Navy Software Process Improvement Initiative (SPII)

ENVIRONMENT
(Jan 2006 Offsite)

OBJECTIVES

- Increase leadership awareness and accountability
- Better align Naval acquisition with our industry partners
- Develop a skilled acquisition force
- Holistic Systems Engineering Approach focused on key functional areas:
  - Software Acquisition Management
  - Software Engineering Practices
  - Business Implications
  - Software Development Techniques
  - Human Resources

Phase I
Understand “As Is” Situation

Phase II
Envision things To change “To Be”

Phase III
Institutionalization

ASN RDA

SSG

HIT

SAM SSE SWDT BI HR

SSG: Senior Steering Group
HIT: Horizontal Integration Team
SAM: Software Acquisition Management
SSE: Software Systems Engineering
SWDT: Software Development Techniques
BI: Business Implications
HR: Human Resources

SPII Charter: 15 May 2006 ASN RDA Memo
The Plan

I. As Is:
Understand current situation and review existing policies and reports

II. To Be:
Envision things to come & document changes

III. Institutionalize:
Leverage existing Mechanisms; PEO and SYSCOM responsibilities

5 Focus Areas

- SW Development Techniques (PEO C4I Lead)
- Human Resources (NAVSEA Lead)
- SW Acquisition Management (NAVAIR lead)
- Business Implications (PEO IWS Lead)
- SW Systems Engineering (NAVAIR Lead)

Institutionalize
Overarching Policy and Guidebook for Acquisition of SW Intensive Systems
Step-wise Accomplishments

- As Is” Report signed 17 May 2007
  - Uncovers the current environment for the acquisition of software intensive systems across the Naval Enterprise
  - Findings are consistent with past DSB and NRAC findings

- “Software Development Techniques Phase 1 Report” signed 10 Jul 2007
  - Provides an overview of existing software development techniques and suggestions for evaluating emerging software development techniques

- Program Office Survey Findings Report promulgated July 2007
  - Report verifies the findings of previous studies (e.g., Defense Science Board (DSB)-2000 and Naval Research Advisory Committee (NRAC)-2006) by tracking them directly to current programs of record

- Contract Language Guidance policy memo signed 13 Jul 2007
  - Provides amplifying guidance information on the 17 Nov 2006 Contract Language policy memo
Accomplishments (cont.)

- Software Metrics White Paper – identified 4 core metrics
- “To Be” Report signed 6 Nov 2007
  - Assists acquisition professionals with a preview of key considerations for major problems having been found to be most troublesome and most commonly documented
- “Role Base Right Fit Training” Report signed 6 Nov 2007
  - Addresses the training issues highlighted by the SAM focus team “As Is” state report, SSE focus team “Program Management Office Survey Findings,” DSB, and NRAC findings
- Contract Language policy memo signed 17 Nov 2006
  - Directs standardized contract language for all contracts containing software development, acquisition and life cycle support beginning with RFPs issued after 1 Jan 2007
    • Requires developers to submit Software Development Plan (SDP)
Core Software Metrics

The four required core metrics
- Software Size/Stability
- Software Cost/Schedule
- Software Quality
- Software Organization

All metrics to be provided during key phases of the system acquisition lifecycle and DoN 2Passes/6Gates

<table>
<thead>
<tr>
<th>ID</th>
<th>Phase</th>
<th>Milestone-Related Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Concept Development</td>
<td>Pre-Concept Decision (CD)</td>
</tr>
<tr>
<td>II</td>
<td>Concept Refinement</td>
<td>Post-CD, Leading to Milestone (MS)-A</td>
</tr>
<tr>
<td>III</td>
<td>Technology Development</td>
<td>Post MS-A, Leading to MS-B</td>
</tr>
<tr>
<td>IV</td>
<td>System Development and Demonstration (SDD)</td>
<td>Post MS-B, Leading to Design Readiness Review (DRR)</td>
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<tr>
<td></td>
<td>(System Integration)</td>
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</tr>
<tr>
<td>V</td>
<td>SDD (System Demonstration)</td>
<td>Post DRR, Leading to MS-C</td>
</tr>
<tr>
<td>VI</td>
<td>Production and Deployment</td>
<td>Post MS-C, Leading to Full Rate Production (FRP) Decision</td>
</tr>
<tr>
<td>VII</td>
<td>Operations and Support</td>
<td>Post FRP Decision Review</td>
</tr>
</tbody>
</table>
Status Reporting Based on Metrics

- Examples of basic and general usage of metrics:
  - Scope creep and software stability based on software size metrics/trends
  - Software cost and schedule variances, trends, and performance indexes
  - Software defects, trouble reports, and other quality trends
  - Software personnel staffing actuals vs. planned, including training and turnover metrics

- Software 4 Core Metrics infused into Naval Probability of Program Success (PoPS) - Complete
SPII is Institutionalized!

- Software Process Improvement Initiative completed – Sept 2008
  - Software Measurement for Naval Software Intensive Systems
    - 4 core metrics
  - Overarching Software Process Improvement Policy for Acquisition of Naval Software Intensive Systems
    - Software Process Management Improvement
    - Contract Language
    - Software Measurement
    - Personnel experience or training
    - Ensure implementation and adherence to processes Software Measurement for Acquisition of Naval Software Intensive Systems
  - Guidebook for Software Process Improvement for Acquisition of Naval Software Intensive Systems
    - Provide support to acquisition stakeholder team
    - Organize to capture focus teams products
    - Structure follows acquisition process timeline
"Should-Be" Software Environment

Planning

WBS

SYSTEM

SYS Engr

SW Engr

Logistics

...  

CSCI 1

CSCI 2

Build 1

Integration 1

...  

Architecture Dev.

Cost Estimating

Reg ID & Dev.

EVMS

Scheduling

Management

MDA SECNAVNOTE 5000.2 GATES AND PASSES

SW Infused WBS Supports Effective Software Metrics and Program Management

MAD CHIEF SYSTEMS ENGINEER

Legend:

Process

Product

Historical Software Data

- Domain
  - Similar systems
- Key attributes
  - E.g.,
    - Accurate
    - Normalized
    - Etc.

Process

Product

Metrics (Core SW)

PoPS Metrics

Risk Mgt

SETR_{SW}
Institutionalization Next Steps

- Infuse software into SE Planning, SE Management, and SE Technical Reviews processes
  - Systems Engineering Technical Review (SETR)
  - Systems Assurance
  - Work Breakdown Structure friendly to Software
- Continue working with USD(AT&L), Services, and DAU to meet human resources and training needs
- RDA CHSENG sponsor next updates to:
  - Software development techniques
  - Contract language guidance, when required
Back-up slides
Infusion Into PoPS for Gate Reviews

- Mapping of software metrics-related timeline phases to Gate Reviews

<table>
<thead>
<tr>
<th>Lifecycle Phases</th>
<th>SECNAVNOTE 5000</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Concept Development</td>
<td>Gate 1</td>
</tr>
<tr>
<td>II: Concept Refinement</td>
<td>Gates 2 &amp; 3</td>
</tr>
<tr>
<td>III: Technology Development</td>
<td>Gates 4 &amp; 5</td>
</tr>
<tr>
<td>IV: System Development</td>
<td>Gate 6</td>
</tr>
<tr>
<td>V: System Demonstration</td>
<td>Gate 6 (Phase 2)</td>
</tr>
<tr>
<td>VI: Production &amp; Deployment</td>
<td>Gate 6 (Phase 3)</td>
</tr>
<tr>
<td>VII: Operations &amp; Support</td>
<td>Gate 6 (Phase 4)</td>
</tr>
</tbody>
</table>

See Backup Slides for overview/description of each Gate Review and policy memos for use of PoPS methodology at Gate Reviews.
SPIII Core Measurement and Metrics Update

Program Office Metrics

KPP and requirements driven

Contract Metrics

KSLOC and/or function point driven

Software Size

Cost/Schedule

Organization

Software Quality

Cross Functional Match – Effective Communications

Key Billets/Skills - DAIWIA driven

Key Billets/Skills – Contract/RFP Identified

Government Independent Cost Estimate (ICE); Official Stamp of Program Baseline; Delta in KPP/Requirements

Contract Mods/Out of Scope/Scope Creep based on KPP/req delta

KPP and requirements driven

Defect Rate/Cost of Rework

T&E Outcomes

Based on Quality

Based on KPP/Req delta

Details are dependent on SAM organization micro-product, HR skills and capability micro-product; BI contract language review
Motivation for SPII Core Metrics

Efforts to develop appropriate metrics for performance measurement and continual process improvement.

- Software Size
- Software Organization
- Software Cost/Schedule
- Software Quality
- Risk Management
- Project Management and Oversight

- software acquisition planning
- requirements development
- requirements management
- ensure that key program personnel have an appropriate level of experience or training in software acquisition
“Successful development and acquisition of software is paramount for acquiring Naval Warfighting and business systems. There are many parallel and related efforts underway that address improvement in the acquisition of software products: mandates such as Public Law 107-314 Section 804 and the Clinger-Cohen Act; initiatives such as Software Assurance and Open Architecture (OA); and the development of best practice models such as the Capability Maturity Model Integration (CMMI) for Acquisition. To consolidate these efforts into a focused initiative, I have formed a steering group composed of my senior engineering professionals and led by the ASN (RD&A) Chief Engineer. This group will evaluate existing policies and implement process improvements to enhance our ability to develop and acquire software without sacrificing the cost, schedule and performance goals of our acquisition programs.

Additionally, five focus teams, led by department software engineering professionals, have been established to achieve our strategic software goals (see attachment):

- Software Acquisition Management (SAM) Focus Team
- Software Systems Engineering (SSE) Focus Team
- Software Development (SWDEV) Techniques Focus Team
- Business Implications Focus Team
- Human Resources Focus Team”
Business Implications (BI)

❖ Accomplished – As Is and To Be
  – Contract Language policy memo signed 17 Nov 2006
    • Directs standardized contract language for all contracts containing software development, acquisition and life cycle support beginning with RFPs issued after 1 Jan 2007
      - Requires developers to submit Software Development Plan (SDP)
  – Contract Language Guidance policy memo signed 13 Jul 2007
    • Provides amplifying guidance information on the 17 Nov 2006 Contract Language policy memo

❖ Institutionalize
  – Re-enforced in the overarching Policy and Guidebook for Acquisition of Naval Software Intensive Systems – signed September 16, 2008
  – Update Contract Language based on future need
Software Development Techniques (SWDT)

- Accomplished – As Is and To Be
  - “Software Development Techniques Phase 1 Report” signed 10 Jul 2007
    - Provides an overview of existing software development techniques and suggestions for evaluating emerging software development techniques
    - Facilitates program managers software risk management

- Institutionalize
  - Guidebook for Acquisition of Naval Software Intensive Systems – signed September 16, 2008
  - Annual update to reflect maturity of existing techniques and emergence of new techniques
Software Systems Engineering (SSE)

❖ Accomplished – As Is and To Be
    • Report verifies the findings of previous studies (e.g., Defense Science Board (DSB)-2000 and Naval Research Advisory Committee (NRAC)-2006) by tracking them directly to current programs of record
  – Software Metrics White Paper – identified 4 core metrics
  – Develop software reviews for inclusion in Systems Engineering Technical Review (SETR)

❖ Institutionalize
    • Provides a set of software metrics to assess program performance
  – Incorporate software reviews into SETR (planned March 2009)
    • Executing under Systems Engineering Stakeholders Group (SESG)
Accomplished – As Is and To Be
- “As Is” Report signed 17 May 2007
  - Uncovers the current environment for the acquisition of software intensive systems across the Naval Enterprise
  - Findings are consistent with past DSB and NRAC findings
- “To Be” Report signed 6 Nov 2007
  - Assists acquisition professionals with a preview of key considerations for major problems having been found to be most troublesome and most commonly documented

Institutionalize
- Tailorable Organization Structure (included in Guidebook Sept 2008)
  - Tool for assessing organizational structure, software expertise, and staffing requirements for software intensive systems program offices
  - Provides a set of software metrics to assess program performance
- Use the Systems Engineering Plan (SEP) and SETR (planned March 2009)
  - On-going effort through the SESG
Human Resources (HR)

- **Accomplished – As Is and To Be**
  - “Role Base Right Fit Training” Report signed 6 Nov 2007
    - Addresses the training issues highlighted by the SAM focus team “As Is” state report, SSE focus team “Program Management Office Survey Findings,” DSB, and NRAC findings

- **Institutionalize**
  - “Establishment of DAWIA Software Acquisition Training and Education Working Group” draft memo by OUSD(AT&L)
    - The “Role Base Right Fit Training” report serves as Naval input to OSD sponsored reviews of software acquisition management competencies for six acquisition disciplines (Program Management, Contracting, Acquisition Logistics, Systems & Software Engineering, and Legal)
Institutionalize – Guidebook

- **Signatory:** ASN RDA

- **Audience:**
  - Primary: Government acquisition community
  - Secondary: Stakeholder community (e.g., developers)

- **Objective:**
  - To provide support to acquisition stakeholder team
  - Organize to capture focus teams products
  - Structure follows acquisition process timeline

- **Status:** Signed September 16, 2008
Institutionalize – Policy

- **Signatory:** ASN RDA
- **Audience:**
  - Primary: Government acquisition community
  - Secondary: Stakeholder community (e.g., developers)
- **Objective:**
  - Improve software acquisition processes
  1. **Software Measurement for Naval Software Intensive Systems**
    - 4 core metrics
  2. **Overarching Software Process Improvement Policy for Acquisition of Naval Software Intensive Systems**
    - Software Process Management Improvement
    - Contract Language
    - Software Measurement
    - Personnel experience or training
    - Ensure implementation and adherence to processes
- **Status:** signed July 22, 2008 & September 16, 2008
### Weighting of Core Metrics Across Gates

<table>
<thead>
<tr>
<th>Core Metric</th>
<th>Gate 1 / Ph I: Concept Development</th>
<th>Gate 2 / Ph II: Concept Refinement</th>
<th>Gate 3 / Ph II: Concept Refinement</th>
<th>Gate 4 / Ph III: Technology Development</th>
<th>Gate 5 / Ph III: Technology Development</th>
<th>Gate 6 / Ph IV: System Development</th>
<th>Gate 6 Phase 2 / Ph V: System Demonstration</th>
<th>Gate 6 Phase 3 / Ph VI: Production &amp; Deployment</th>
<th>Gate 6 Phase 4 / Ph VII: Operations &amp; Support</th>
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</thead>
<tbody>
<tr>
<td>Size/Stability</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>25%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
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<tr>
<td>Organization</td>
<td>50%</td>
<td>40%</td>
<td>50%</td>
<td>40%</td>
<td>30%</td>
<td>25%</td>
<td>15%</td>
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<tr>
<td>Cost/Schedule</td>
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<td>40%</td>
<td>30%</td>
<td>25%</td>
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<td>Quality</td>
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<tr>
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## Software Size/Stability Metric

<table>
<thead>
<tr>
<th>Phase</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline/Basis of Metric</td>
<td>Concept expectation of %-age of system functionality to be delivered by SW (vice, e.g., HW)</td>
<td>Concept expectation of %-age of system functionality to be delivered by SW (vice, e.g., HW)</td>
<td>SW Size Estimates</td>
<td>SW Size Baseline</td>
<td>SW Stability</td>
<td>SW Stability</td>
<td>SW Stability</td>
</tr>
<tr>
<td>Who Collects Measurements</td>
<td>Program Office</td>
<td>Program Office</td>
<td>Program Office / Bidders</td>
<td>SW developer/integrator</td>
<td>SW developer/integrator</td>
<td>SW developer/integrator</td>
<td>Program Office / SW developer/integrator</td>
</tr>
<tr>
<td>Who Analyzes</td>
<td>Program Office</td>
<td>Program Office</td>
<td>Program Office</td>
<td>Program Office / SW developer/integrator</td>
<td>SW developer/integrator</td>
<td>SW developer/integrator</td>
<td>Program Office</td>
</tr>
<tr>
<td>Metric</td>
<td>%-age of functionality in SW</td>
<td>%-age of functionality in SW</td>
<td>Estimated SLOC, FP, or Req'ts.</td>
<td>ESLOC, FP, or Req'ts.</td>
<td>ESLOC, FP, or Req'ts.</td>
<td>ESLOC, FP, or Req'ts.</td>
<td>ESLOC, FP, or Req'ts.</td>
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<tr>
<td>Use of Metrics</td>
<td>Risk, Lessons Learned</td>
<td>Risk, Lessons Learned, Concept Selection</td>
<td>Risk, Lessons Learned, Source Selection</td>
<td>Risk, Lessons Learned, Performance</td>
<td>Risk, Lessons, Learned, Performance</td>
<td>Risk, Lessons, Learned, Performance</td>
<td>Risk, Performance, Lessons Learned, Database/Archival</td>
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## Software Cost/Schedule Metric

<table>
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<tr>
<th>Phase</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline/Basis of</td>
<td>SW related</td>
<td>SW related</td>
<td>Actual SW cost &amp; schedule data</td>
<td>Actual SW cost &amp; schedule data</td>
<td>Actual SW cost &amp; schedule data</td>
<td>Actual SW cost &amp; schedule data</td>
<td>Actual SW cost &amp; schedule data</td>
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<td>Metric</td>
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<td>IERs, SDXs</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Who Collects</td>
<td>Sponsors &amp;</td>
<td>Sponsors &amp;</td>
<td>Program Office / SW developer/integrator</td>
<td>Program Office / SW developer/integrator</td>
<td>Program Office / SW developer/integrator</td>
<td>Program Office / SW developer/integrator</td>
<td>Program Office / SW developer/integrator</td>
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<tr>
<td>Measurements</td>
<td>Advocates</td>
<td>Advocates</td>
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<tr>
<td>Who Analyzes</td>
<td>Sponsors &amp;</td>
<td>Sponsors &amp;</td>
<td>Program Office</td>
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<td>Program Office</td>
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<td>Advocates</td>
<td></td>
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</tbody>
</table>

- **Phase I** (Baseline/Basis of Metric): SW related IERs, SDXs
- **Phase II**: SW related IERs, SDXs
- **Phase III**: Actual SW cost & schedule data
- **Phase IV**: Actual SW cost & schedule data
- **Phase V**: Actual SW cost & schedule data
- **Phase VI**: Actual SW cost & schedule data
- **Phase VII**: Actual SW cost & schedule data

- **Who Collects Measurements**: Sponsors & Advocates
- **Who Analyzes**: Sponsors & Advocates
- **Metric**: 
  - # IERs/SDXs produced by SW
  - Cost/Schedule Variance/Performance index
  - Cost/Schedule Variance/Performance index
  - Cost/Schedule Variance/Performance index
  - Cost/Schedule Variance/Performance index

- **Use of Metrics**: Risk, Lessons Learned
## Software Quality Metric

<table>
<thead>
<tr>
<th>Phase</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline/Basis of Metric</td>
<td>SW related IERS &amp; SDXs</td>
<td>SW related IERS &amp; SDXs</td>
<td>Defects per SLOC</td>
<td>Defects per SLOC, Defects per system interface</td>
<td>Defects per SLOC, Defects per system interface</td>
<td>Defects per SLOC, Defects per system interface</td>
<td>Defects per SLOC, Defects per system interface</td>
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<tr>
<td>Who Analyzes</td>
<td>Sponsors &amp; Advocates</td>
<td>Sponsors &amp; Advocates</td>
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<td>Program Office</td>
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<tr>
<td>Metric</td>
<td>% SW generated IERs/SDXs</td>
<td>% SW generated IERs/SDXs</td>
<td>Qty performance index/ variance</td>
<td>Qty performance index/ variance</td>
<td>Qty performance index/ variance</td>
<td>Qty performance index/ variance</td>
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<td>Use of Metrics</td>
<td>Risk, Lessons Learned</td>
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# Software Organization Metric

<table>
<thead>
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<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline/Basis of Metric</td>
<td>Effort/KSA</td>
<td>Effort/KSA</td>
<td>Effort/KSA/Turnover</td>
<td>Effort/KSA/Turnover</td>
<td>Effort/KSA/Turnover</td>
<td>Effort/KSA/Turnover</td>
<td>Effort/KSA/Turnover</td>
</tr>
<tr>
<td>Who Collects Measurements</td>
<td>Program Office</td>
<td>Program Office</td>
<td>Program Office / Bidders</td>
<td>Program Office / Contractor</td>
<td>Program Office / Contractor</td>
<td>Program Office / Contractor</td>
<td>Program Office / Contractor</td>
</tr>
<tr>
<td>Who Analyzes</td>
<td>Program Office</td>
<td>Program Office</td>
<td>Program Office</td>
<td>Program Office / SW developer/ integrator</td>
<td>Program Office / SW developer/ integrator</td>
<td>Program Office / SW developer/ integrator</td>
<td>Program Office / SW developer/ integrator</td>
</tr>
<tr>
<td>Metric</td>
<td>Planned # of people or planned # of labor hours/actual trng vs required trng</td>
<td># of people or # of labor hours/actual trng vs required trng/# of people lost &amp; gained</td>
<td># of people or # of labor hours/actual trng vs required trng/# of people lost &amp; gained</td>
<td># of people or # of labor hours/actual trng vs required trng/# of people lost &amp; gained</td>
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