through AFIT

Planned Improvement: The Air Force will complete development of an HSI course in FY13 utilizing DAWDF.

1.7 Area for Improvement Identified in FY 2011: Identification of Systems Engineering and Development Planning resources across the Air Force

The Air Force continues to improve the identification of SE and DP resources through the Core Function Master Plan development process. The Air Force has made great strides in integrating S&T and DP into the CFMP development. In conjunction with program office SE departments, the S&T and DP communities supported the CFMPs by developing technology and capability roadmaps that identify potential materiel solutions and the associated S&T needs. Roadmap development brought together the SE, DP, and S&T communities and produced resource planning documents for future Air Force capabilities.

AFMC's Center-Level Technical Authority: As stated in last year's report, paragraph 1.6, the Center-Level Technical Authority (CLTA) positions have improved visibility and management of SE and DP resources across the Air Force. The establishment of the Director of Engineering position at the AFRL two-letter organizational level solidifies this function as the AFRL Technical Engineering Authority. Also, the Director represents AFRL at the Development Planning Working Group, the group responsible for recommending resource investments in DP activities across the Air Force.

AFRL is improving systems engineering and technical management by committing to enterprise-wide training. LAB 202, *Advanced Science and Technology Program Management*, funded by DAWDF, is a joint AFRL/AFIT training class required for any scientist or engineer who manages an AFRL program. It includes best practices such as applying systems engineering process to S&T program initiation proposals. Over 2,100 AFRL scientists and engineers have taken the training.

Space Flightworthiness Criteria (SFWC): The SFWC was developed to ensure the Operational Safety, Suitability, and Effectiveness (OSS&E) of space missions. It distills good systems engineering practices to a set of checklists applicable to each acquisition phase and to the launch campaign. Because the SFWC has demonstrated value in SMC launch campaigns, SMC/EN is developing a similar set of criteria applicable to the terrestrial segments of SMC programs.

Test Like You Fly (TLYF): TLYF integrates developmental test and evaluation (DT&E) with the SE processes at SMC. TLYF is a SE process that creates an enhanced, more robust form of DT&E using operational test and evaluation (OT&E) principles and techniques. It is a blend of traditional DT&E and OT&E that includes specific test techniques that apply mission operability characteristics to DT&E. Mission characteristics include space environment (e.g., radiation, thermal, vacuum) and mission attributes (e.g., commanding, telemetry, configuration, operations environment, continuous clocks, etc.). This approach to test design differs from traditional functional or performance tests for requirements verification because it takes place in a more dynamic, realistic environment that emulates real world conditions and missions as much as possible without going into space. It is designed to demonstrate that the item under test is capable of performing its tasks in the context of mission conditions and timelines. SMC Commander issued a Guidance Memorandum in FY12 directing all SMC space programs

to implement a TLYF strategy. The key elements of the approach were codified in the draft SMC Supplement to AFI 99-103 to be published in FY13. Additionally, key TLYF requirements language was developed for inclusion in SMC contract compliance documents.

Specialty Engineering Disciplines (SED): Published by SMC on 3 Oct 2011, "Specialty Engineering Disciplines" includes the essential activities, tasks, and products that shape the body of knowledge for each specialty engineering discipline. This framework is required to effectively scope, plan, staff, execute and integrate specialty engineering activities (e.g., Manufacturing and Producibility, R&M, HSI, Test and Evaluation, Spectrum Management). It supports DoD STEM Strategic Plan Goal 1 by aiding in the definition of Air Force requirements for STEM talent.

1.8 Area for Improvement Identified in FY 2011: Air Force Update on Government Accountability Office (GAO) SECTION 804-Software Acquisition Improvement Program

The FY 2003 National Defense Authorization Act (NDAA) Section 804, *Improvement of Software Acquisition Processes,* requires DoD, the Services and Agencies to implement software acquisition improvement programs and provide specific requirements for these programs. In FY 2009, the GAO recommended DoD report periodically to Congress on Section 804 implementation. DoD's response to the report, agreed to by the GAO, was to address this recommendation as part of the annual Weapon Systems Acquisition Reform Act (WSARA) report.

Software Acquisition Guidebook (SAG): The SAG is complete with a web accessible tool. This valuable resource has been accessed by the Navy, Vandenberg AFB, Electronic Systems Command (ESC) and various software acquisition agencies.

Software Measurement Standard: The Software Measurement Standard will provide a core set of metrics to simplify the art of selecting and utilizing software metrics in managing software acquisition cost and schedule growth as well as performance and suitability. It has been informally reviewed by numerous industry partners. Currently in early informal comment stage, the first formal coordination gate will be the Supplier Quality Improvement Council.

Software Lifecycle Manpower: MILSATCOM Directorate initiated a study to determine the enterprise and individual program software development manpower needs based on program life-cycle needs. The study will develop "as-is" and "should-be" workforce data and use it to support decisions to strengthen software management across the enterprise.

AFI 63-101, *Integrated Life Cycle Management*: AFI 63-101 was revised to implement OSD guidance on information technology (IT) acquisition. It provided additional tailoring guidance specifically for IT in AFPAM 63-128.

1.9 FY 2013 Plan: Priority Areas to Improve Systems Engineering and Development Planning

The Air Force is committed to improving its SE craft and supporting the initiative to recapture acquisition excellence. The *Air Force Systems Engineering Strategic Plan* released August 2011 identifies and prioritizes our goals and objectives. This Strategic Plan, focused on people, processes, and practices, is the foundation for our FY 2013 activities to improve systems engineering and Development Planning. Progress and improvement emphasis areas for 2013 are:

Re-Energizing Emphasis on Human Systems Integration

The Air Force, based on an Air Force Scientific Advisory Board's (SAB) recommendation from the F-22 Aircraft Oxygen Generation Quicklook Study, is re-energizing its emphasis on Human Systems Integration (HSI) throughout the weapons system lifecycle, with much greater emphasis during pre-Milestone A and during Engineering and Manufacturing Development Phases. In accordance with AFI 10-601, special focus is on the integrated and comprehensive analysis, design and assessment of requirements, concepts and resources for system manpower, personnel, training, environment, safety, occupational health, habitability, survivability, and human factors engineering.

SAF/AQ and AFLCMC established a high performance team (HPT) to address how to improve Program Execution, Forcing Functions, and Workforce Development. Program execution initiatives are to ensure specific HSI responsibilities are assigned and reflected in organizational and IPT structure and elevate unresolved HSI issues to the PM. Forcing Function initiatives are to ensure HSI domain representatives are included in existing technical reviews (preliminary design reviews, etc.) and program reviews (PSR, etc.) before certifying readiness for milestone decisions, and to incorporate HSI metrics into a global status tool (such as SMART).

Workforce development initiatives include defining and developing HSI core competencies, expanding HSI Cells to each MAJCOM to improve quantity and quality of HSI practitioners by providing two to three line-funded education quotas per year for Airmen to obtain advanced degrees in Human Systems Integration and/or Human Factors with follow-on to key assignments at the 711 HPW or MAJCOM HSI Cells, and launching AFIT HSI Courses (SYS 261 and SYS 269) utilizing DAWDF funding.

2.0 Systems Engineering Workforce

2.1 Workforce Development Initiatives

Air Force SE workforce initiatives continued to support goals established by the SAE in the 2009 *Air Force Acquisition Human Capital Strategic Plan*. Foremost of these is the Air Force acquisition growth initiative, begun in 2008 under its Acquisition Excellence initiative and Acquisition Improvement Plan (AIP), which supports the Air Force goal to size the acquisition workforce based on program requirements. Based on requirements identified by the PEOs in fall 2008 and validated by the Air Force Corporate Process, the Air Force successfully programmed for new positions in the FY10 and FY11 budget cycles. The Air Force used DAWDF funding to accelerate the hiring against these future positions in support of the Secretary of Defense (SECDEF) growth initiative and Air Force AIP. As of 31 July 2012, the Air Force had achieved the growth target established by OSD to include 379 system engineers. This growth hiring was primarily targeted at gaps identified by the Program Executive Officers. The judicious use of DAWDF-funded employment incentives, such as student loan repayment and first duty station move, has enhanced the Air Force's ability to attract highly qualified recent graduates and experienced journeymen.

The Air Force continues to use FY 2008 NDAA Section 852 DAWDF funding in support of workforce development, replenishment and knowledge transfer strategies identified in the *Air Force Acquisition Human Capital Strategic Plan*. Air Force DAWDF-funded initiatives directly support DoD STEM Strategic Plan goal 1 to attract, develop and retain a highly competent STEM workforce based on DoD requirements. DAWDF funds for recruiting and hiring are allocated to acquisition commands, which determine the highest priority needs for these funds by Center and functional area. In the current austere budget environment, DAWDF is integral to our workforce development strategies as it provides resources needed to address training gaps and has enabled the Air Force to offer civilian acquisition workforce members the same acquisition training opportunities afforded their military counterparts.

The Air Force, in partnership with the Office of Personnel Management, has developed branding and enterprise recruiting strategies for its acquisition workforce. Tailored to the unique challenges of each of its acquisition product, sustainment and test locations, this DAWDF-funded effort includes development and maintenance of recruiting websites, enterprise-wide advertising and other recruitment materials and tools. Work was completed initially at hard-to-fill locations of Hanscom, Los Angeles AFB, and the Air Force Test Center; remaining locations will be completed early in FY13.

Through the Air Force Science, Technology, Engineering, and Mathematics (STEM) Advisory Council's active management of the STEM workforce, the Air Force had RAND Corporation investigate current and future STEM requirements for officers and civilians. RAND worked with Air Force functional managers and revalidated STEM requirements for career fields and helped the Air Force establish an academic listing of STEM degrees.

In 2012, the Air Force approved an academic listing of STEM degrees and is developing a model to monitor the state of health of the civilian and military STEM workforce.

In 2012, the Air Force's online interactive sustainment model developed to inform workforce members of career opportunities and provide information that assists managers in shaping and managing career field resources was prototyped for civilian analytical career fields within STEM. The model is supported by an FY12 AFMC Training Guide and is used to plan, manage, develop, onboard, and control training for military and equivalent civilian engineering positions. The Air Force has progressed in its effort to build a competency-based engineering workforce. Competencies for the career development of subject matter experts in areas leading to senior level positions have been identified to allow for a clear path along the technical expert career path. The Air Force has identified competencies for personnel to be credentialed to make airworthiness decisions.

Looking forward to FY13, with its acquisition workforce growth initiative completed in FY12, the Air Force plans to pilot an advance replenishment hiring strategy using DAWDF funding to hire recent graduates and journeymen in advance of forecast attrition and retirements. This strategy will be used to develop a productive bench ahead of losses, enabling timely recruiting, hiring, acculturation, initial skills training and knowledge transfer. The Air Force will continue to use DAWDF resources to respond rapidly as training and development gaps are identified. An example is Human Systems Integration courses currently under development that are expected to be deployed in FY13.

2.2 Additional Authorities or Resources Needed

The Air Force needs continuation of the DAWDF and Science, Mathematics and Research for Transformation (SMART) program to fully execute acquisition workforce improvement initiatives for recruiting, hiring, and training to support knowledge transfer and workforce replenishment.

2.3 Department of the Air Force SE Workforce

Total Number of Civilian and Military Acquisition-Coded SPRDE-SE/PSE Personnel				
Fiscal Year	Year Ending	US Air Force*		
FY05	30-Sep-05	6,505		
FY06	30-Sep-06	6,237		
FY07	30-Sep-07	6,162		
FY08	30-Sep-08	6,429		
FY09	30-Sep-09	7,197		
FY10	30-Sep-10	7,625		
FY11	30-Sep-11	8,514		
FY12	30-Sep-12	8,649		
Planned Growth in Civilian and Military Acquisition-Coded SPRDE-SE/PSE*				
Fiscal Year	Year Ending	US Air Force**		
As Reported In:		FY10	FY11	FY12
FY13	30-Sep-13	86	-86	-435***
FY14	30-Sep-14	170	160	77
FY15	30-Sep-15	(4)	-6	-18
FY16	30-Sep-16		-9	-33
FY17	30-Sep-17			-13
FY18	30-Sep-18			-10
Planned End-State Total Number of Civilian and Military Acquisition-Coded SPRDE-SE/PSE				
Fiscal Year	Year Ending	US Air Force**		
FY16	30-Sep-16	8,240		
FY17	30-Sep-17	8,227		
FY18	30-Sep-18	8,217		

*Source: USD AT&L DataMart Q4 FY12
**Data based on FY14 PB 23 as of 31 Dec 2012
***Overhires play a significant role in the delta between FY12 personnel and FY13 positions. As of 30 Sept 12, there were 193 SPRD&E-SE/PSE overhires on board funded by DAWDF alone. Additionally, there was a minor difference of 12 between USD AT&L DataMart and AF DoDI 5000.55 end of FY12 personnel count

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Acronyms

ACAT	Acquisition Category
ADM	Acquisition Decision Memorandum
AFI	Air Force Instruction
AFIT	Air Force Institute of Technology
AFLCMC	Air Force Life Cycle Management Center
AFMC	Air Force Materiel Command
AoA	Analysis of Alternatives
APB	Acquisition Program Baseline
AS	Acquisition Strategy
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics, and Technology
ASD(R&E)	Assistant Secretary of Defense for Research and Engineering
ASN(RDA)	Assistant Secretary of the Navy for Research, Development, and Acquisition
AT&L	Acquisition, Technology, and Logistics
BKCASE	Body of Knowledge and Curriculum to Advance Systems Engineering
C4	command, control, communications, and computers
CAPE	Cost Assessment and Program Evaluation
CDD	Capability Development Document
CDR	Critical Design Review
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
COTS	commercial off-the-shelf
CPD	Capability Production Document
CTE	critical technology element
DAB	Defense Acquisition Board
DAES	Defense Acquisition Executive Summary
DAG	Defense Acquisition Guidebook
DAPS	Defense Acquisition Program Support
DASD(SE)	Deputy Assistant Secretary of Defense for Systems Engineering
DASN(RDT&E)	Deputy Assistant Secretary of the Navy for Research, Development, Test, and Evaluation

DAU	Defense Acquisition University
DAWDF	Defense Acquisition Workforce Development Fund
DAWIA	Defense Acquisition Workforce Improvement Act
DIB	Defense Industrial Base
DMSMS	diminishing manufacturing sources and material shortages
DoD	Department of Defense
DoDAF	Department of Defense Architecture Framework
DoDI	Department of Defense Instruction
DON	Department of the Navy
DOT&E	Director of Operational Test and Evaluation
DPAP	Defense Procurement and Acquisition Policy
DPWG	Development Planning Working Group
DSPO	Defense Standardization Program Office
DT	developmental test
DT&E	developmental test and evaluation
DTM	Directive-Type Memorandum
EMD	Engineering and Manufacturing Development (phase)
FDD	Functional Description Document
FFRDC	Federally Funded Research and Development Center
FIPT	Functional Integrated Product Team
FRP	Full-Rate Production
FY	fiscal year
GFE	Government-furnished equipment
GIDEP	Government-Industry Data Exchange Program
GRCSE	Graduate Reference Curriculum for Systems Engineering
HCI	Human Capital Initiatives
HSI	human systems integration
IA	information assurance
IBD	Integrated Base Defense

ICD	Initial Capabilities Document
IEEE	Institute of Electrical and Electronics Engineers
IIPT	Integrating Integrated Product Team
INCOSE	International Council on Systems Engineering
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IPR	In-Progress Review
IPT	Integrated Product Team
ISR	intelligence, surveillance, and reconnaissance
IT	information technology
ITAB	Information Technology Advisory Board
JCIDS	Joint Capabilities Integration and Development System
JROC	Joint Requirements Oversight Council
KDP	Key Decision Point
KLP	Key Leadership Position
KPP	key performance parameter
KSA	key system attribute
LCSP	Life Cycle Sustainment Plan
LRIP	Low-Rate Initial Production
M&S	modeling and simulation
MAIS	Major Automated Information System
MAJCOM	major command
MBSE	model-based systems engineering
MDA	Milestone Decision Authority
MDA	Missile Defense Agency
MDAP	Major Defense Acquisition Program
MDD	Materiel Development Decision
MRL	Manufacturing Readiness Level
MS	milestone

MSA	Materiel Solution Analysis (phase)
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
NDAA	National Defense Authorization Act
NDIA	National Defense Industrial Association
N-M	Nunn-McCurdy
NPS	Naval Postgraduate School
NSEG	Naval System Engineering Guide
O&S	Operations and Support (phase)
OCSE	Office of the Chief Systems Engineer (Army)
OIPT	Overarching Integrated Product Team
ORD	Operational Requirements Document
OSA	open systems architecture
OSD	Office of the Secretary of Defense
OT&E	operational test and evaluation
PARM	participating acquisition resource manager; participating manager
PD	Production and Deployment (phase)
PDR	Preliminary Design Review
PEO	Program Executive Office
PL	Public Law
PM	program manager
PMO	Program Management Office
POM	Program Objective Memorandum
PPP	Program Protection Plan
PQM	Production, Quality, and Manufacturing
PRR	Production Readiness Review
PSE	Program Systems Engineer
PSR	Program Support Review
R&M	reliability and maintainability

RAM	reliability, availability, and maintainability
RAM-C	reliability, availability, maintainability, and cost
RDECOM	Research, Development and Engineering Command (Army)
RDT&E	research, development, test, and evaluation
RFP	request for proposal
RGC	reliability growth curve
RT	Research Topic
S&E	science and engineering
S&T	science and technology
SAF/AQ	Secretary of the Air Force for Acquisition
SDD	System Development and Demonstration
SE	systems engineering
SE WIPT	Systems Engineering Working Integrated Product Team
SEAC	Scientist and Engineer Advisory Council
SEP	Systems Engineering Plan
SERC	Systems Engineering Research Center
SESG	Systems Engineering Stakeholders Group
SETR	Systems Engineering Technical Review
SETRH	System Engineering Technical Review Handbook
SFR	System Functional Review
SLOC	source lines of code
SoS	system of systems
SoSE	system-of-systems engineering
SPAWAR	Space and Naval Warfare Systems Command
SPRDE	Systems Planning, Research, Development, and Engineering
SPRDE-PSE	Systems Planning, Research, Development, and Engineering–Program Systems Engineer
SPRDE-SE	Systems Planning, Research, Development, and Engineering–Systems Engineering
SRCA	systemic root cause analysis
SRR	System Requirements Review

STEM	science, technology, engineering, and mathematics
SwA	software assurance
SWaP-C	space, weight, power, and cooling
SwE	software engineering
SYSCOM	systems command
T&E	test and evaluation
TD	Technology Development (phase)
TDS	Technology Development Strategy
TEMP	Test and Evaluation Master Plan
TES	Test and Evaluation Strategy
TIM	technical information meeting
TPM	technical performance measure
TRA	Technology Readiness Assessment
TRL	Technology Readiness Level
TRR	Test Readiness Review
UARC	University Affiliated Research Center
UAS	unmanned aircraft system
USAF	United States Air Force
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USD(P&R)	Under Secretary of Defense for Personnel and Readiness
USMC	United States Marine Corps
USN	United States Navy
WIPT	Working Integrated Product Team
WSARA	Weapon Systems Acquisition Reform Act

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