# *DoD Software Engineering and System Assurance*

## New Organization – New Vision

**Kristen Baldwin**

Systems and Software Engineering

Software Engineering and System Assurance Directorate

***October 26, 2006***

# *USD(AT&L) - Achieving the Vision*

*"In order to meet the demands of the 21st century joint warfighter in an effective, timely and efficient manner, the Department is actively reshaping its business and decision making processes to make a more adept and responsive support infrastructure ... by creating more integrated and responsive decision making processes, organizations and business practices."*

**Honorable Kenneth J Krieg**
**Congressional Testimony**
**September 7, 2006**

# *Strategic and Tactical Acquisition Excellence Vision of Success*

## Streamlined and Simplified Acquisition

- Reduced Decision Making Cycle Time
- Earlier Initial Operational Capability

## Affordable and Predictable Outcomes

- Bounded Choices – Trade Space Driven
- Open and Transparent Data and Information Management

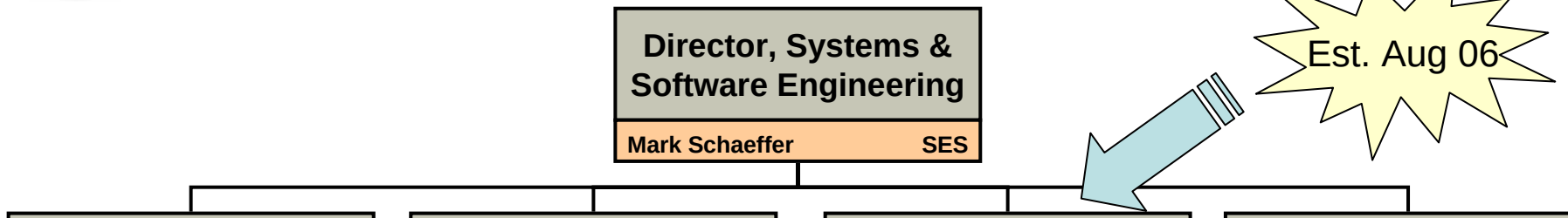
## Improved Centers of Excellence

- Systems and Software Engineering
- Program Mgmt/Contract/Pricing/Cost Expertise

## Responsibility and Accountability Alignment

- Trust, Integrity and Ethics as the Cornerstones

# Systems and Software Engineering
## Organizational Core Competencies




### Deputy Director Enterprise Development
**Bob Skalamera SES**

**CORE COMPETENCIES**

- SE Policy
- SE Guidance
  - SE in *Defense Acquisition Guidebook*
  - Technical Planning
  - Risk Management
  - Reliability & Maintainability
  - Contracting for SE
  - SoS SE Guide
- SE Education and Training
  - DAU SE Curriculum
  - SPRDE Certification Rqmt
- Corrosion
- R-TOC
- Value Engineering

### Deputy Director Developmental Test & Evaluation
**Chris DiPetto SES**

**CORE COMPETENCIES**

- DT&E Policy
- DT&E Guidance
  - T&E in *Defense Acquisition Guidebook*
  - TEMP Development Process
- DT&E Education and Training
  - DAU DT&E Curriculum
  - DT&E Certification Rqmt
- Joint Testing, Capabilities & Infrastructure
- Targets Oversight
- Acq Modeling & Simulation
- Energy
- DSOC/Acq Tech Task Force

### Deputy Director Software Engineering & System Assurance
**Mark Schaeffer (Acting) SES**

**CORE COMPETENCIES**

- SWE and SA Policy
- SWE and SA Guidance
  - SoS, SA Guides
- SWE and SA Education and Training
  - DAU SW Acq Curriculum
  - Continuous Learning Modules for SWE, SoS, SA
- Software Engineering
  - Acquisition Support
  - Software Engineering Institute (SEI)
- Process Improvement
  - CMMI Sponsor
- DoD/National Software Investment Strategy

### Deputy Director Assessments & Support
**Dave Castellano SES**

**CORE COMPETENCIES**

- Support of ACAT I and Other Special Interest Programs (MDAP, MAIS)
- Assessment Methodology (Program Support Reviews - PSRs)
- T&E Oversight and Assessment of Operational Test Readiness (AOTR)
- Systems Engineering and Developmental Test Planning and Support
- Lean/6-Sigma Training/Cert

*Acquisition program excellence through sound systems and software engineering*

# *Why focus on Software: Software Growth in DoD Systems*

- Software Requirements Growth (% of functionality provided by software)[1]:
  - 1960s: 8%
  - 1980s: 40%
  - 1990s: 60%
  - 2000s: 80%
- Software Size Growth[2]
  - From < 2M estimated source lines of code in 1980s to > 10M lines of code in 1990s
  - Now approaching 20M ESLOC
- Software Overruns
  - 1994: 16.2% of SW projects completed on-time, on-budget[3]
  - 2005: 50% of SW projects still late, over budget[4]

1 CSIS/DSB/PM Magazine
2 CSIS Analysis

# *Why focus on Software: Software Concerns*

- President's Information Technology Advisory Committee Report, February 2005
  - Identifies SW as "major vulnerability"
  - Recommends for priority attention: "Secure Software Engineering and Software Assurance" and "Metrics, Benchmarks, and Best Practices"
- Defense software research investment has been static or declining
  - DARPA computer science R&D funding to universities down 50% (2001-2004)[5]
  - In contrast, total federal government support to universities up 50%[5]
  - DoD software S&T funding relatively level for past decade[5]
- Defense software workforce needs
  - CSIS Software Industrial Base Study finds concerns with availability of senior software personnel[6]
- Continued software cost and schedule overruns in DoD programs

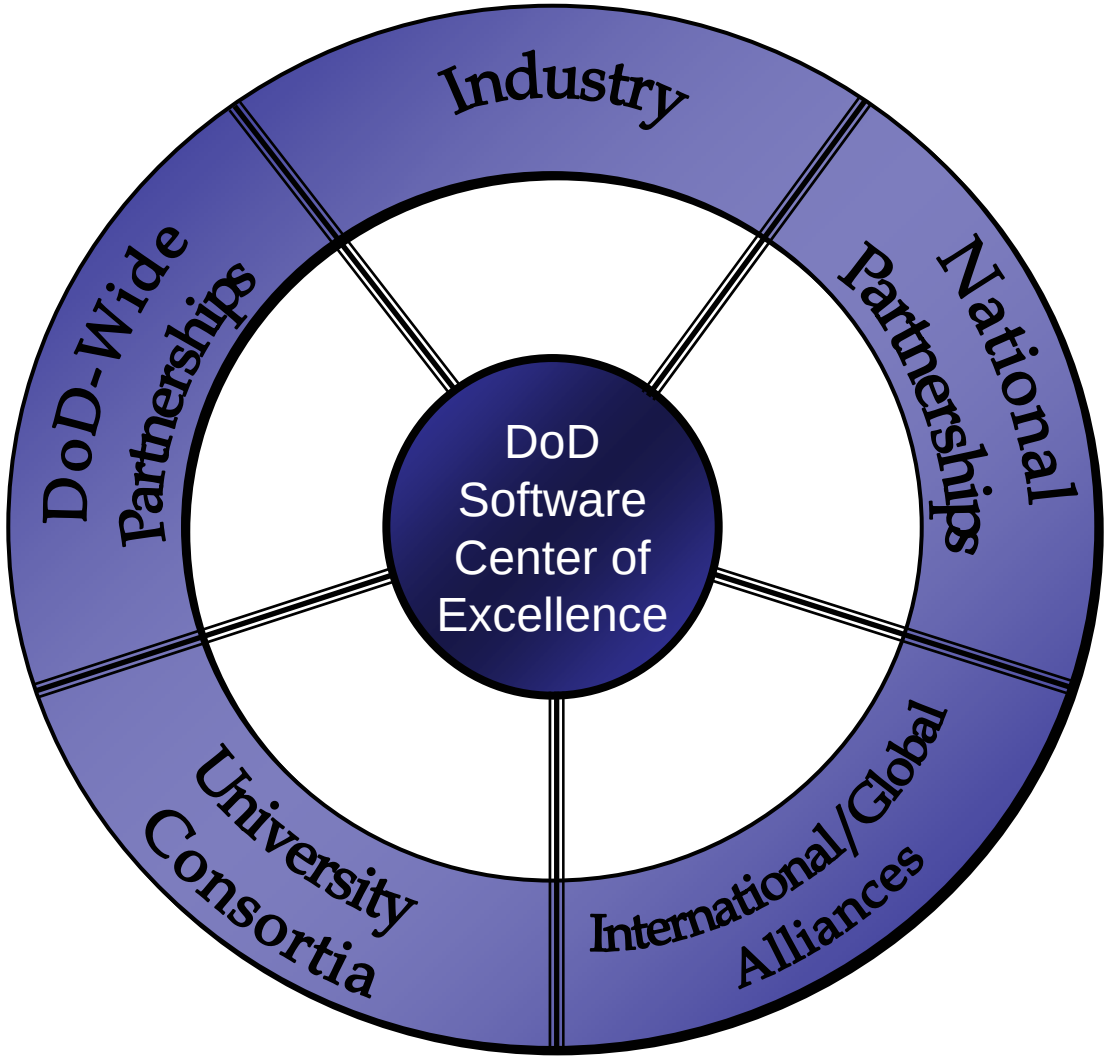
5 President's Information Technology Advisory Committee Report, February 2005, "Cyber Security: A Crisis of Prioritization"
6 Center for Strategic and International Studies, October 2006

# *DoD Software Performance: What We're Seeing**

- 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 in the past 2 ½ years**

# Establishing a DoD Software Center of Excellence




**DoD Software Center of Excellence**

- Support Acquisition Success
- Improve State-of-the-Practice of Software Engineering
- Leadership, Outreach and Advocacy
- Foster Resources to Meet DoD Needs

# *Elements of a DoD Strategy for Software*

- 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.
- 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***

# *Getting Started – What are we Doing?*

- Identify software issues, needs
  - Software Industrial Base Study
  - NDIA Top Software Issues Workshop
  - Defense Software Strategy Summit
- Creating opportunities, partnerships
  - Established network of Government software POCs
  - Chartered the NDIA Software Committee
  - Information exchanges with Government, Academia, and Industry
  - Planning the Systems & Software Technology Conference, TAMPA!
- Executing focused initiatives
  - CMMI Integrity, CMMI-ACQ, CMMI Guidebook
  - Handbook on Engineering for System Assurance
  - SoS Systems Engineering Guide
  - Providing software support to acquisition programs
  - Transparent data vision for Acquisition Reform

# Software Industrial Base Study* Summary Findings

- The lack of comprehensive, accurate, timely and comparable data about software projects within DoD limits the ability to undertake any bottom-up analysis or enterprise-wide assessments about the demand for software.
- The overall pool of software developers appears to be adequate
- A supply-demand imbalance exists in the upper echelons of the software developer/ management cadres, exacerbated by the fact that this talent is not fungible outside their domains of expertise
  - This senior cadre can be growth but it takes time (10 years plus) and a concerted HR/career strategy
  - Worthwhile investigating management/architecture/systems engineering tools to improve the effectiveness of this senior cadre
- Defense business system/COTS software modification also stress limited pools of key technical/management talent
- "Desire" versus Supply as opposed to Demand versus Supply worth further investigation
  - What is the total demand for software maintenance versus the funded portion, what is being deferred? What is the true cost and/or risk of deferral?

***Performed by Center for Strategic and International Studies, 2006**

# *Top Software Issues**

1. The impact of requirements upon software is not consistently quantified and managed in development or sustainment.
2. Fundamental system engineering decisions are made without full participation of software engineering.
3. Software life-cycle planning and management by acquirers and suppliers is ineffective.
4. The quantity and quality of software engineering expertise is insufficient to meet the demands of government and the defense industry.
5. Traditional software verification techniques are costly and ineffective for dealing with the scale and complexity of modern systems.
6. There is a failure to assure correct, predictable, safe, secure execution of complex software in distributed environments.
7. Inadequate attention is given to total lifecycle issues for COTS/NDI impacts on lifecycle cost and risk.

***NDIA Top Software Issues Workshop August 2006**

# *Defense Software Strategy Summit*

- OSD led Summit co-hosted by NDIA Oct 18-19, 2006
- Nearly 100 participants from across DoD, industry and academia
- Plenary:  PEO Panel, Chief Engineer Panel, Keynote Speakers
- Four Workshops:
  - Software acquisition and sustainment
  - Software policy
  - Human capital
  - Software engineering practices
- Next steps:
  - Summit briefings and results will be available on NDIA website
  - NDIA Software Committee consolidating findings, final report forthcoming
  - Prioritize work, develop action plans, and move out

# Summit Workshops Discussion Topics

- Software Acquisition and Sustainment
  - Acquiring software in the context of systems acquisition
  - Life cycle management of software requirements
  - Software expectation management, progress tracking
  - Software size, complexity, estimation

- Policy and Guidance
  - Current policy in place, related guidance and it's effectiveness
  - Policy consistency across DoD
  - Implementation of DSB & other study recommendations
  - Software Standards

- Human Capital
  - Education and training
  - Attracting and retaining software resources
  - Developing on-the-job competency
  - Issues regarding remote site and offshore development

- Software Engineering Practices
  - Synchronization of systems and software engineering
  - Assessing software quality
  - COTS / Open Source issues
  - Methods, tools, and techniques

# ***Emerging* Summit Recommendations**

- Policy and Guidance
  - Create awareness of software practices, guidance
  - Develop a roadmap of software policy
  - Create documentation efficiency, data transparency
- Human Capital
  - Set and require PEO software engineering responsibilities
  - Consider software engineering career track
  - Address “golden collar” shortages
  - Provide leadership software training
- Software Acquisition and Practices
  - Revisit the SE process in light of agile software development and SoS
  - Establish program support for software, architecture, assessments, etc
  - Hold annual software acquisition workshops/conference
  - Augment EVM guide with software guidance
  - Develop software RFP language
  - Specify SETA support expectations

# System-of-Systems Engineering

- Studying systems engineering considerations for SoS
  - Capturing national and international models, definitions, processes, solutions
- Developing System-of-Systems (SoS) Systems Engineering guide
  - 6-month effort addressing areas of agreement across community
  - Initial focus on SoS with stated requirements and organizations responsible for execution – future versions will capture less defined instances
  - Addresses Defense Acquisition Guide technical process and considerations for technical management across system life cycle
    - Focused on systems engineering challenges characteristics of SoS and suggested approaches
  - Audience: Program Managers and Lead/Chief Engineers for SoS acquisition programs, legacy systems, and constituent programs

***Draft of initial version of guide is out for review***

# CMMI: New Release and Next Steps

Issues:

- Integrity of CMMI appraisals
- Misperception and misuse of the CMMI by acquirers

Actions:

- Implemented changes to the CMMI v1.2 product suite to ensure:
  - Integrity of appraisals
  - Quality of the product suite
  - Education of acquirers
  - Opportunities for streamlining where appropriate
- Developing a CMMI model for Acquirer process improvement
  - Partnership with General Motors
  - Stakeholders cross DoD, Govt Agencies and Industry
- Writing a CMMI guidebook
  - Help acquirers understand what CMMI is and is not
- DCMA study of actual process implementation

# System Assurance

Issues:

- Vulnerability of our systems to malicious tampering or access
- Numerous assurance, protection and safety initiatives that are not aligned

Actions:

- Developing a comprehensive System Assurance strategy
- Promoting nationwide collaboration
- Identifying standards activities to address system vulnerabilities
- Developing a Handbook for Engineering System Assurance
  - Guidance for PMs and Engineers on how Systems Engineering practice can be applied to mitigate system vulnerability to malicious control/tampering

# *Our Challenge*

- Given the shortage of software resources and critical software reliance
  - We cannot afford to be stovepiped
  - We must integrate across cross-functional perspectives to improve our software capability
- The Summit was a great start
  - Created awareness of key software initiatives
  - Discussed the state of play
  - Shared ideas
- Now…
  - Work together to implement Summit recommendations
  - Contribute to ongoing initiatives:  SoS, Sys Assurance, CMMI Guides, more

***Become a DoD Software Center of Excellence***