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Tools and Resources to Enable Systems Engineering Improvement

Michael T. Kutch, Jr.

SPAWAR Systems Center Charleston (SSC-C)

Head, Intelligence & Information Warfare Systems Engineering Department

National Competency Lead for I/A 5.8

Deputy National Competency Lead for ISR/IO 5.6

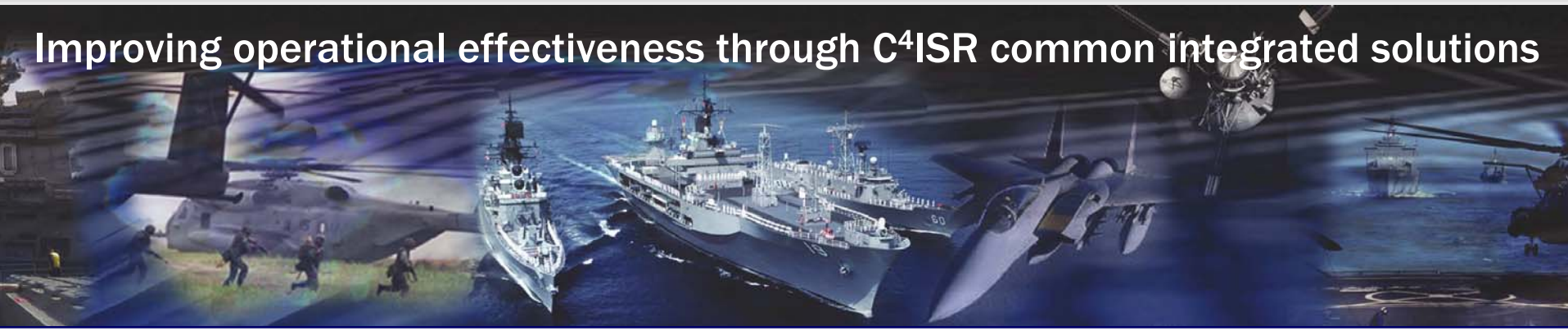
Mike Knox

Technical Software Services, Inc.

Director, Implementation and Support

SEI Authorized Instructor

10th Annual Systems Engineering Conference
October 23, 2007



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Presentation Outline

- **Vision and Strategy**
  - Elements of Implementation
- **Process Asset Library**
- **Tools**
  - ePlan Builder and eWBS
  - Organizational Measurement Repository
- **Training**
  - Training Architecture
  - Courses
- **Results**
- **Going Forward**

Process Improvement and Systems Engineering Strategy - 2003

- **Vision**
  - Develop and maintain a World Class Systems Engineering Organization
- **Approach**
  - Achieve Command-wide operational consistency
  - Based on ISO 15288 – systems engineering
  - Based on ISO 12207 – software engineering
  - Measure using best practices of CMMI®
- **Goals**
  - CMMI Maturity Level 2 by April, 2005
  - CMMI Maturity Level 3 by April, 2007

Both Goals attained on schedule

1st SPAWAR Systems Center to Achieve ML2 and ML3

New Goal: Maturity Level 4 by 2010

Which one is World Class?

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When you want it done right,
Who do you want working on it ?

Cutting corners, undisciplined, untrained

Rigorous processes, Skilled resources

Permission to use Redneck Mechanic photo received from Dave Lilligren, 3/9/2007
Permission to use NASCAR Technical Institute photo received from Popular Mechanics, 3/16/2007

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Critical Success Factors

CRITICAL SUCCESS FACTORS FOR SE REVITALIZATION	
Command-wide Policy (Create vision that is urgent)	Assign Responsibilities (Strong Change Agents are essential)
Strategy and Plan (Include knowledge of why change is necessary and benefits)	Provide Training
Senior Management Support	Build Central Repository
Provide Resources and Funding (New Organizational Structure Usually Needed)	Measure and Communicate Progress

SSC-C SE Revitalization Plan Aligned with DoD SE Revitalization

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Elements of SSC-C SE Revitalization

Policy / Guidance

- SSC-C SE Instruction
- SSC-C SE Process Manual
- SSC-C SW-Dev Process Manual
- SSC-C SW-Maint Process Manual
- EPO Website
- ePlan Builder

Training / Education

- Intro to PI WBT
- SE 101 WBT
- SE Fundamentals
- SE for Managers
- Project & Process Workshop
- Intro to Software Engr.
- Architecture Dev. WBT
- Certification/Degrees

Assessment & Support

- CMMI® Level 2
- CMMI® Level 3
- CMMI® Level 4/5
- Project Reviews
- Balanced Scorecard
- Lean Six Sigma
- Integrated Product Teams
- IT Tools

Underway

Completed/Ongoing

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Process Improvement Infrastructure: Organization

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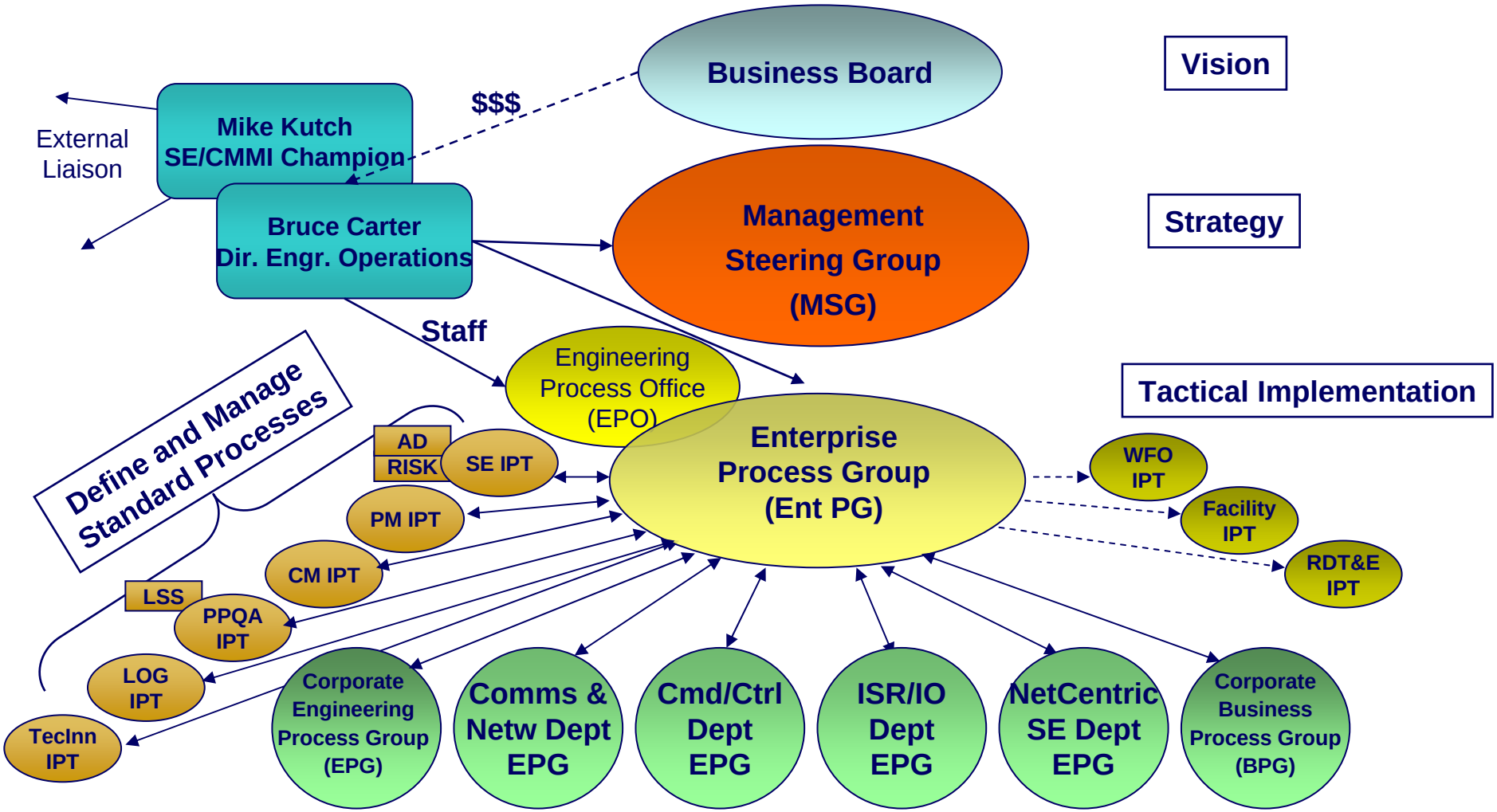

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Engineering Process Office (EPO)

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- **Supports the Director of Engineering Operations**
- **Developed Policies**
  - Policy for each CMMI Level 2, 3, 4, & 5 Process Area
- **Developed Standard Process Manuals**
  - Top Level
    - Systems Engineering
    - Software Development
    - Software Maintenance
  - Supporting Processes
    - Process Manual for each CMMI Level 2, 3, 4, & 5 Process Areas
    - Additional process documentation as needed – Reviews, Tailoring, etc
- **Develop plan templates**
- **Coach and mentor selected projects**
- **Build tools**
- **Develop and deliver training**
- **Perform interim assessments**

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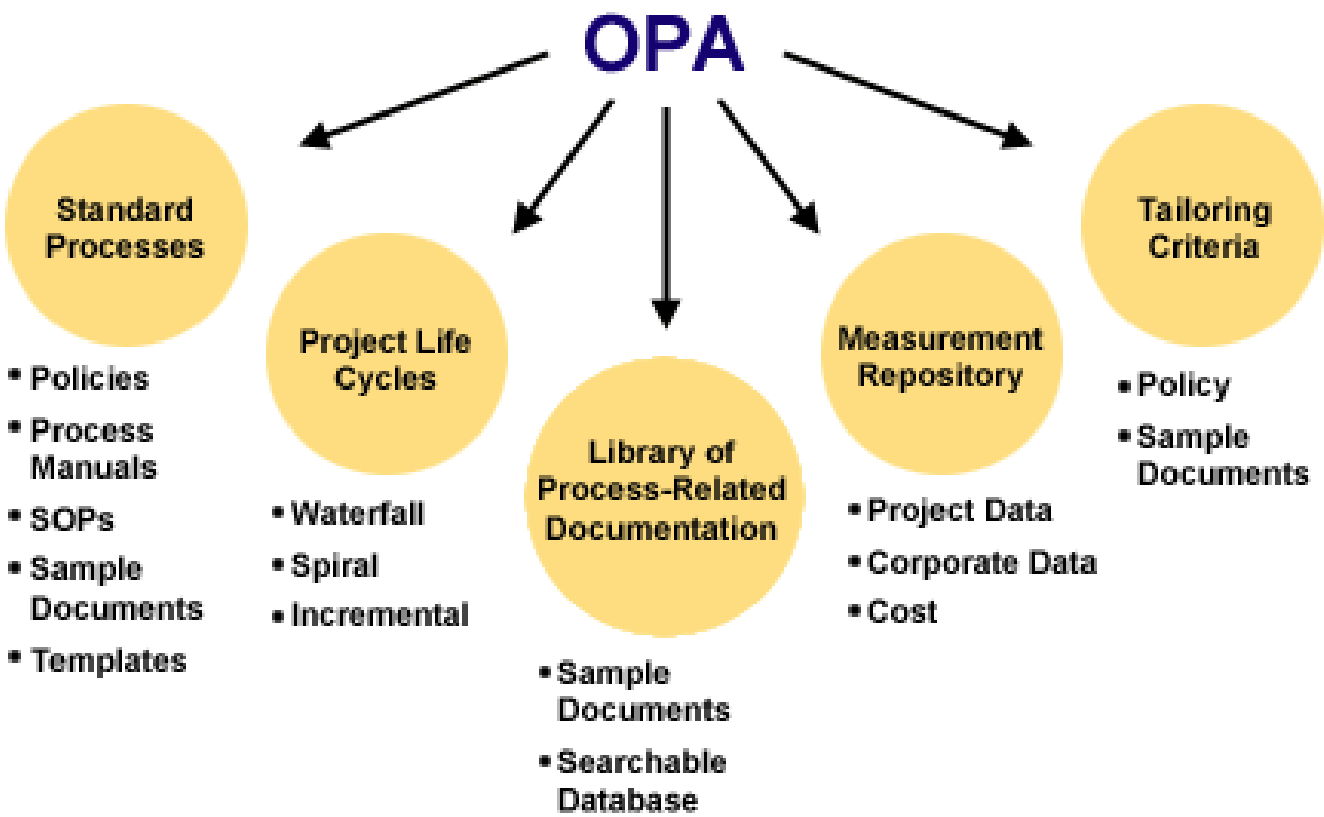
Process Asset Library

Recognized early need for central repository for Organizational Process Assets



EPO website provides access to all of SSC-C's organizational process assets

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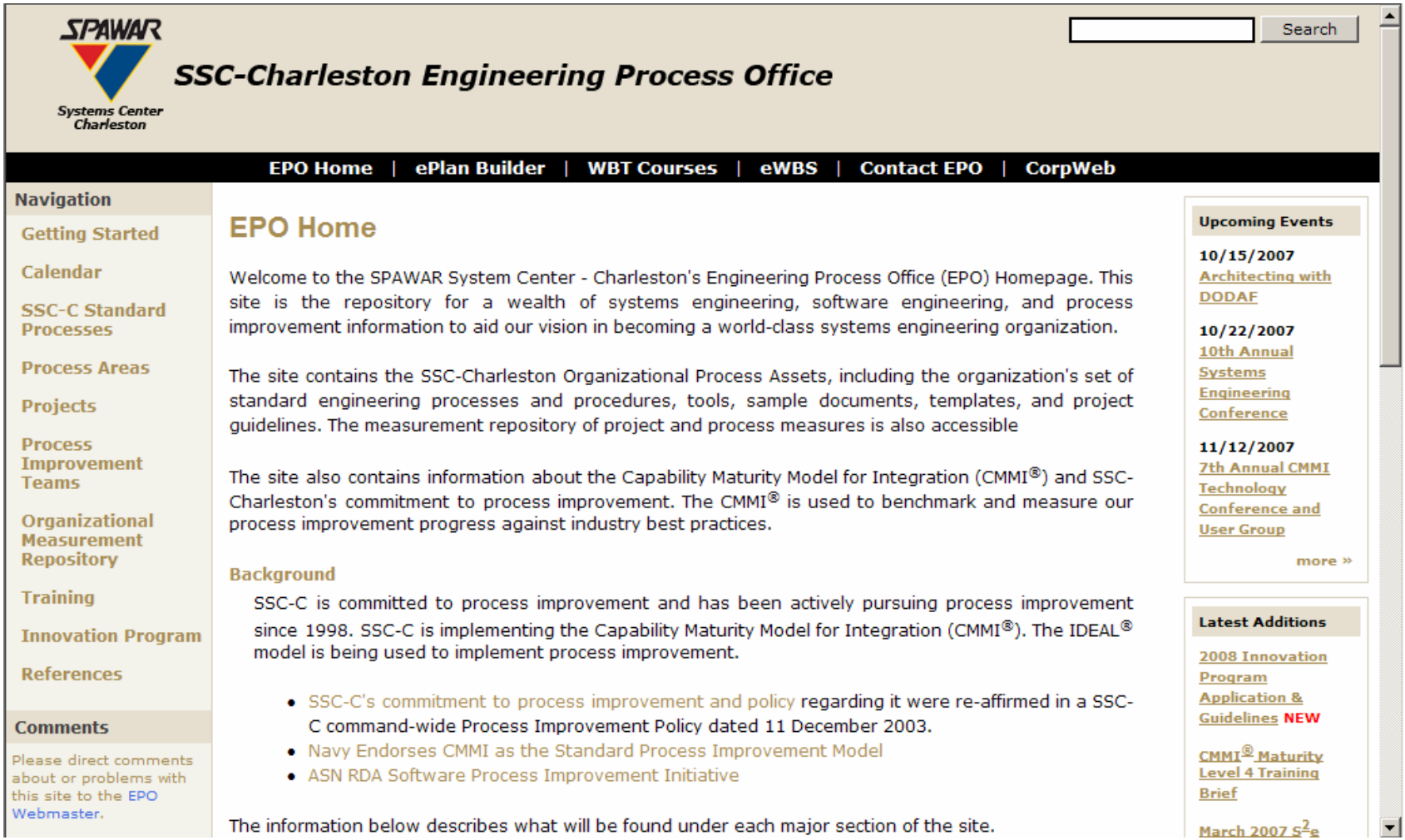
Approximately 100 pages of content; over 1000 documents available



Process Area Pages

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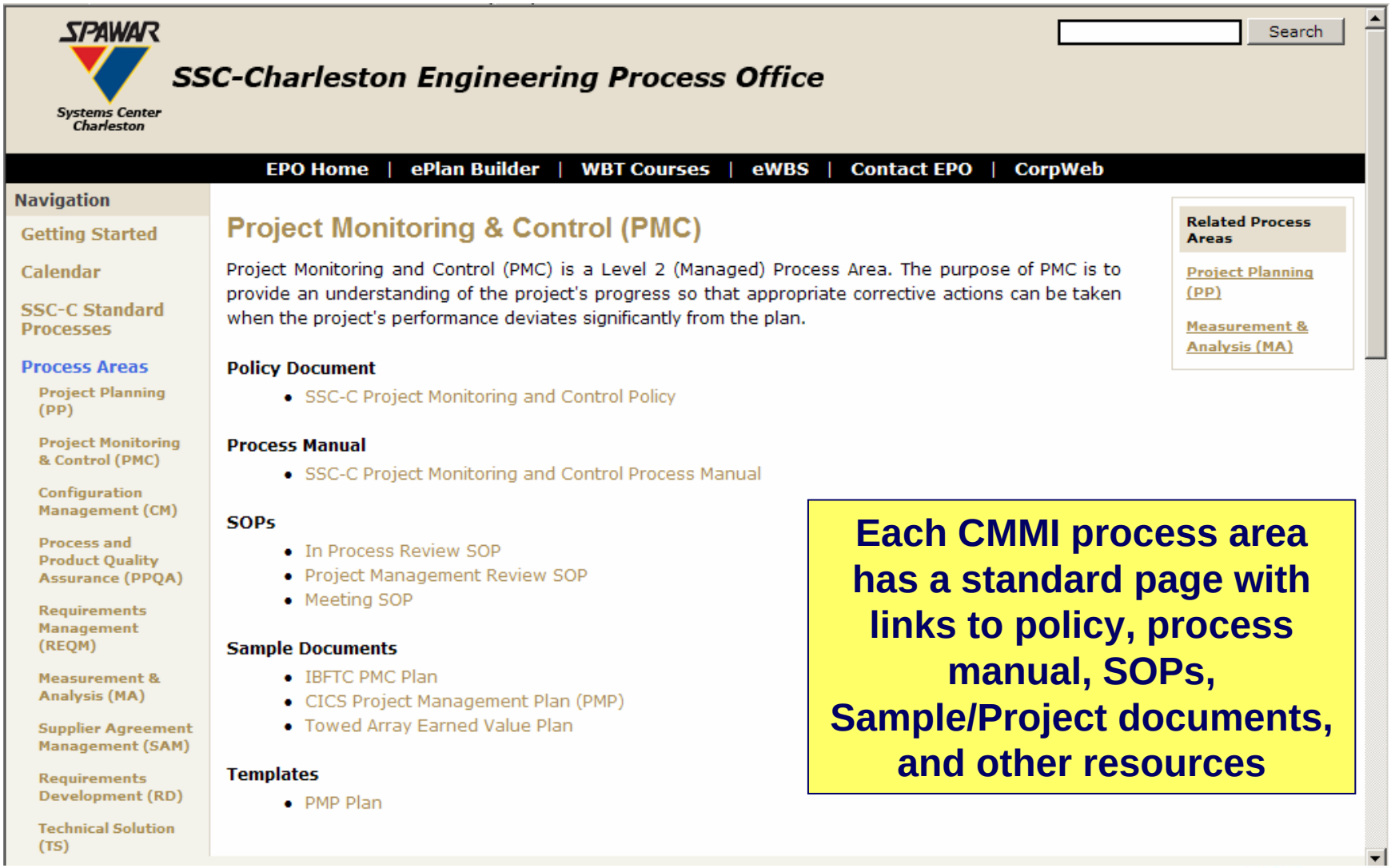

Each CMMI process area has a standard page with links to policy, process manual, SOPs, Sample/Project documents, and other resources

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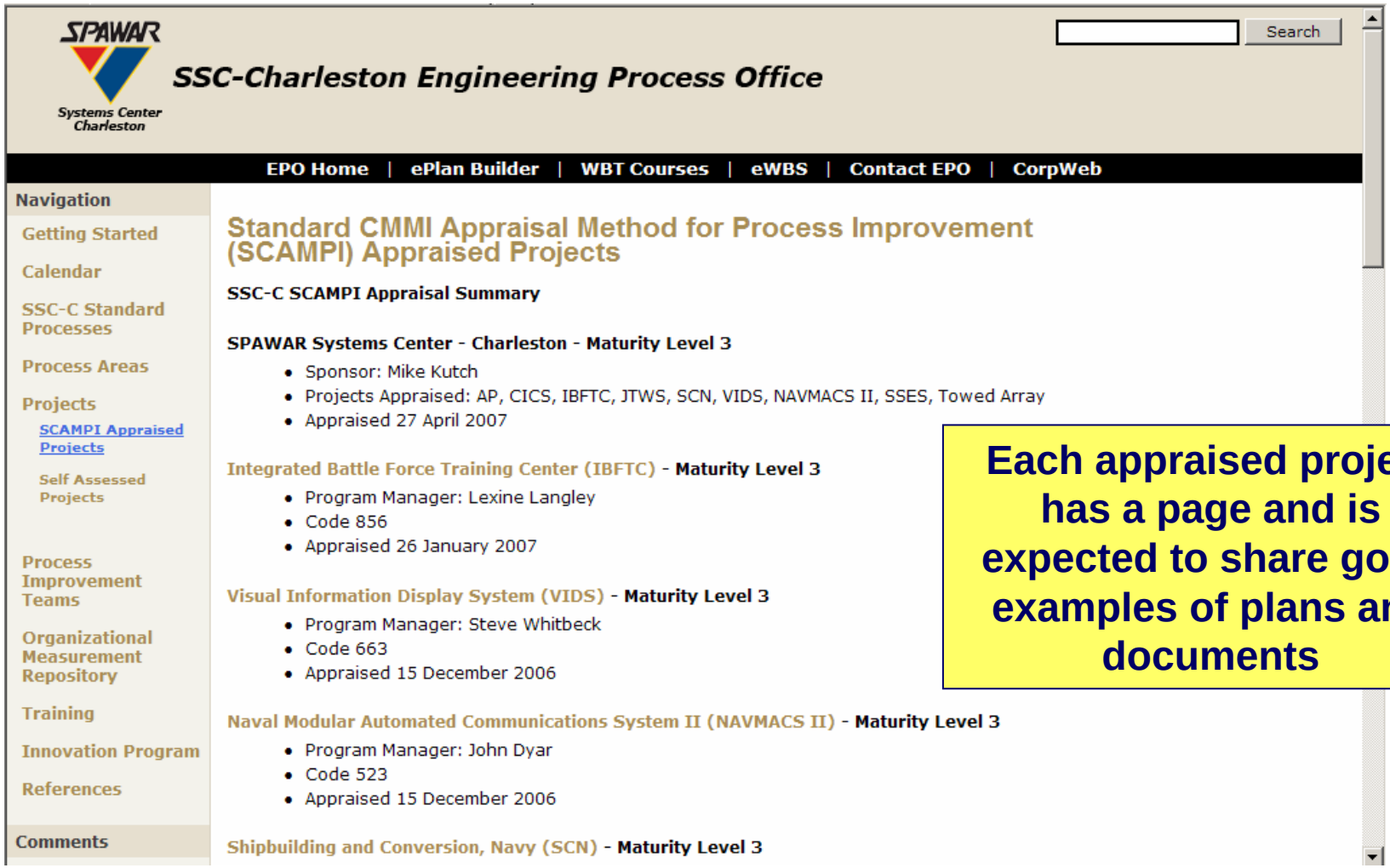
Projects Section



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SSC-Charleston Engineering Process Office

Search

EPO Home | ePlan Builder | WBT Courses | eWBS | Contact EPO | CorpWeb

Navigation

- Getting Started
- Calendar
- SSC-C Standard Processes
- Process Areas
- Projects
  - SCAMPI Appraised Projects
  - Self Assessed Projects
- Process Improvement Teams
- Organizational Measurement Repository
- Training
- Innovation Program
- References

Comments

Standard CMMI Appraisal Method for Process Improvement (SCAMPI) Appraised Projects

SSC-C SCAMPI Appraisal Summary

SPAWAR Systems Center - Charleston - Maturity Level 3

- Sponsor: Mike Kutch
- Projects Appraised: AP, CICS, IBFTC, JTWS, SCN, VIDS, NAVMACS II, SSES, Towed Array
- Appraised 27 April 2007

Integrated Battle Force Training Center (IBFTC) - **Maturity Level 3**

- Program Manager: Lexine Langley
- Code 856
- Appraised 26 January 2007

Visual Information Display System (VIDS) - **Maturity Level 3**

- Program Manager: Steve Whitbeck
- Code 663
- Appraised 15 December 2006

Naval Modular Automated Communications System II (NAVMACS II) - **Maturity Level 3**

- Program Manager: John Dyar
- Code 523
- Appraised 15 December 2006

Shipbuilding and Conversion, Navy (SCN) - **Maturity Level 3**

Each appraised project has a page and is expected to share good examples of plans and documents

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Tools

- ePlan Builder
- Organizational Measurement Repository
- Appraisal Wizard

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ePlan Builder Tool

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ePlan Builder tool

- An interactive, web-based application that leads the user through a structured interview process (like TurboTax®) to generate a CMMI®-compliant plan
- Includes standard, consistent text
- Generates an initial project-specific document
  - Project Management Plan (with Work Breakdown Structure)
  - Configuration Management Plan
  - Process and Product Quality Assurance Plan
  - Requirements Management Plan
  - Measurement and Analysis Plan
  - Supplier Agreement Management Plan (by end of 2007)
  - Systems Engineering Plan (DoD SEP Format)

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EPB – Select Tasks for each Role

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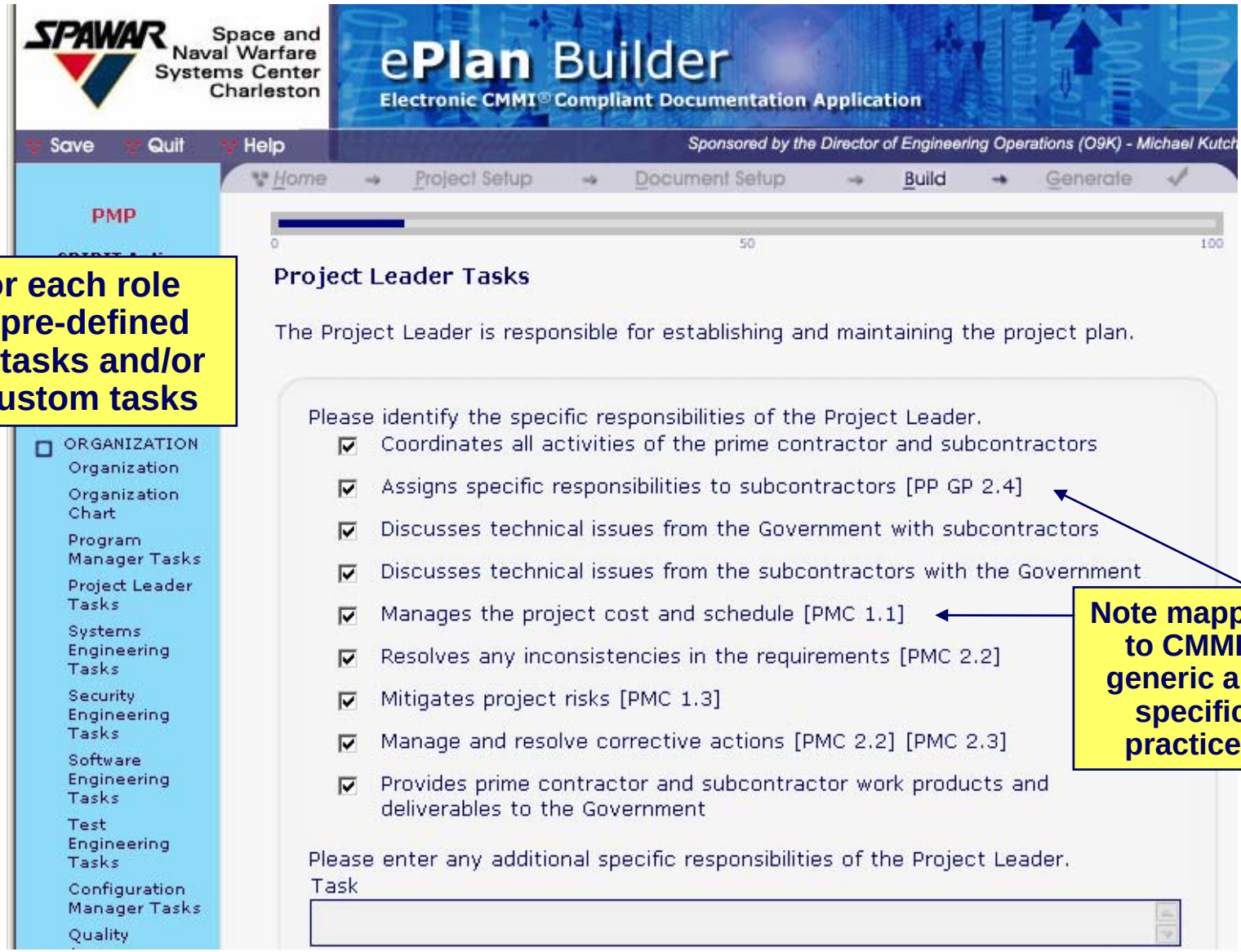

Tailor each role from pre-defined list of tasks and/or add custom tasks

Note mapping to CMMI® generic and specific practices

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Work Breakdown Structure (WBS) in a Project Management Plan

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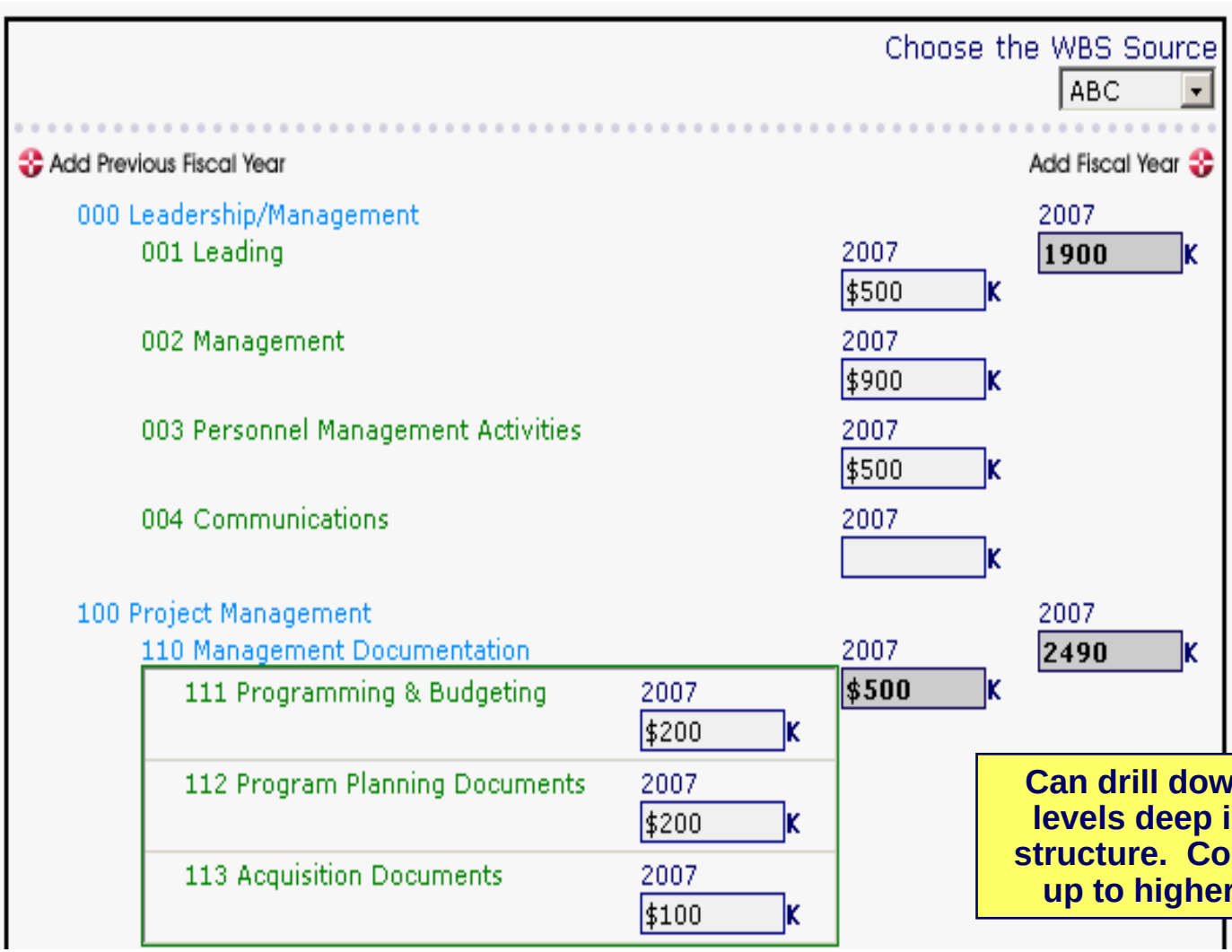

Cost estimates entered using the SPAWAR global WBS or the SSC-C Activity Based Costing WBS

ePB accommodates multi-year projects

Can drill down three levels deep in WBS structure. Costs sum up to higher level.

Risk Identification in PMP

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Risks

This page allows you to enter a list of known or expected risks. The severity of the risks and the mitigation approach for each should be identified. Please use the table below to identify the major risks associated with the project.

Click for more information about risks

Risk Category	Impact/Concern	Level	Mitigation Approach
Schedule	Products are required by the customer by 10/1/06	High	Be prepared to provide draft materials if development of
Quality	Will products be ready for 10/15/06 in a condition	Medium	Provide technical data to contractor in accordance with schedule with
Technical	Ability to get teh technical ata from the	High	Interact directly with the satellite manufacturer to obtain the technical

Add More Items

PMP may also reference a more comprehensive Risk Management Plan

Measurement & Analysis Plan

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Cost, Schedule, and Process Performance are standard categories of measures

Collection, Storage, and Analysis is defined for each Project measure

Cost is a measure within the Financial Performance category that measures the cost for activities, events, and products. The measure provides an easy-to understand view of the budget. Comparison of planned and actual cost data provides insight into significant and repetitive cost changes at the activity level.

While more detailed cost information provides more insight into the project's total cost, until the project personnel have achieved a certain level of proficiency in estimating costs, it is recommended that the cost data should be captured at a level commensurate with this level of experience.

Collection and Storage

Identify the level of detail for capturing cost data
Project Level

Please select how the Project Leader will report contract costs from the list below. If the Project Leader is not responsible for managing contracts, select "Project".
Project

Identify who will provide the actual cost data:
Project Leader

Identify the tool to be used to collect cost data:
BSA and PMACS

Identify how often the actual cost data will be collected:
Monthly

Analysis Procedures

Identify how often the cost data will be analyzed:
Monthly

Identify the cost alert threshold:
95%

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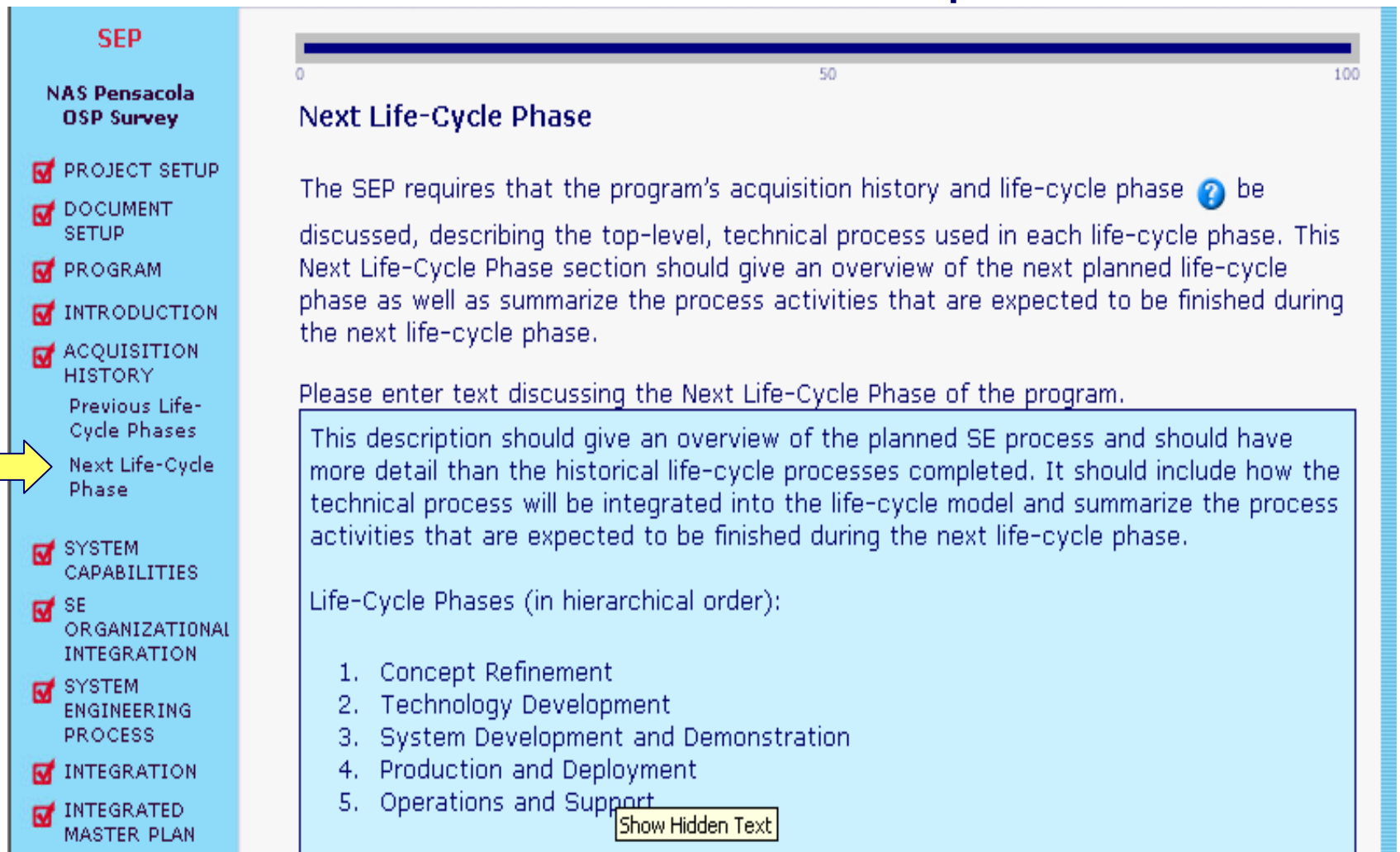
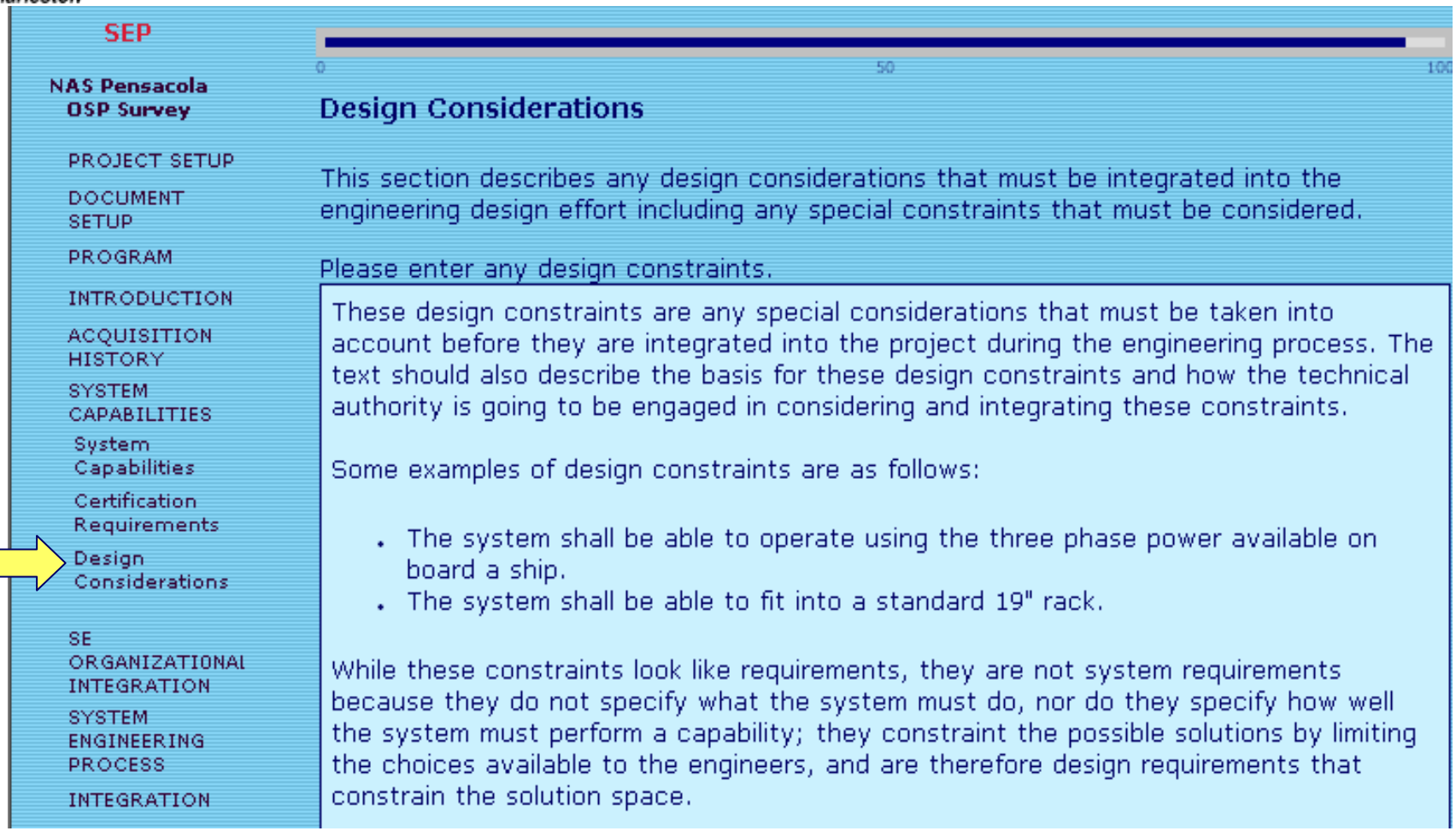
Systems Engineering Plan (SEP)

SEP format follows the DoD SEP Preparation Guide



Systems Engineering Plan (SEP)

Systems Center Charleston



The nature of the SEP requires more open input text fields, but EPB helps by providing elaborations and examples for the user

SEP – Planned Trade Studies

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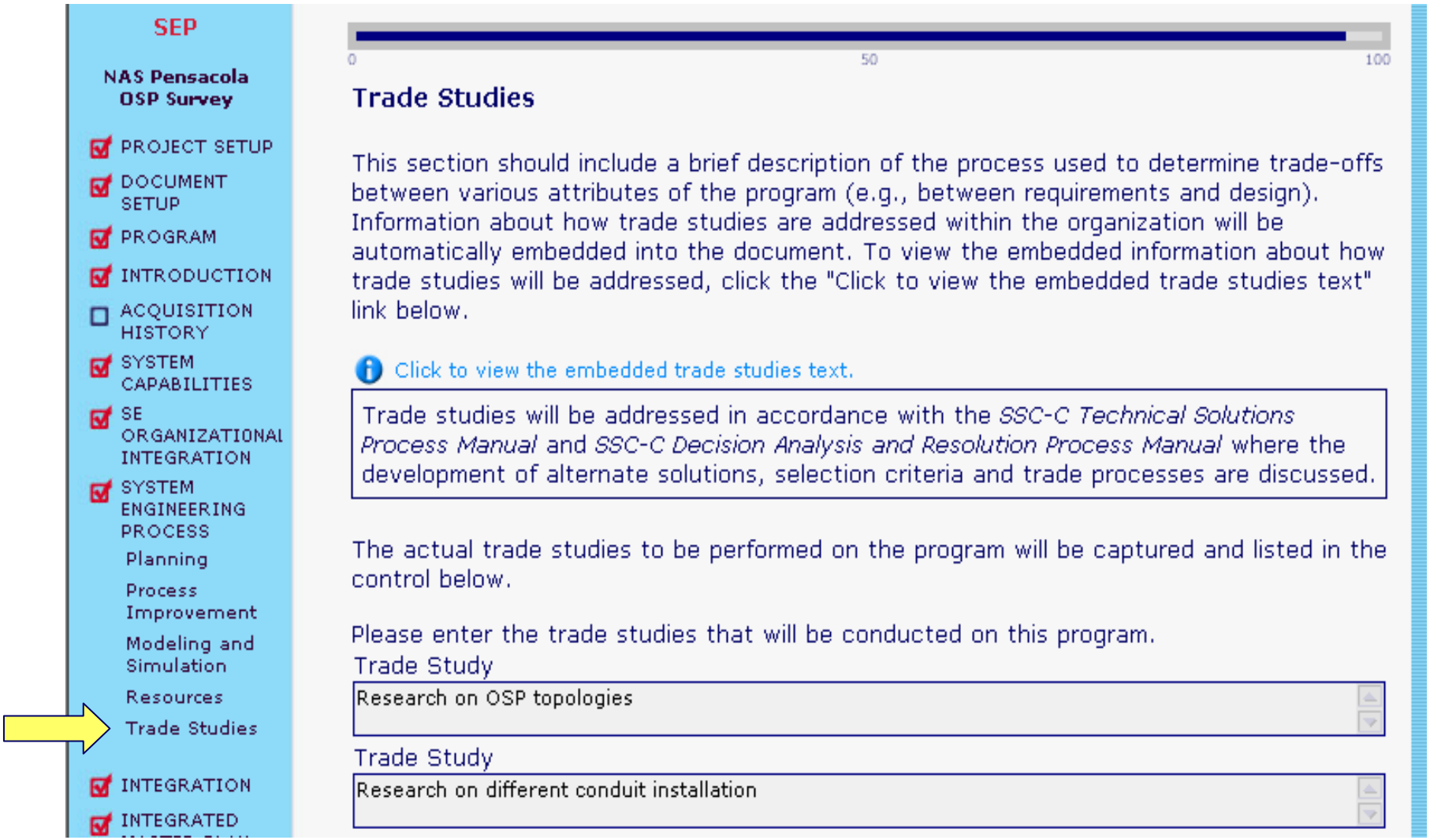

ePB Output
SEP Table of Contents

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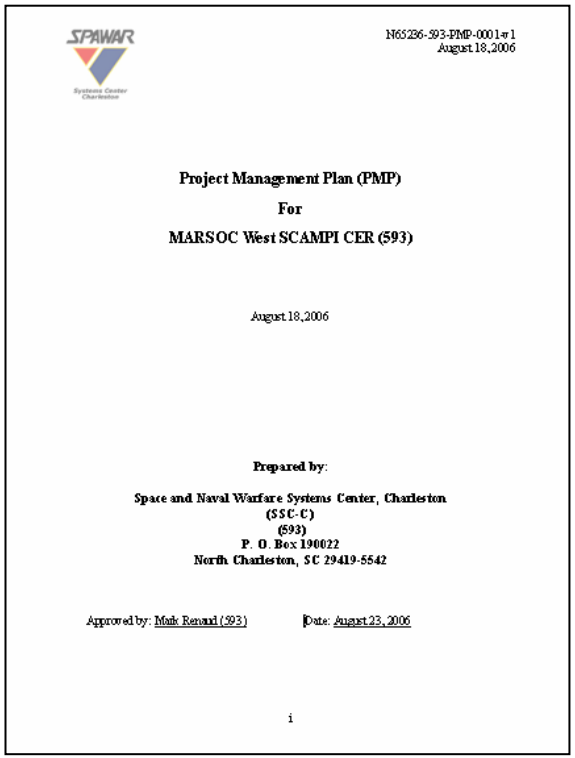

N65286-593-PMP-0001v1
August 18, 2006

Project Management Plan (PMP)

For

MARSOC West SCAMPI CER (593)

August 18, 2006

Prepared by:

Space and Naval Warfare Systems Center, Charleston
(SSC-C)
(593)
P. O. Box 190022
North Charleston, SC 29419-5542

Approved by: Mark Renaud (593) Date: August 23, 2006

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Appendix – CMMI® Compliance Matrix

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N65236-593-PMP-0001-v1
August 18, 2006

PROJECT PLANNING

CMMI®-SE/SW Goal/Practice Number	CMMI®-SE/SW Level 2 Process Area Project Planning (PP)	SSC-C PP Process Manual Paragraph	593 PMP Paragraph
1	Establish Estimates. Estimates of project planning parameters are established and maintained.	3.2	1.2.1
PP 1.1	Estimate the Scope of the Project. Establish and maintain a top-level work breakdown structure (WBS) to estimate the scope of the project.	3.2	1.2.1 3 Appendix A
PP 1.2	Establish Estimates of Project Attributes. Establish and document estimates of the attributes of the work products and tasks.	3.2	1.2.1 1.3
PP 1.3	Define Project Life Cycle. Define the project life cycle phases upon which to scope the planning effort.	3.2	1 1.2.1
PP 1.4	Determine estimates of Effort and Cost. Estimate the project effort and cost for the attributes of the work products and tasks based on estimation rationale.	3.2	1.3 1.2.1 Appendix A
PP 2	Develop a Project Plan. A project plan is established and maintained as the basis for managing the project.	3.3	1 1.2.1

Compliance matrix cross references CMMI® practices with associated SSC-C Process Manual and Project-specific plan

(No matrix for SEP)

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Organizational Measurement Repository (OMR)

- Organizational database for collecting standard project measures and providing analysis
- Currently, the OMR accepts the following standard project measures

Category	Core Measure
Schedule Performance	• Estimated vs. Actual Milestone dates • Estimated vs. Actual Monthly Task completions
Cost Performance	• Estimated vs. Actual Milestone costs • Estimated vs. Actual Monthly costs
Process Performance	• Total # of noncompliance issues

OMR Structure

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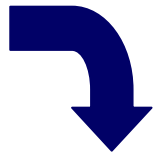
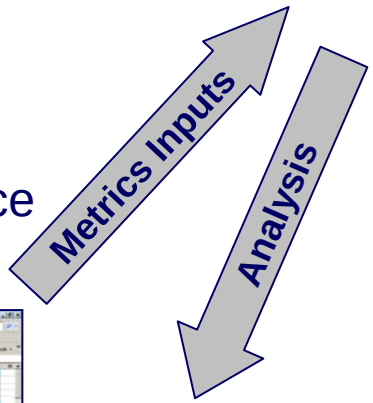
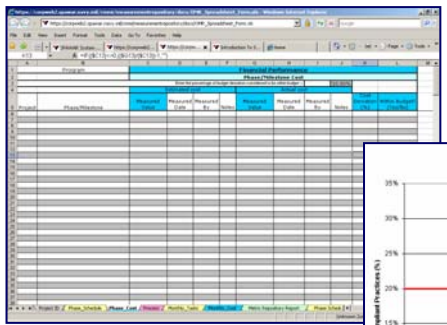
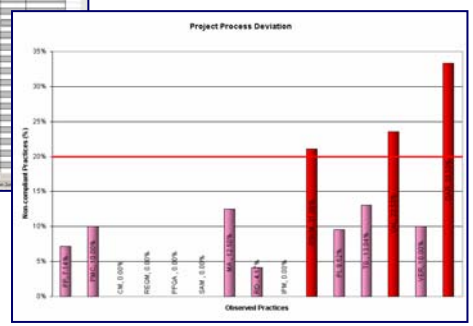


Project Performance

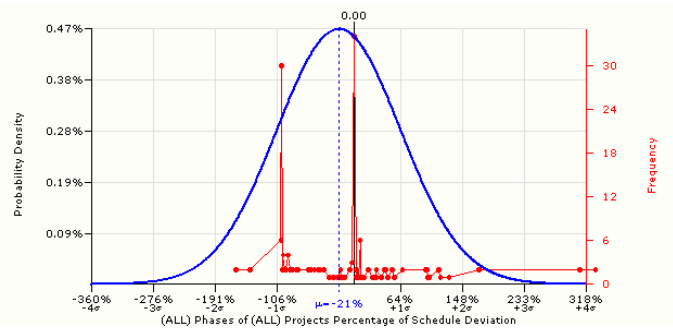






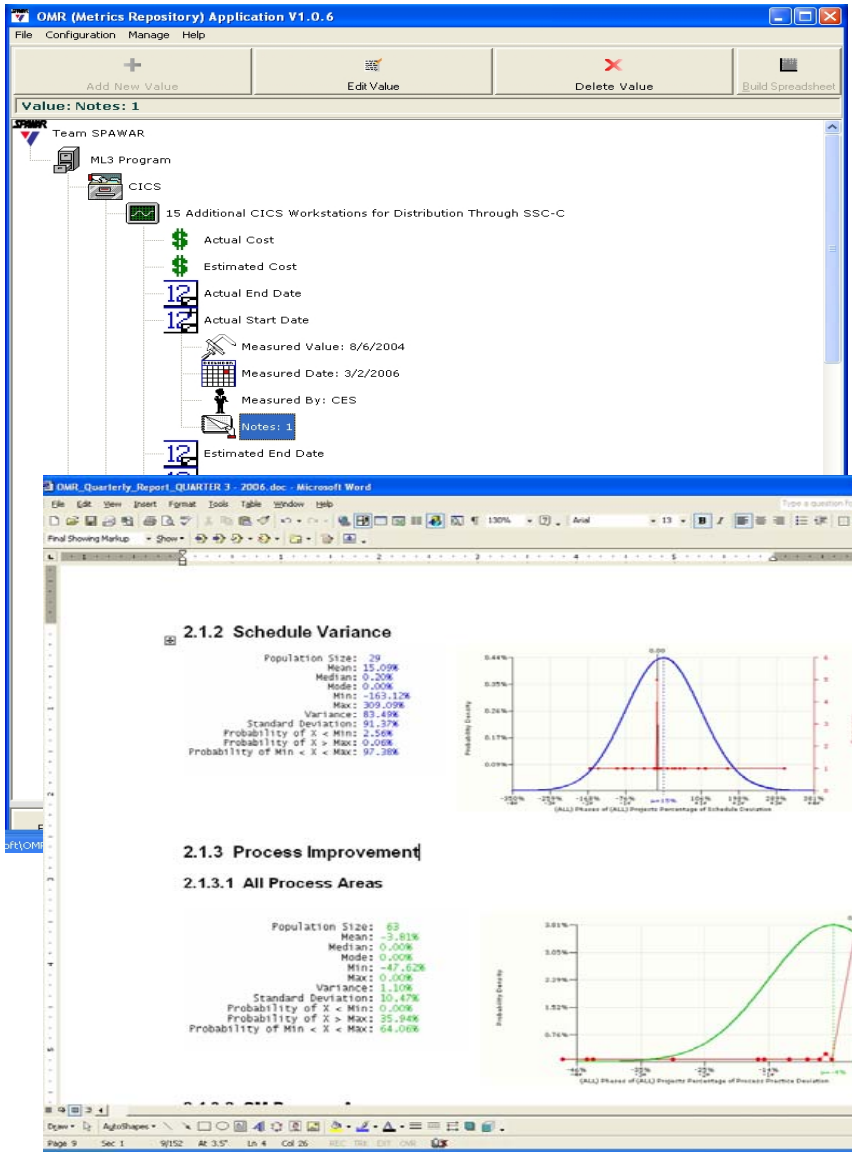
Organizational Performance & Analysis

```
Population Size:  172
            Mean: -21.22%
          Median: -6.22%
            Mode: 0.00%
             Min: -163.12%
             Max: 330.77%
        Variance: 71.85%
Standard Deviation: 84.76%
Probability of X < Min: 4.75%
Probability of X > Max: 0.00%
Probability of Min < X < Max: 95.25%
```



OMR Application

- **Provides interface for input and query functions**
- **Generates quarterly organizational report**
- **Projects can use to manage own projects**
  - Capture standardized cost, schedule, and process performance
- **OMR implementation included hands-on training**
- **Laying the groundwork for higher maturity**



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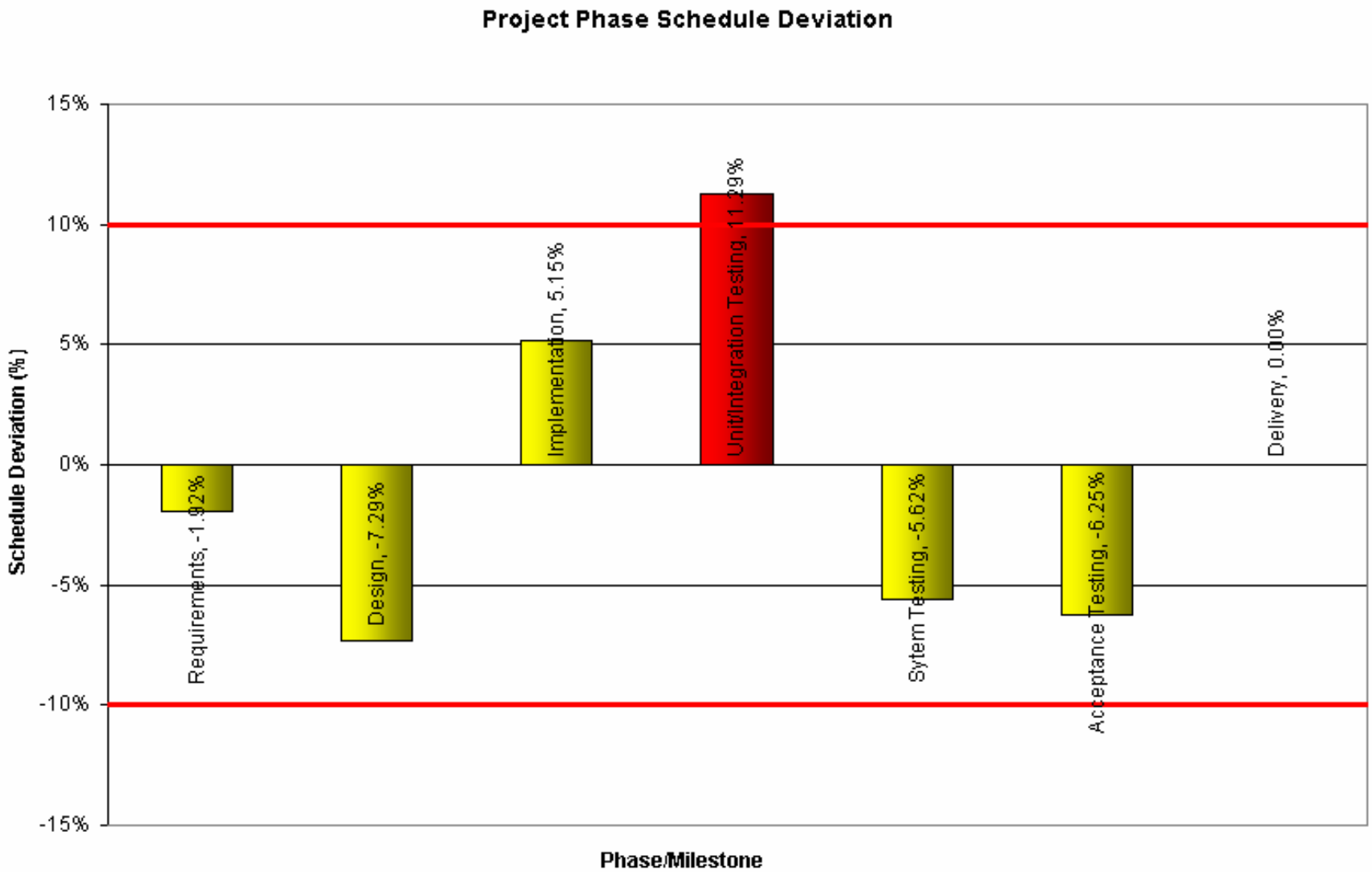
OMR Reports
Project-Level Schedule Deviation



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Additional/Modified Measures To Be Implemented in OMR

Category	Core Measure
Cost Performance (More granularity)	• **Government vs Contractor budget** – ODC – Travel – Training – Materials
Quality	• **Peer Reviews** – Effectiveness – ROI (hours expended vs hours saved) • **Pre-Deployment Defect Detection/Prevention** – Defect decrease for successive phases – PITCO vs SOVT defects • **Post-Deployment Defects**

Need improved project and organizational measures to address Maturity Level 4/5 requirements

Appraisal Wizard Tool Used for SCAMPI Appraisals

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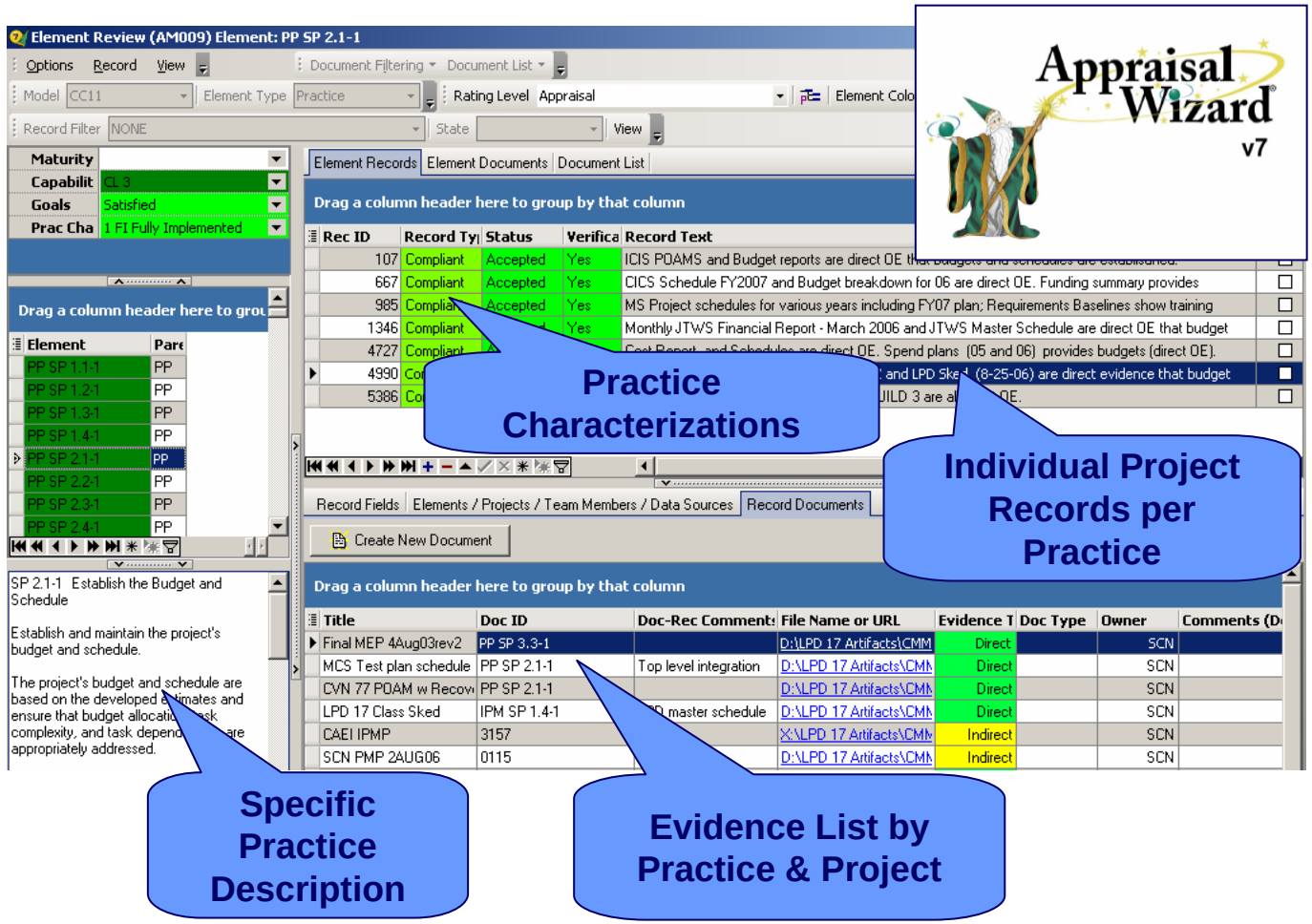
- Designed for CMMI appraisals
- Link to project documents
- Easy to configure
- Captures team comments
- Improves efficiency of appraisal team



Appraisal Wizard is a product from Integrated Systems Diagnostics, Inc.
http://www.isd-inc.com

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Training

- Training Architecture
- Courses

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SE & PI Training Architecture

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Foundation of PI and CMMI®

- **PI WBT** → **SEI Intro to CMMI® 3-day**

Core SSC-C project and engineering processes (Level 2 and 3)

- Engineering Project & Process Mgmt Workshop
- SE for Managers
- SEMP Workshop
- SE Fundamentals
- Intro to Software Engineering
- **SE 101 WBT**
- **Architecture Dev. WBT**
- **Risk Management WBT**

Subject Matter Experts - Use commercially available on-site classes

- Quality Engineering
- Risk Management
- Requirements Analysis

Prepare Projects for BSC or SCAMPI

- Appraisal & Assessment Workshop

Existing
Existing - revise
New - develop
New - buy

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Intro to Process Improvement WBT

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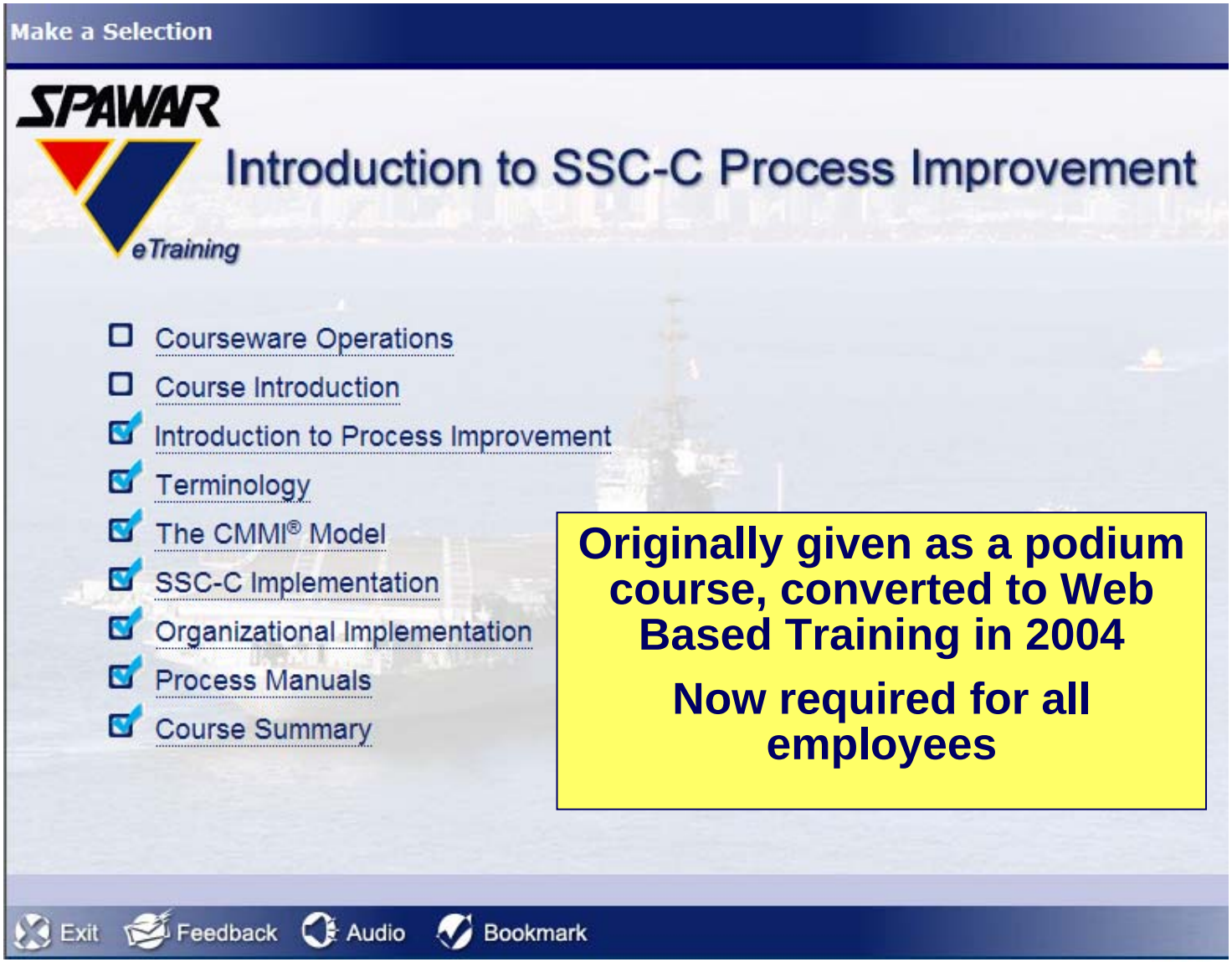

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SEI Intro to CMMI® for SSC-C

Taught on-site since Apr. 2004

- **3-day *Introduction to CMMI®* course teaches the full CMMI® model**
  - Students learn how the best practices build and relate across process areas
  - Learn the terminology
- **SEI-Authorized instructors are well-versed in our implementation to augment material with SSC-C specific content**
  - Highlight SSC-C tools and resources
  - Actively involved in projects, teams, and infrastructure
- **Over 350 employees trained**
  - Want to build a cultural foundation within the engineering departments

Systems Engineering Training

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3-day on-site, classroom course

- Based on SMU SE Masters course
- Customized to incorporate SSC-C SE process
- Over 340 SSC-C engineers trained

1-day SE for Managers course added

- Over 60 SSC-C managers trained

Began in Dec. 2004

"It was extremely beneficial to have a professor with extensive knowledge of the subject matter and one who could apply it to the SPAWAR methods."

"The most positive aspects I took from the class was the visual correlation with what was asked for and what was produced."

"I would recommend it to all the program leads/engineers."

Student Feedback

New On-Site Courses

- **Risk Management**
  - Piloted in September, 2007
    - 4-day course
  - Designed for Risk Managers or Project Managers
- **Engineering Project & Process Mgmt Workshop (aka SE Process Improvement)**
  - Focus on how to use the SSC-C processes on your project
    - Using ePlan Builder to develop plans
    - How to establish your CM and PPQA procedures
  - Round 2 of curriculum review completed in September
- **Quality Assurance (FY2008)**
  - Initial discussions held with ASQ certified instructor to tailor course for Quality Managers at the project level

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Web Based Training (WBT) Modules

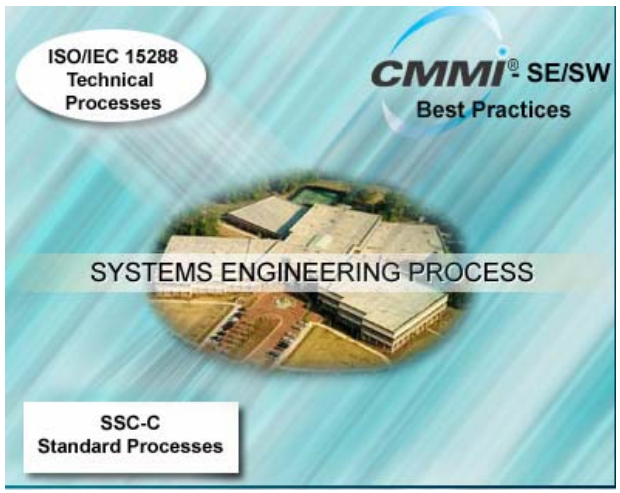
- **Developed to directly meet SSC-C's needs**
  - Embedded links directly to SSC-C documents and SOPs
  - DAU too ACAT-level/large program oriented
- **WBTs feature extensive branching and rollovers**
  - Better course flow and maintains interest
  - Provides more detail for those interested
- **Audio summary on many pages**
- **Bookmark progress – come back later**
- **Courses developed to be NMCI and 508 compliant**
  - Utilize HTML, JavaScript, and ASP pages with SQL Server database
  - Designed for Internet Explorer (5.5 +), Flash (5.0 +), Windows Media Player (9.0 +)

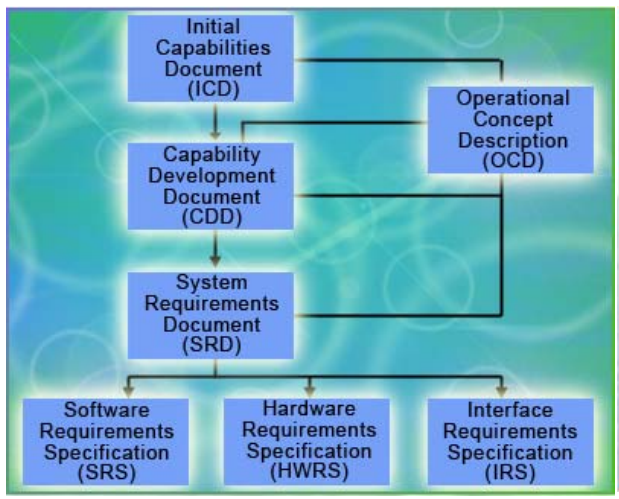
SE 101 Web-Based Training

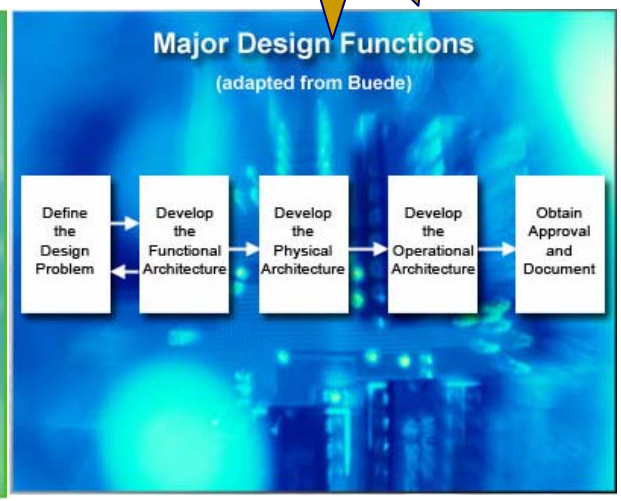
Introduction to Systems Engineering

- 10-module web-based training (~16 hours)
- Closely aligned to SSC-C SE Process, SE Fundamentals Course, ISO/IEC 15288 and IEEE standards
- Includes hotlinks to referenced documentation
  - Process manuals, policies, standards
  - Great for Topic-specific refresher training

Released in Jan. 2006

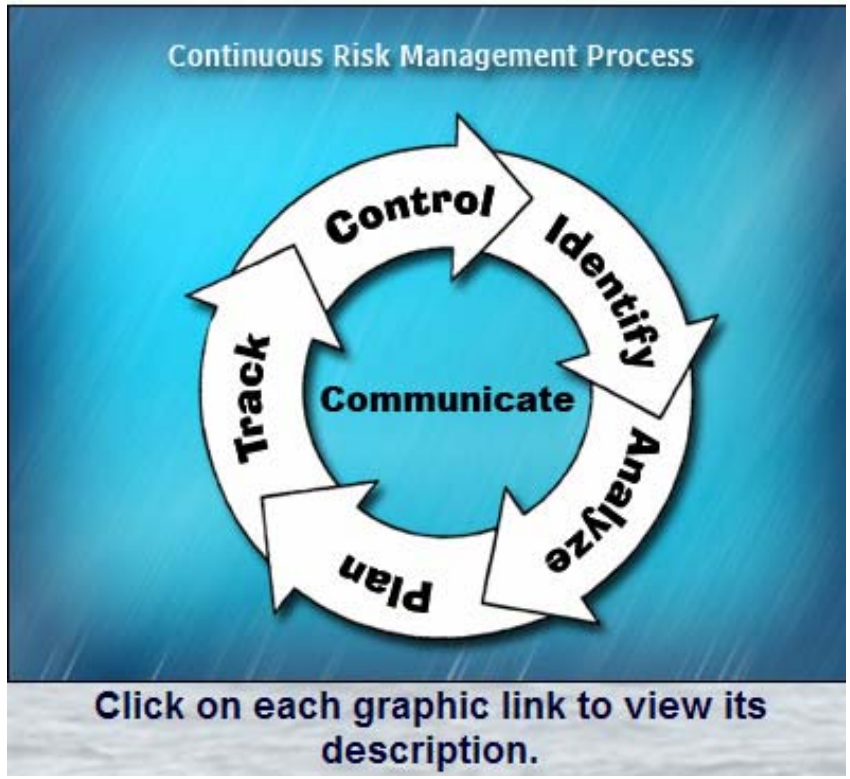






Risk Management WBT

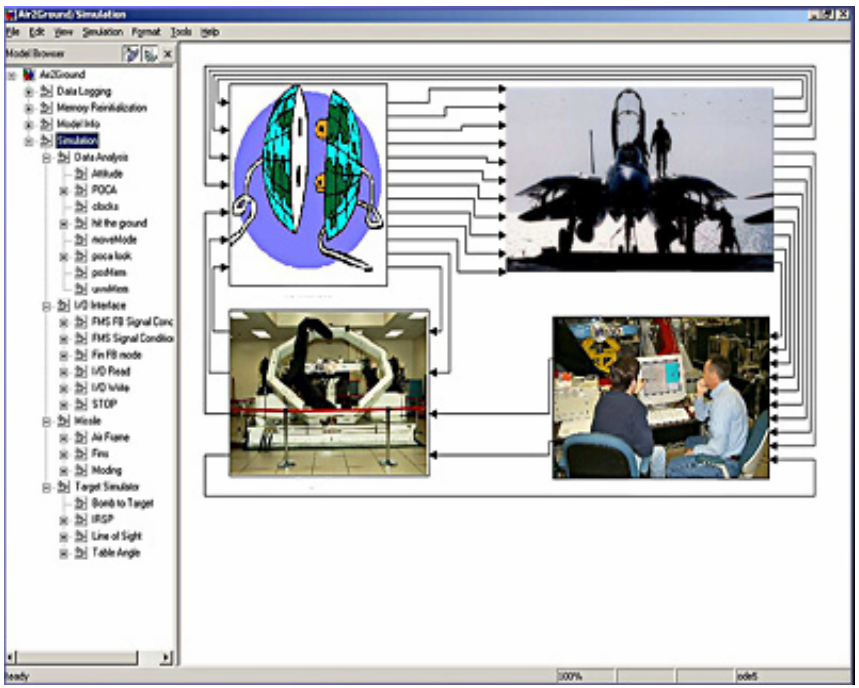
- **Topics**
  - Risk identification
  - Analysis tools and techniques
  - Mitigation planning
  - Risk monitoring
- **Section Test Questions**
- **Hot Links to Examples**
  - SSC-C Formats
  - Project Risk Reports
  - Tools
  - DAU / External resources

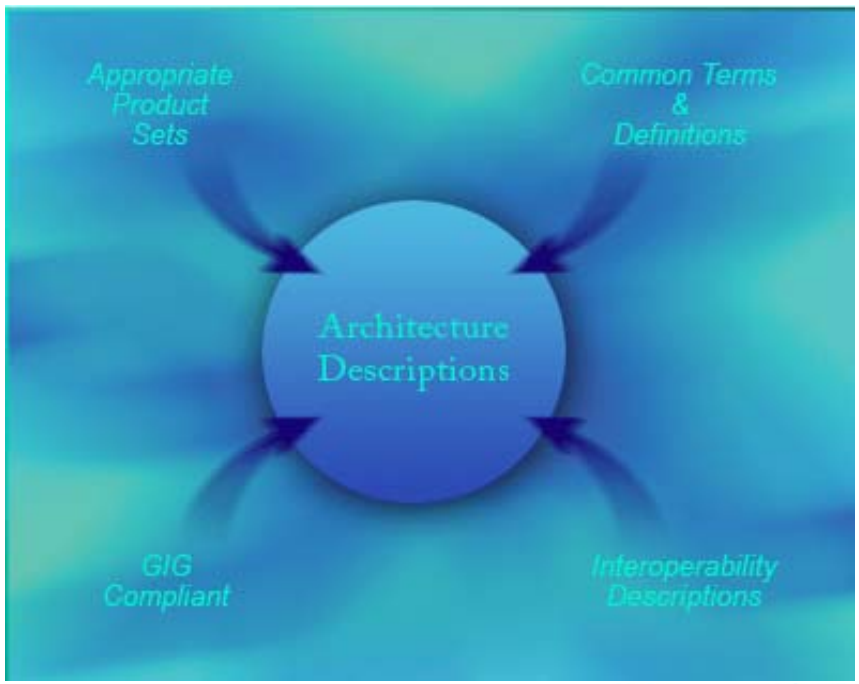


More relevant and understandable for SSC-C than the DAU module

Architecture Development WBT

- **Introduction to Architecture Development and DoDAF**
  - Designed to educate and promote value of system architecture to non-architects and new engineers
  - Tests for understanding after each section





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Summary and Results

SEIPartner
TECHSOFT
Technical Software Services, Inc.

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What We Have Accomplished

- **Process Focus**
  - Defined Policies and Processes
  - Aligned with DoD and SPAWAR guidance
  - Aligned with industry standards and CMMI® model
  - Built organization structured around processes and process improvement
- **Training is Critical**
  - Providing Fundamentals of Engineering for new and old professionals
  - Developed web-based training for “self-paced” and refresher training
  - Defining a structured technical career development path for engineers
- **Tools for the Engineers**
  - Developed *ePlan Builder* application to generate planning documents
  - Developed templates, checklists, and web-based document repositories to link standards and DoD guidance to day-to-day tasks and processes

Early and persistent Systems and Software Engineering applied to programs and projects

SEI Partner
TECHSOFT
Technical Software Services, Inc.

Lessons Learned

- **Senior Management support is critical to success**
- **Training**
  - Everyone needs to be engaged – “train the masses”
  - Specific training for process owners/subject matter experts
- **Utilize Teams (IPTs) as champions of specific processes**
  - Multi-department representation
  - Change agent mentality
  - Process-focused charters
- **Resource Properly**
  - Implement with projects that want to improve, can benefit from efforts, and that recognize own weaknesses
  - EPO staff provided skilled coaching, resources, support, and tools
  - Project members learned by doing and maintaining
- **Goals and Publicity**
  - Keep goals to sizable bites (projects)
  - Publicize successes; Share best practices

Is the SE Revitalization Working ?

- **Recognition of SE and CMMI effort**
  - 1st SPAWAR Systems Center to achieve Maturity Level 2 (2005)
  - 1st SPAWAR Systems Center to achieve Maturity Level 3 (2007)
  - Multiple presenter at NDIA SE and CMMI conferences
    - High interest in Tools, Training, and Implementation

Is the SE Revitalization Working ?

- **Business Results**
  - SCN: “They see us as a model and want to increase our efforts.”
  - Automation Program: “We had hundreds of sites and there was a need for a structured organization to put a ‘wrapper’ around that and control it. CMMI became the wrapper.”
  - CICS: “CMMI was key to achieving the project goal.”
  - VIDS: “The VIDS failure (2000) motivated implementing CMMI because the team needed to change course or the customer would have no confidence in system development. It was a tremendous success…”
- **Others Asking for Help**
  - PMS 408 – CREW program
  - SESG / NAVAIR / NAVSEA
  - Marine Corp – Quantico
  - Air Armament Center, Eglin AFB

Going Forward

- **Increase usage of tools across departments/projects**
- **Add additional plans to ePlan Builder as needed**
- **Continue internal CMMI Level 3 mini assessments**
- **Enhance/Expand OMR**
- **Command and Department Project Reviews process**
  - Look at quality of plans and implementation of best practices
  - Reviews of project status by management driven by project metrics
  - More Peer Reviews to measure “saves”
- **Better tailoring guidance for smaller projects**

Begin Maturity Level 4/5 implementation

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Any Questions?

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