Accelerating the Adoption of CMMI® and Earned Value Management

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Defense Mission Systems (DMS) Background

- **Leading developer and integrator of complex, mission-enabling C4I systems**
  - Division of Northrop Grumman Mission Systems
  - Geographically dispersed with a diverse customer base
    - Over 6,000 people in 43 states and 9 countries
    - Mixture of large and small programs

- **Process Maturity**
  - Created out of seven separate legacy organizations, January 2002; institutionalized a common OSSP, the DMS Integrated Enterprise Process
  - Tri-Service certified Program Management System and Earned Value System
  - S/W & SE CMMI® Level 5 – In November 2003 DMS was externally appraised at CMMI-SE/SW Level 5

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*CMMI® is a registered trademark of Carnegie Mellon University*
Problem

- Senior management recognizes the value of CMMI/EVMS
  - Projects required by policy to implement CMMI and EVMS
  - Most successful projects have both CMMI credentials and a strong EVMS program

- Issue is how to facilitate adoption of CMMI/EVMS by new projects throughout the organization
  - Some sites do not have CMMI/EVMS background or local experts available
    - These sites are reliant on out-of-town experts to help set up these programs
    - Result can be delay, rework, frustration for projects at these sites

- Six Sigma process improvement team formed to reduce the cycle time needed to implement CMMI/EVMS

Why tackle CMMI and EVMS on the same Six Sigma project?
## CMMI Synergy with EVMS

<table>
<thead>
<tr>
<th>CMMI Process Area</th>
<th>No. of Practices* that Map to EVMS</th>
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<tbody>
<tr>
<td>All Project Process Areas - Generic Practices</td>
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<tr>
<td>2.2 – Planning (Partial**)</td>
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<td>2.3 – Resources (Partial**)</td>
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<td>2.4 – Responsibility</td>
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<td>2.8 – Monitoring and Control (Partial**)</td>
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<td>Project Planning Process Area (PA)</td>
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<tr>
<td>Project Monitoring and Control PA</td>
<td>5</td>
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<tr>
<td>Measurement and Analysis PA</td>
<td>4</td>
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<tr>
<td>Integrated Project Management PA</td>
<td>2</td>
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<tr>
<td>Requirements Management PA</td>
<td>2</td>
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<tr>
<td>Process and Product Quality Assurance PA</td>
<td>4</td>
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<tr>
<td>Supplier Agreement Management PA</td>
<td>1</td>
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<tr>
<td>Requirements Development PA</td>
<td>1</td>
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<tr>
<td>Risk Management PA</td>
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* CMMI-SE/SW Model
** Partial - Elements related to budget, schedule, effort, and earned value
## Strong CMMI/EVMS Relationships

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<td>2.1a Work Breakdown Structure (WBS) [L2, Organizational, Goal 1]</td>
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<td>2.1b Organization structure [L2, Organizational, Goal 2]</td>
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<td>2.2a Schedule of authorized work [L3, Planning, Goal 1]</td>
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<td>2.2b Progress indicators  [L3, Planning, Goal 2]</td>
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<td>2.2c,d Control account budget baseline [L2, Planning, Goals 1; L3, Planning, Goal 3]</td>
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<td>2.2e Work packages [L2, Planning, Goal 2]</td>
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<tr>
<td>Project Monitoring and Control</td>
<td>2.4a,b Schedule/cost variance analysis [L2, Analysis, Goal 1]</td>
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<td>2.4c Indirect cost variance  [Level 3, Analysis, Goal 3]</td>
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<td>2.4d Element summary [Level 3, Analysis, Goal 4]</td>
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<td>2.4e Managerial actions  [Level 2, Analysis, Goal 3]</td>
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<td>2.4f Estimate at completion  [Level 3, Analysis, Goal 5]</td>
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<tr>
<td>Integrated Project Management</td>
<td>2.1c Integration of plan, schedule, budget [L3, Organizational, Goal 1]</td>
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<td>2.1e Integrate WBS and org structure [L3, Organizational, Goal 3]</td>
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<td>2.2a Identification of task dependencies  [L3, Planning, Goal 1]</td>
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<td>2.2d Budgets for authorized work [L3, Planning, Goal 3]</td>
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<td>2.4 a-f (see Project Monitoring and Control)</td>
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<td>2.5a Incorporation of changes into budget and schedule [L2, Revisions, Goal 1]</td>
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<td>2.5e Changes to performance measurement baseline [L2, Revisions, Goal 4]</td>
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<tr>
<td>Measurement and Analysis</td>
<td>2.2b Progress indicators  [L3, Planning, Goal 2]</td>
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CMMI/EVMS Project Summary

• Goal is to substantially reduce the cycle time for start up projects to reach CMMI Level 3 and implement an EVMS
  – 6 months for CMMI Level 3 as measured by an independent internal appraisal conduct by EPG
  – 3 months for implementation of an EVMS as measured by an internal independent audit conducted by the EVMS group

• Expected benefits
  – Cost savings from reaping benefits of CMMI and EVMS earlier in the project life cycle
  – Reduction in rework in setting up EVMS
  – Increased award fees resulting from better management
Process Improvement — DMAIC

**DEFINE**
- Charter team, map process & specify CTQs
- Customer CTQs derived and documented

**MEASURE**
- Measure process performance
- CTQs Measured
- Process Capability
- Process Stability
- Baseline Sigma Calculated

**ANALYZE**
- Identify & quantify root causes
- Identify, Quantify and Verify Root Causes
- Benefits Estimated

**IMPROVE**
- Select, design & implement solution
- Cost/Benefit Analysis
- Benefits Validated

**CONTROL**
- Institutionalize improvement, ongoing control
- Ongoing Measurement & Monitoring Plan Implemented
- Process Standardized

The team is currently in this step.
Map Process/SIPOC

**Suppliers**
- Buyer
- Organization
- Control Account Managers /Process Owners
- Engineering Process Group (EPG)
- Program Control

**Inputs**
- RFP, Contract
- Policies, Processes, Training
- Plans, project’s defined process
- CMMI Appraisal Findings & Action Items
- EVMS Findings & Discrepancy Reports

**Process**
- Executing Program Start-up for CMMI and EVMS Processes

**Outputs**
- Successful Integrated Baseline Review/CMMI Appraisal
- Cost Performance Reports

**Customers**
- Project, Business & Senior Mgt.
- Program Control

**Process Steps**
- Proposal: Evaluate RFP & Policy for CMMI/EVMS Requirements
- Award: Define processes, develop plans, set up EVMS
- Execute Processes
- Appraise CMMI processes audit EVMS
- Address findings and actions
- Verify Corrective Action
Voice of the Customer – Survey Findings

- **Issues with both CMMI and EVMS**
  - Value received vs. cost to implement
  - Degree of project-level CMMI/EVMS knowledge
  - Affordability, particularly for small projects
  - Degree of management buy-in

- **Issues with CMMI**
  - Lack of a simple roll-out procedure
  - Consistency between appraisers
  - Need for additional templates
  - Marginal value of some practices

- **Issues with EVMS**
  - Lack of integrated tools
  - High degree of paperwork
  - Inflexibility in making changes
  - Difficulty with complex contract structures
Cause and Effect Analysis

**Hypothesis H1:** Projects lack the knowledge to implement CMMI and EVMS
- No local source of help

**Hypothesis H2:** Projects are not motivated to implement CMMI and EVMS
- Lack of buy-in
- Conflicting priorities

- Too long to get to CMMI L3 and EVMS
Distribution of Size – Measured Projects

Small, medium, and large projects were measured.
Projects exhibited a high degree of CMMI commitment and expertise.

Projects did not have on-site CMMI expertise.

Distribution of Time to Achieve CMMI L3
Distribution of Time to Implement EVMS

Projects exhibited a high degree of EVMS commitment and expertise

Projects did not have on-site EVMS expertise
CMMI Process Stability

TEST 1. One point more than 3.00 sigmas from center line.
TEST 5. 2 out of 3 points more than 2 sigmas from center line
TEST 8. 8 points in a row more than 1 sigma from center line

Extreme schedule pressure on project diverted focus from CMMI
Projects already at CMMI L3 and set a goal of achieving CMMI L3 within the year

Mean = 22.22
LCL = 5.483
UCL = 38.96

CMMI Process Stability
Root Cause Verification

- Performed correlation analysis of 18 DMS CMMI projects and 7 DMS EVMS projects

- Results showed that projects implement both CMMI and EVMS more quickly when
  - Expert help or other projects that have successfully implemented CMMI/EVMS is available at the project site (confirms H1)
  - Projects give CMMI/EVMS a high priority (confirms H2)

- Projects implement CMMI L3 more quickly when
  - Project is already at CMM L3 (Confirms H1)
  - Project sets a management goal to achieve CMMI L3 by a given date (Confirms H2)

- Projects implement EMVS more quickly when
  - Project designates a single person responsible for implementing EVMS (Confirms H2)
  - Project size is smaller
Improvements Under Consideration

- Develop a proactive integrated startup CMMI/EVMS startup process and schedule
  - Contrasted with a project being reactive to appraisal/audit findings

- Harmonize engineering (CMMI) and EVMS processes
  - Ensure that processes are mutually aware and complementary
  - Eliminate conflicts and redundancies

- Provide training for above processes
  - Include benefits/ROI analysis of CMMI/EVMS to increase buy-in

- Recommend that CMMI/EVMS experts be located at key development/integration sites
Conclusions

- Even if the organization has established CMMI/EVMS credentials and significant resources available, getting these capabilities to all sites will be a challenge.

- CMMI and EVMS have enough in common to warrant a common startup approach.

- The key barriers to successful implementation are lack of knowledge and lack of motivation.
  - Documented startup processes and training are ways to overcome these barriers.