DoD Systems and Software Engineering

Taking it to the Next Level

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Mark D. Schaeffer
Director, Systems and Software Engineering
Office of the Deputy Under Secretary of Defense (A&T)
Recent Acquisition & Technology Reorganization

Under Secretary of Defense Acquisition Technology & Logistics

Deputy Under Secretary of Defense Acquisition & Technology

Director Systems & Software Engineering

Systems Engineering is well positioned in DoD
Systems and Software Engineering
Mission Statement

- Shape acquisition solutions and promote early technical planning
- Promote the application of sound systems and software engineering, developmental test and evaluation, and related technical disciplines across the Department's acquisition community and programs
- Raise awareness of the importance of effective systems engineering and drive the state-of-the-practice into program planning and execution
- Establish policy, guidance, best practices, education, and training in collaboration with academia, industry, and government communities
- Provide technical insight to program managers and leadership to support decision making

Evolving System Engineering Challenges
Systems Engineering Revitalization Effort

- Issued Department-wide Systems Engineering (SE) policy
- Issued guidance on SE, T&E, and SE Plans (SEPs)
- Instituted system-level assessments in support of DAB, OIPT, DAES, and in support of programs
- Established SE Forum to ensure senior-level focus within DoD
- Integrating DT&E with SE policy and assessment functions--focused on effective, early engagement of both
- Instituting a renewed emphasis on modeling and simulation in acquisition
- Working with Defense Acquisition University to revise curricula (SPRDE, T&E, PQM, LOG, PM, ACQ, FM, CONT)
- Leveraging close working relationships with industry and academia
Top 10 Emerging Systemic Issues

1. Management
   - IPT roles, responsibilities, authority, poor communication
   - Inexperienced staff, lack of technical expertise

2. Requirements
   - Creep/stability
   - Tangible, measurable, testable

3. Systems Engineering
   - Lack of a rigorous approach, technical expertise
   - Process compliance

4. Staffing
   - Inadequate Government program office staff

5. Reliability
   - Ambitious growth curves, unrealistic requirements
   - Inadequate “test time” for statistical calculations

6. Acquisition Strategy
   - Competing budget priorities, schedule-driven
   - Contracting issues, poor technical assumptions

7. Schedule
   - Realism, compression

8. Test Planning
   - Breadth, depth, resources

9. Software
   - Architecture, design/development discipline
   - Staffing/skill levels, organizational competency (process)

10. Maintainability/Logistics
    - Sustainment costs not fully considered (short-sighted)
    - Supportability considerations traded

Major contributors to poor program performance
Necessary but not sufficient

now

“Take SE to the Next Level”
**SAR data for MAIS and MDAP programs under OSD Systems Engineering Oversight.**
## Initiatives For Strategic and Tactical Acquisition Excellence

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<th>OBJECTIVES</th>
<th>INITIATIVES</th>
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| Making Decisions that Balance the Trade-Space  
  • Affordable, Feasible Investments | • Portfolio Management  
  • Tri-Chair Concept Decision / Time-Defined Acquisition  
  • Evaluation of Alternatives  
  • Synchronize Existing Processes  
  • Tri-Chair Investment Balance Reviews |
| Starting Programs Right  
  • Improved, Up-Front Planning  
  • Awareness of Risk / Improved Source Selection  
  • More Responsive Acquisition Solutions | • Risk-Based Source Selection  
  • Small Business Innovative Research  
  • Acquisition of Services Policy  
  • Systems Engineering Excellence  
  • Award Fee and Incentives |
| Process efficiency  
  • Tailored, agile, transparent | • DAB / OIPT Process Optimization  
  • Common Data / DAMIR  
  • Restructured DAES |
| Program Stability  
  • No Downstream Surprises  
  • Issue Awareness | • Program Baseline Assurance  
  • Capital Accounts |

*Improving the Full Range of Acquisition Execution*
Make Decisions that Balance the Trade Space

Early Lifecycle Planning

- Early lifecycle involvement of Systems Engineering:
  - Inform evaluation of alternatives with technical insights
  - Ensure solutions balance requirements with technical feasibility
  - Ensure solutions can be validated and verified

- Appropriate resourcing (personnel/funding) required

*Technology Development and Risk Reduction
Starting Programs Right
Shaping Systems Acquisition Solutions

System Level

- Application of System Engineering principles contributes to successful program execution
- Leverage System Engineering relationship to cost, schedule, and performance
- Ensure enabling disciplines are in concert with technical planning

Ensuring program and milestone reviews are informed by technical planning, verification and validation, and complementary business rules
Starting Programs Right
Shaping System-of-Systems Acquisition Solutions

- System-of-Systems Level
  - Needs will be satisfied by groupings of legacy systems, new programs, and technologies
  - Presents additional integration and management issues
  - Success depends heavily upon software interfaces
  - Broad context and knowledge of system interrelationships and CONOPS are critical to decision-making
  - Sound SE practices enable the integration of these SoS solutions
Vision for Systems Engineering and Software

- Competencies Improved
- Delivered Product Suite
  - Courseware
  - Policy/Guidance
  - Program Support methods
- Elevated Stature
- Raised Awareness
- Positive Influence

- World class leadership
- Broaden to Software Engineering, System Assurance, Complex Systems-of-Systems, Test & Evaluation
- Responsive and agile, technical discipline to shape acquisition solutions
- Ensure appropriate human capital needs are met

... the Technical Foundation that Enables Acquisition Excellence
Why the Focus on Software…

- Research investment has been static or declining
  - DARPA computer science R&D funding 50% ↓ ('01 - '04, universities)
- Requirements growth 10X (% functionality) ’60s -’00s
- Need vs. skilled/clearable workforce - gaps increasing
- President’s Information Technology Advisory Committee Report, February 2005
  - Identifies SW as “major vulnerability”
  - Recommends priority attention: “Secure Software Engineering and Software Assurance” and “Metrics, Benchmarks, and Best Practices”
- Cost, schedule and performance issues

Software is an increasingly, important factor
Systems and Software Engineering

An Organizational Construct

Director, Systems & Software Engineering

- Deputy Director
  - Enterprise Development
- Deputy Director
  - Developmental Test & Evaluation
- Deputy Director
  - Software Engineering & System Assurance
- Deputy Director
  - Assessments & Support

NEW

Management Visibility – Best Practices – Acquisition Excellence
DoD Software Center of Excellence
Organizational Tenets

➢ Support Acquisition Success
   • Ensure effective and efficient software solutions across the acquisition spectrum of systems, SoS and capability portfolios

➢ Improve the State-of-the-Practice of Software Engineering
   • Advocate and lead software initiatives to improve the state-of-the-practices through transition of tools, techniques, etc.

➢ Provide Leadership, Outreach and Advocacy
   • Implement at Department and National levels, a strategic plan for meeting Defense software requirements

➢ Foster Software Resources to meet DoD needs
   • Enable the US and global capability to meet Department software needs, in an assured and responsive manner

Promote World-Class Leadership for Defense Software Engineering
How do we get there?
Driving Technical Excellence into Programs!
Systems Engineering Policy

- Policy Memorandum (February 2004) and Policy Addendum (October 2004)
  - Programs shall apply robust SE approach and develop a SE plan
  - Each PEO shall have a lead or chief systems engineer
  - Event-driven technical reviews with entry criteria and independent SMEs unless waived by MDA
  - OSD shall review program SEPs for ACAT ID and IAM programs
  - Defense Systems shall establish a SE Forum
Systems Engineering Guidance

- Establish Defense Acquisition Guidebook System Engineering Baseline
- Developed the following guides:
  - Reliability, Availability, and Maintainability
  - Integrated Master Plan and Integrated Master Schedule Preparation and Use
  - Systems Engineering Plans
  - Risk Management for DoD Acquisition
  - CMMI version 1.2
- In development:
  - Update Defense Acquisition Guidebook
  - Contracting for SE Guide
  - CMMI Guide for Acquirers
  - System Assurance Guide
  - Systems-of-Systems System Engineering Guide
Systems Engineering
Education, Training, & Outreach

- Updated/Developed Systems Engineering curriculum
- Reviewed and modified enabling disciplines curriculum
  - Acquisition Program Management, Contract Management, Finance, Logistics
- Continuous learning, on-line courses:
  - Developed: Reliability and Maintainability, Technical Reviews, System Safety, Modeling and Simulation, Technical Planning
  - In development: Corrosion Prevention and Control, Modular Open Systems Approach, Trade Studies
- Established new, strengthened certification requirements for DoD systems engineers
  - New Systems Engineering career path provides for broader experience and training for selected positions
- Engaging universities:
  Stevens Institute of Technology, University of Southern California, Stanford, Southern Methodist, George Mason, Service Academies and Naval Postgraduate School, Air Force Institute of Technology Center for Systems Engineering
Driving Technical Rigor Back into Programs “Portfolio Challenge”

Systems and Software Engineering have been tasked to:

- Review program’s SE Plan (SEP) and T&E Master Plan (TEMP)
- Conduct program support reviews

Portfolio of major acquisition (ACAT ID and IAM) programs, supporting 10 Domain Areas:

- Business Systems
- Communication Systems
- C2ISR Systems
- Fixed Wing Aircraft
- Unmanned Systems
- Rotary Wing Aircraft
- Land Systems
- Ships
- Munitions
- Missiles

Systems Engineering and T&E Support to Over 150 Major Programs in 10 Domain Areas
Software systemic issues are significant contributors to poor program execution

- Software requirements not well defined, traceable, testable
- Immature architectures, COTS integration, interoperability, obsolescence (electronics/hardware refresh)
- Software development processes not institutionalized, planning documents missing or incomplete, reuse strategies inconsistent
- Software test/evaluation lacking rigor and breadth
- Schedule realism (compressed, overlapping)
- Lessons learned not incorporated into successive builds
- Software risks/metrics not well defined, managed

*Based on ~40 program reviews to date
Other Challenges

- Implementing a DoD vision and strategy for software and systems assurance
- Component and Industry adoption and effective implementation of sound SE practices as early as possible in the system life cycle
- SE support to Acquisition Initiatives stemming from the QDR
- Retention and development of technical acumen in an aging and shrinking acquisition workforce
- Meeting all requests for technical support to programs
- Continue to evolve “high visibility” initiatives:
  - Energy
  - CMMI
  - System-of-Systems
  - Modeling & Simulation
  - Defense Safety Oversight Council
Global Acquisition

- Benefits of leveraging reliable non-US sources
  - Price, performance, and schedule benefits
  - Increase interoperability with allies and coalition partners
  - International competition spurs US innovation and efficiencies
  - Mutually beneficial industrial linkages enhance access to global markets

- US is committed to effective systems engineering and best value

- Norway has demonstrated it is committed to being a Global Supplier by:
  - Formation of the National Center of Expertice in Systems Engineering
  - Securing significant Joint Strike Fighter work this past year with best value products

*Much is Left to do…Vector is Correct*
How do we get there?
Systems Engineering Revitalization

- **Policy**
  - No new policies in 2006

- **Guidance**
  - Continues to be refined

- **Education and Training**
  - E&T portfolio refreshed and growing

- **Program Support**
  - Gaining momentum; yielding systemic insights
Defining User Requirements

I'll design the system as soon as you give me the user requirements.

Better yet, you could build the system, then I'll tell your boss that it doesn't meet my needs.

I don't mean to frighten you, but you'll have to do some actual work.

That's crazy talk.

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### Balancing Key Programmatic Elements

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