Overview of Department of Defense (DoD) Software Engineering Initiatives

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Office of the Director, Defense Research and Engineering
12th Annual NDIA Systems Engineering Conference
October 29, 2009
Elements of a DoD Strategy for Software Engineering

• **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*
1. The impact of requirements upon software is not consistently quantified and managed in development or sustainment. “SW Requirements”

2. Fundamental system engineering decisions are made without full participation of software engineering. “SE/SW Integration”

3. Software life-cycle planning and management by acquirers and suppliers is ineffective. “SW Sustainment”

4. The quantity and quality of software engineering expertise is insufficient to meet the demands of government and defense industry. “Human Capital”

5. Traditional software verification techniques are costly and ineffective for dealing with the scale and complexity of modern systems. “SW Testing”

6. There is a failure to assure correct, predictable, safe, secure execution of complex software in distributed environments. “SW Assurance”

7. Inadequate attention is given to total lifecycle issues for COTS/NDI impacts on lifecycle cost and risk. “SW COTS / NDI / Reuse”
Top Software Issues - 2006 vs. Software Systemic Findings - 2008

National Defense Industrial Association (NDIA)
Top 7 Software Issues
September 2006

Software Human Capital
Software Requirements
Systems/Software Integration
Software Assurance
Software Testing
Software Sustainment
Software COTS/NDI

ODDRE/SE Systemic Analysis of Program Support Review Findings

Software Human Capital
- Resources
- Quality Level

Software Requirements
- Engineering
- Management
- Acquisition Strategy

Systems/Software Integration
- Systems of Systems
- Interoperability
- Tech Refresh

Software Assurance
- Resources
- Quality Level

Software Development
- Software Testing*
- Software Sustainment/Maintenance*
- Software COTS/NDI*
- Technology Readiness
- Software Architecture

Software Metrics
- Software Metrics
- EVM

Software Engineering Management
- Project Planning
- Management Oversight
- Software Configuration Management

Knowledge Sharing
- Process
- Reporting

NDIA SE Conference-SW Initiatives
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Current Software Engineering Initiatives

• **Program Support**
  - Provide software support for acquisition program reviews.
  - Develop independent schedule and defect estimates.

• **Human Capital**
  - Software Acquisition Training and Education Workgroup:
    - Establish SW competencies across the acquisition career fields
  - Reference Curriculum for Graduate Study of Software Engineering:
    - Version 1.0 completed this month, to be sustained by IEEE and ACM.

• **Advance the State of the Practice**
  - Software Sustainment, NDIA Software T&E Summit/Workshop

• **Policy and Guidance**
  - Oversight of Services’ SW Acquisition Process Improvement Programs.
Notional Example of Schedule Feasibility Analysis

Current Plan (Dec 2013)

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Review Team Projection (50th percentile - Dec 2014)

Likelihood of delivery to current schedule: less than 1%

Review Team Projection (50th percentile Dec 2014)
Software and Systems Reliability

• DoD has renewed emphasis on systems reliability and lifecycle costs of shortfalls
  – DDRE effort underway to consolidate software reliability guidance

• Starting to use parametric models to project numbers of latent software defects and discovery rates
  – Used to support:
  – Development of satellite launch plans
  – Aircraft production decisions
  – Operational test readiness reviews

• Gauging software reliability using Mean Time to Defect (MTTD) discovery
Software Human Capital Efforts

Software Industrial Base Study – July 2007
There is a choke-point in availability of top-tier software managers, architects, and domain experts.
Supply of sufficiently trained SW developers is inadequate near-term.

- **Software Acquisition Training and Education (SATEWG)**
  - Chartered February 2008 by USD(AT&L) to add software competencies to DoD’s 13 acquisition career fields
  - Recent accomplishments:
    - Developed software competency framework,
    - Established SPRDE software competencies
    - Gap analysis of SATEWG competency framework and DAU’s Software Acquisition Management courses
    - Current focus is on PM, Contracting and Test career fields

- **Graduate Software Engineering Reference Curriculum (GSwERC)**
  - Partnership with Industry and Academia
  - Version 1.0 completed September 2009
  - Transitioned to IEEE and ACM for sustainment
Software Sustainment Challenges

- **Software intensive systems encourage***:
  - Build-a-little, test-a-little, field-a-little risk reduction
  - Incremental and spiral development efforts
  - Concurrent planning, development and sustainment activities

- **No longer a natural ‘break point’ where software development can be transitioned to a sustainment organization**
  - Technical capability of Government sustainment organizations reduced due to acquisition reform

- **Planning for software sustainment now a lost art**
  - Acquisition programs no longer produce MIL-HDBK-347 Computer Resource Life Cycle Management Plans

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Better planning needed to partition software work among multiple developers and increase competition
NDIA Software Test and Evaluation Summit/Workshop – Sep 2009

• **Purpose:** “Recommend policy and guidance changes to emphasize robust software T&E approaches in Defense acquisition.”

• **Speakers from Government, Industry and Academia**

• **Conducted workshops on:**
  - How much software T&E is enough
  - Software T&E involvement across the lifecycle
  - Emerging paradigms: SOA, SoS, Security

• **Workshops specifically addressed:**
  - Policy & guidance, Human capital, RFP language, SW T&E tools

• **NDIA Software Experts and DT&E sub-committee to produce white paper by December 2009**
Software Measurement and Analysis
Improvement Areas

Determine better methods of obtaining cost estimating data

Generate software appropriate WBS

Improve estimation tools, techniques, & practices

Find best Earned Value Management (EVM) practices for SW

Link quality indicators to EVM

Concepts - Requirements - Arch/Design - Development - Maintenance

Integrate software guidance into proven management techniques
Software Earned Value Management (EVM) Study/Pilot

• Develop methods to combine EVM and software metrics to predict cost and schedule overruns
• Piloted on a 5-year ACAT 1D software development program
• Pilot indicator shows estimate-at-completion (EAC) forecasts for:
  – Existing program management plans
  – Milestone-based EVM measures
  – Software metrics, i.e, growth profile of size, effort, defects

Equivalent EAC forecasts provide an increased confidence in project plans
Estimates at Completion (EAC) for Metrics, Earned Value, Program Plans

SW Metric EAC

BAC = $1420

Calculated Schedule Range:
05/14/08 - 06/18/08
Calculated Estimate at Complete Range:
$1,570K - $1,710K
Cumulative CPI = 0.79

Confidence increases as EACs overlap
Multiple measures reaching the same conclusion
Questions/Discussion

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