A Process-Oriented (Practical) Approach to Program Office Systems Engineering Management Using the CMMI-AM as a Guide

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Acknowledgements

The following individuals contributed to this presentation:

**SEI**
- Tim Morrow
- Mike Gagliardi

**PMA-290**
- Mike Van Wie
- Mike Gomes

**The Mitre Corporation**
- Dr. John Miller

This presentation is based on work performed by the SEI, Mitre, and the MMA Program Office (PMA-290) over the period from February-August, 2004

This presentation has been updated to reflect recent work in progress
Agenda

Process Improvement in the Program Office
Program Office System Engineering Activities
MMA Program Context
Program Office Documentation Hierarchy
Program Office System Engineering Planning
How Did We Integrate Processes with the SEMP?
OSD Guidance
Lessons Learned
Acquirer/Supplier Mismatch

- **Mismatch**
  - mature acquirer mentors
  - low maturity supplier
  - outcome not predictable

- **Matched**
  - acquirer and supplier are both high maturity
  - highest probability of success

- **Disaster**
  - no discipline
  - no process
  - no product

- **Mismatch**
  - immature acquirer
  - customer encourages short cuts.
  - mature supplier

**Acquirer**
- High
- Low

**Supplier**
- Low
- High

**Technical & Management Skill**
- Low
- High
Agenda

Process Improvement in the Program Office

Program Office System Engineering Activities

MMA Program Context

Program Office documentation hierarchy

Program Office System Engineering Planning

How Did We Integrate Processes with the SEMP?

Recent OSD Guidance

Lessons Learned
In what areas does the Program office spend its technical time?
PMO System Engineering Activities (Notional)

Review of Contractor Materials (CDRLs, IDE)
Participation on IPTs
Preparation of PMRs
Risk Management Activities
Probing Contractor Activities for Award Fees Determination
Facilitate Technical Reviews (Gov’t only and Contractor)
Plan for Subsequent Years
Manage Government Furnished Property
Manage Functional Baseline
Plan for Spiral Development
Participation in Councils, Boards, and Working Groups
Manage Stakeholder Involvement
## OSD System Engineering Focus

<table>
<thead>
<tr>
<th>Date</th>
<th>Document</th>
<th>Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 20, 2004</td>
<td>Policy for Systems Engineering in DOD</td>
<td>• Develop a SEP that describes overall technical approach, including processes, resources, metrics, and applicable performance incentives.</td>
</tr>
</tbody>
</table>
|                 |                                                    | • Detail timing, conduct, and success criteria of Tech Reviews  
|                 |                                                    | • Director, Defense Systems - review program SEPs (where AT&L is the MDA) as part of preparation for DAB reviews.                           |
| March 20, 2004   | Implementing Systems Engineering Plans in DOD – Interim Guidance | • Address the integration of the technical aspects of the program with the overall program planning, SE activities, and execution tracking |
Details of March 20 Guidance

- Processes to be applied, how they will be implemented and tailored, how they will support the technical & programmatic products required of each phase.
- Technical baseline approach: how developed, managed, and used to control requirements, design, integration, VER, and VAL. Discuss metrics (TPM) for the technical effort and how they will be used to measure progress.
- Timing, conduct, success criteria, and expected products of technical reviews. How they will be used to assess technical maturity, assess technical risk, and support program decisions. Updates to include results of completed technical reviews.
- How SE activities will be integrated within and coordinated across IPTs; how IPTs will be organized; what SE tools they will employ; resources, staffing, management metrics, and integration mechanisms; how SE activities are integrated in the program’s overall integrated schedules.
FY03 NDAA Section 804 (Dec 02)

Services/departments shall establish programs to improve the <software> acquisition process ... 120 days after enactment

Program Requirements

- Documented process for planning, requirements development and management, project management and oversight, and risk management
- Metrics for performance measurement and continual process improvement
- A process to ensure adherence to established process and requirements related to the acquisition of software

ASD(C3I) and USD(AT&L):

- Prescribe uniform guidance for implementation across DoD
- Assist services/departments by:
  - Ensuring source selection criteria include past performance and the maturity of the software products offered by potential sources
  - Serving as a clearinghouse for best practices in software development and acquisition in both the public and private sectors
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Multi-mission Maritime Aircraft
The P-3 aircraft provides the USN with blue water and littoral Undersea Warfare (USW) capabilities, and performs armed intelligence, surveillance and reconnaissance functions.

To recapitalize the capabilities currently provided by the P-3 aircraft systems.

Purpose of Multi-mission Maritime Aircraft (MMA) Program

Sea Power 21:
- Right availability at the right cost
- Innovative logistic solutions
- Fleet transformational training objectives
- Open Systems Architecture

Sea Shield:
- Persistent ASW
- ASUW

Sea Strike:
- ISR
- Common Undersea Picture (CUP) provider

Sea Basing:
- FORCEnet

ASUW-Anti-surface Warfare  ISR-Intelligence, Surveillance, & Reconnaissance
ASW-Anti-submarine Warfare
MMA SDD contract awarded to Boeing for the 737 MMA on 14 June 2004
### Growth Area

<table>
<thead>
<tr>
<th>Parameter</th>
<th>737-800ERX MMA</th>
<th>P-3C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (ft)</td>
<td>129.5</td>
<td>116.7</td>
</tr>
<tr>
<td>Span (ft)</td>
<td>117.2</td>
<td>99.7</td>
</tr>
<tr>
<td>Height (ft)</td>
<td>42.1</td>
<td>33.7</td>
</tr>
<tr>
<td>Useable Floor Area (ft²)</td>
<td>1018</td>
<td>658</td>
</tr>
<tr>
<td>Wing Area (ft²)</td>
<td>1,341</td>
<td>1,300</td>
</tr>
<tr>
<td>Max ZFW (lb)</td>
<td>146,600</td>
<td>77,200</td>
</tr>
<tr>
<td>Max Fuel (lb)</td>
<td>75,058</td>
<td>62,560</td>
</tr>
<tr>
<td>MTOW (lb)</td>
<td>184,200</td>
<td>139,760</td>
</tr>
</tbody>
</table>

- **Search Radar**
- **Aerial Refueling**
- **Mission Tactical Workstations**
- **INMARSAT Antenna**
- **MAD**
- **“A” size Sonobuoy Storage Racks**
- **Weapons Bay**
- **Automated Rotary Launchers**
- **Wing Pylons (2 per wing)**
- **Lower Lobe Access Hatch**
- **Integral Equipment Cabinet**
- **Observer Stations (2)**

#### CFM56-7B 180 kVA IDG Engines (2)
Summary

- MMA requirements firm
- Founded in analysis, validated by process and fleet
- Transformation of Maritime Patrol and Reconnaissance Force
- Navy relying on MMA for Core ASW / ASUW capability

Challenge: Affordable capability improvements without “requirements creep”
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MMA SEP Outline

Introduction
Reference Documents
Systems Engineering Process Plan (SEPP)
Technical Team Organization
Technical Planning and Control
Technical Reviews
Program Reviews
Spiral Development/Technology Transition
Ex.: Systems Engineering Process

Inputs
Requirements Analysis
Functional Analysis / Allocation
Synthesis
System Analysis
Verification and Validation

Outputs
Ex.: Use of Annotated Outline

PERFORMANCE MEASUREMENT AND ANALYSIS

Earned Value Management
Discuss the EVM contractual requirements we’ve placed on the vendor.
Explain that a cost account manager (CAM) counterpart matrix will be established at the IBR.
Describe the technical approach to determining the vendor award fee.
Describe how the government team will monitor progress against their IMP / IMS and make decisions based on status (control). Refer to the Decision Analysis and Resolution process and Technical Management Processes sections of Appendix A as appropriate.

Technical Performance Measures
Identify the TPM philosophy for MMA and identify the candidate TPMs. Use the data from VSEMP 4.4

Technical Metrics
Identify and expand upon the goal of having technical metrics at the cost account level to augment the earned value data coming from the contractor EVMS. Identify the types of technical metrics we plan to use. Specifically discuss SW metrics. Grab the SW metrics chart from the CAD Software Development Plan CDRL. For metrics related to execution of the Government team processes and IMP / IMS, refer to the Measurement and Analysis process section of Appendix A.
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SEP Process Definition Outline

Conceptually use process definitions as SOWs for future sub-tier plans
Use interview technique to identify "To Be" process state
Use a specific outline for the process definitions
Create diagrams that illustrate the relationships between the processes
Explicit identification of generic characteristics (measures, configuration management items, reports, training)
Use of the CMMI-AM as a set of practices that represent the PMO
## MMA SEP Processes

<table>
<thead>
<tr>
<th>Process Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Planning, Monitoring and Control</td>
</tr>
<tr>
<td>Solicitation and Contract Monitoring</td>
</tr>
<tr>
<td>Risk Management</td>
</tr>
<tr>
<td>Integrated Teaming</td>
</tr>
<tr>
<td>Requirements Development and Management</td>
</tr>
<tr>
<td>Integrated Testing</td>
</tr>
<tr>
<td>Measurement and Analysis</td>
</tr>
<tr>
<td>Configuration Management</td>
</tr>
<tr>
<td>Decision Analysis and Resolution</td>
</tr>
<tr>
<td>Training</td>
</tr>
<tr>
<td>Product and Process Quality Assurance</td>
</tr>
</tbody>
</table>
Generic Process Outline

Introduction
Process Description (with Context Diagram)
Activities
Technical Baseline and Programmatic Products
Decisions
Communications
Configuration and Data Management
Metrics
Training
Ex.: Integrated Teaming – Context
Ex.: Support Process – Context
<table>
<thead>
<tr>
<th>Task/Activity</th>
<th>Type</th>
<th>Responsibility</th>
<th>Sub-process?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop MMA Test Plans</td>
<td>Event</td>
<td>Team Leads</td>
<td>Yes</td>
</tr>
<tr>
<td>Conduct MMA Test Plan Readiness Reviews</td>
<td>Event</td>
<td>Team Leads</td>
<td>Yes</td>
</tr>
<tr>
<td>Attend Testing IPT Meetings</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Prepare Facilities Plan</td>
<td>Event</td>
<td>Team Leads</td>
<td>Yes</td>
</tr>
<tr>
<td>Develop TEMP</td>
<td></td>
<td>Testing Lead</td>
<td>No</td>
</tr>
<tr>
<td>Evaluate CDRLs</td>
<td></td>
<td>Team Leads</td>
<td>Yes</td>
</tr>
<tr>
<td>Attend Milestone Reviews</td>
<td>Event</td>
<td>APMSE</td>
<td>No</td>
</tr>
<tr>
<td>Conduct Product Evaluations</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Establish and maintain the testing schedule</td>
<td></td>
<td>Team Leads</td>
<td>No</td>
</tr>
</tbody>
</table>
Ex.: Solicitation and Contract Monitoring – Metrics

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Source</th>
<th>Frequency</th>
<th>Analysis Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Quality</td>
<td>Solicitation and Source Selection Preparation and Execution</td>
<td>As Occurring</td>
<td>Survey Bidders and Source Selection Team Members</td>
</tr>
<tr>
<td>Contractor Quality</td>
<td>CDRLs and other Work Products</td>
<td>As Occurring</td>
<td>Comparison to DID, Audit Work Products</td>
</tr>
<tr>
<td>Government Timeliness</td>
<td>Adherence to Contract Schedule, CDRL Reviews</td>
<td>As Occurring</td>
<td>Compare delivery/review dates to due dates</td>
</tr>
<tr>
<td>Contractor Timeliness</td>
<td>Adherence to Contract Schedule, CDRL Deliveries</td>
<td>As Occurring</td>
<td>Compare delivery dates to due dates</td>
</tr>
<tr>
<td>Customer (Govt.) Satisfaction</td>
<td>PMRs</td>
<td>Quarterly</td>
<td>Satisfaction Ratings</td>
</tr>
<tr>
<td>Contractor Satisfaction</td>
<td>PMRs</td>
<td>Quarterly</td>
<td>Satisfaction Ratings (?)</td>
</tr>
<tr>
<td>Number of Bidders’ questions to RFP</td>
<td>Contract Bids</td>
<td>As Occurring</td>
<td>Comparison to RFP</td>
</tr>
</tbody>
</table>
### Ex.: Technical Planning, Monitoring and Control – Communications

<table>
<thead>
<tr>
<th>Name</th>
<th>Frequency</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP</td>
<td>Continuous</td>
<td>MS Excel</td>
</tr>
<tr>
<td>IMS</td>
<td>Continuous</td>
<td>MS Project (or Sigma)</td>
</tr>
<tr>
<td>Corrective action list</td>
<td>Weekly</td>
<td>MS Excel</td>
</tr>
<tr>
<td>Systems Engineering Coordination</td>
<td>Weekly</td>
<td>Meeting</td>
</tr>
<tr>
<td>MMA Core Team Coordination</td>
<td>Weekly</td>
<td>Meeting</td>
</tr>
<tr>
<td>MMA Leadership Coordination</td>
<td>Weekly</td>
<td>Meeting</td>
</tr>
<tr>
<td>Task descriptions</td>
<td>A/R</td>
<td>e-mail</td>
</tr>
<tr>
<td>Team (and Sub-Team) Coordination</td>
<td>Weekly</td>
<td>Meeting</td>
</tr>
<tr>
<td>IPT Coordination</td>
<td>Weekly</td>
<td>Meeting</td>
</tr>
<tr>
<td>Status information put into IDE</td>
<td>Weekly</td>
<td>MS Word</td>
</tr>
<tr>
<td>Relevant stakeholders input and review</td>
<td>Continuous</td>
<td>MS Word or email</td>
</tr>
<tr>
<td>Critical path in IMS</td>
<td>Weekly</td>
<td>MS Project</td>
</tr>
</tbody>
</table>
### Ex.: Integrated Testing – Configuration Items

<table>
<thead>
<tr>
<th>Configuration Item</th>
<th>CM/DM</th>
<th>File Type</th>
<th>Expected Update?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Plan CDRLs</td>
<td>CM</td>
<td>MS Word</td>
<td>Based on government and supplier comments and reviews</td>
</tr>
<tr>
<td>Testing IPT meeting minutes</td>
<td>DM</td>
<td>MS Word</td>
<td>After each meeting</td>
</tr>
<tr>
<td>Review meeting minutes</td>
<td>CM</td>
<td>MS Word</td>
<td>After each review</td>
</tr>
<tr>
<td>Test Reports</td>
<td>CM/DM</td>
<td>MS Word, MS Excel</td>
<td>After completion of testing effort</td>
</tr>
<tr>
<td>Coding Standards</td>
<td>CM</td>
<td>MS Word</td>
<td>Based on government and supplier comments and reviews</td>
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</tbody>
</table>

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How Did We Integrate Processes with the SEP?
Recent OSD Guidance
Lessons Learned
New Guidance from OSD

Systems Engineering Application to Life Cycle Phases
  • System Capabilities, Requirements and Design Considerations
    - Capabilities to be Achieved
    - Key Performance Parameters
    - Certification Requirements
    - Design Considerations
  • SE Organizational Integration
    - Organization of IPTs
    - Organizational Responsibilities
    - Integration of SE into Program IPTs
    - Technical Staffing and Hiring Plan
  • Systems Engineering Process
    - Process Selection
    - Process Improvement
    - Tools and Resources
    - Approach for Trades
New Guidance from OSD – 2

Systems Engineering Application to Life Cycle Phases

- Technical Management and Control
  - Technical Baseline Management and Control (Strategy and Approach)
  - Technical Review Plan (Strategy and Approach)

- Integration with Other Program Management Control Efforts
  - Acquisition Strategy
  - Risk Management
  - Integrated Master Plan
  - Earned Value Management
  - Contract Management
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Collaboration Mechanisms
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Lessons Learned

The SEP activity was new ground, not much legacy to draw on... led to prototyping and reevaluation of end state, and took longer than we wanted

The Program Office recognized the need for improvement, and worked with us shoulder to shoulder to develop the SEP... a different situation would have made this task very challenging

Ideally, the SEP should be an evolving document from an earlier program life-cycle... OSD guidance points future programs to create this document early in the life-cycle and evolve it as they proceed from milestone to milestone

Throughout the process OSD guidance was evolving... not an optimal condition

Be clear about the difference between Verification and Product and Process Quality Assurance

SEP Prep Guide V 0.90 Released 18 Oct 04 by OSD will help in evolution of document to include initial release for future programs
Recent Updates

Process Improvement Plan has been developed that supports the SEP

- Compelling reasons for process improvement
- Roles and Responsibilities
- Strategy, Activities, Resources, and Schedule
  - Implementation Schedule
  - Process Action Plan Skeleton
- MMA Program Context Information
- Plan Measures
- Plan Risks
- Plan Outputs
- Plan Communications
Plan Highlights

Plan scoped for five (5) years of implementation and improvement activity
Identified responsibility for three levels of organization:
  • SE Process Steering group
  • SE Process group
  • Technical Working Group
Approximately three (3) process per year
Focused workshops are integral to the process action plans