Presentation to the
NDIA 6\textsuperscript{th} Annual
CMMI Technology
Conference
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November 13-16, 2006
Agenda

- Implementing processes for CMMI® Levels 2 and 3
  - Approach
  - Challenges
- Measurement
  - In the Measurement and Analysis Process Area
  - Estimates and Actuals for projects
- Benefits and Similar Observations
Implementing Processes for CMMI® Levels 2 and 3
Approach

- Set up the process improvement activity as a project
- Established the infrastructure first
- Selected documentation format
- Leveraged a strong set of existing practices
- Rolled out defined processes to pilot projects with training for everyone
A Project Approach

1. Plan
   • Objectives
   • Monitoring and control strategy
   • Risks
   • Resource estimates
   • Milestones
   • Quality assurance and configuration management
   • Schedule

2. Function as a Team
   • Regularly scheduled meetings
   • Delegate activities
   • Assignment of Action Items
   • Follow-up

3. Measure and Report
   • Establish reasonable performance thresholds
   • Collect progress data at regular intervals
   • Analyze results
   • Take corrective action
The Process Infrastructure

- Establish form of documentation
- Appropriate fit and formality for the organization
- Address functions of the model and the organization
Documentation Format

Flowcharts and Entry, Task, Verification and eXit (ETVX) tables

<table>
<thead>
<tr>
<th>Entry Criteria</th>
<th>Task(s) to be Performed</th>
<th>Job Aids</th>
<th>Exit Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Approved Process Change Requests</td>
<td>1. EPG CM determines need for a pilot or training.</td>
<td>1. Process Change Request Form and work instructions.</td>
<td>Approved/Declined/Postponed PCR.</td>
</tr>
<tr>
<td></td>
<td>3. Implement change according to the timeframe documented in the PCR or by the EPG.</td>
<td>4. Process Hierarchy Architecture 4. ETVX Diagram.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Once the change is complete notify PCR owner and the EPG.</td>
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</tr>
</tbody>
</table>

Verification Steps

- EPG configuration audits
- EPG configuration status reports
Existing Practices

- Estimating levels of effort
- Project schedules
- Vision documents
- Defect tracking in an automated tool
- Test scripts
- Independent quality assurance organization
- Version management for all documents
Roll out of Defined Processes

- Train pilot projects
- Invite everyone
- Rework as required
Challenges

- Everyone wanted to be on all the process action teams
- No one wanted to be a process area owner
- Constraints on membership in the Management Steering Committee
- Measures
- Tailoring
- Common practices
- Lack of well defined chain of command for reporting
New Words and Different Meanings

- Project Plan is not equal to a project schedule
- Validation can have many names
- Configuration audits are not the same as process audits
- Quality assurance is not testing
- Product integration occurs, even if it is not a distinct procedure
- Tailoring means flexibility, not a waiver
Tailoring

- Define project size thresholds (value, FTE, or duration?)
- How to record project tailoring selections
- Document the guidelines to include roles and responsibilities
- Notations on process or work product, optional, alternative practice or must use as-is
Identifying Existing Practices

- Confusion: same words, different meanings
- Confusion: different words, same meanings
- Confusion: new words
- Existing practices not fully documented
- Existing practices not consistently practiced
- Not all existing practices known across the organization
Measures

- Benefit hard to see
- We do enough of this already
- No time; the contract doesn’t pay for it
- How can you estimate these things? (Quality cannot be predicted (estimated))
- Size does not mean estimated resource or level of effort
- Staff level of effort is not the entire level of effort
Measurement
Measurement and Analysis Process Area

- Corporate level Measures Guide
- Four measurement categories
- Measures worksheet
- Industry best practices for thresholds
- Repository on Sharepoint
- Earned Value
Measures Categories

For the Measurement and Analysis Process Area

- Level of effort
- Size
- Quality
- Schedule
## Industry Best Practices

<table>
<thead>
<tr>
<th>Measure</th>
<th>Threshold for Analysis</th>
<th>Corrective Action</th>
</tr>
</thead>
</table>
| Effort  | 10% *(Example: Cumulative labor time differs from the original estimate by 10% at any point in the project lifecycle)* | 1. Review original estimating basis and determine impact on project schedule and cost  
2. Assess impact on project risk  
3. Report to relevant stakeholders |
| Quality | 15% *(Example: Number of cumulative findings differs from the original estimate by 15% at any point in the project lifecycle.)* | 1. Review original estimating basis and determine impact on project schedule and cost  
2. Assess impact on project risk  
3. Assess impact on deliverables  
4. Report to relevant stakeholders |
Measures Worksheet

<table>
<thead>
<tr>
<th>Measure</th>
<th>Measure Description</th>
<th>Initial Estimates</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort Estimates in Staff Hours</td>
<td>Effort Project End Estimate</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Project Management</td>
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<tr>
<td></td>
<td>Quality Assurance</td>
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<tr>
<td></td>
<td>Product or Service Development</td>
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</tr>
</tbody>
</table>

| Total Estimated Effort          | Sum of Estimated Effort      | 0 0 0 0 0 0       |
| Effort Actuals in Staff Hours   | Project Management           |                   |     |     |     |     |     |
|                                 | Quality Assurance            |                   |     |     |     |     |     |
|                                 | Product or Service Development|                  |     |     |     |     |     |

| Total Actual Effort             | Sum of Actual Effort         | 0 0 0 0 0 0       |
Measure: Estimated Effort - Project A
Measure: Actual Level of Effort – Project A
Measure: Estimated Effort – Project B

![Graph showing estimated effort over time for Project B with labels for PM, QA, and Dev]
Measure: Actual Level of Effort – Project B
Measure: Estimated vs Actual Effort – Project A

- PM - E
- PM - A
- QA - E
- QA - A
- Dev - E
- Dev - A
Measure: Estimated vs Actual Effort Project B

![Graph showing estimated vs actual effort for Project B over time, with lines for PM, QA, and Dev roles.]
Measure: Effort Final Results – Project A

The graph shows the estimated effort (Total Est) and the actual effort (Total Actual) for each month from January to July. The project came in under estimated effort by 1.44%.
Measure: Effort Final Results – Project B

Project exceeded estimate by 8%
Measure: Size

Estimated vs Actual Number of Requirements - Project A

- Estimated Requirements
- Actual Requirements


Values:
- Jan: 362
- Feb: 357
- Mar: 360
- Apr: 373
- May: 384
- Jun: 415
- Jul: 441

Estimated: 443
Actual: 441
Measure: Quality

Estimated vs Actual Defects (Non-Cumulative) Project A


Estimated: 61, 70, 100, 85, 0, 23
Actual:    8, 10, 0, 0, 0, 20
Measure: Quality

Estimated vs Actual Defects - Project B

- Estimated Defects
- Actual Defects
Measure: Schedule

Schedule Measures (Deliverables per month)
Project A

- Est Completions
- On-Time Completions
- Late Completions
- Additional Unplanned Completions
PI Measures - Quality

Actual Process Nonconformances (Non-Cumulative) from Audits

- Actual ISO Major Nonconformances
- Actual ISO Minor Nonconformances
- Actual CMMI Process Major Nonconformances
- Actual CMMI Process Minor Nonconformances
PI Measures - Effort

Effort (Hours - Non-Cumulative) by PI Task

PI Tasks

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
PI Measures - Schedule

Deliverable Status (Non-Cumulative)

- Estimated Completions
- On-Time Completions
- Late Completions
PI Measures - Size

Number of Items in the PAL (Cumulative)

- Cumulative Estimated Size
- Cumulative Actual Size
Benefits and Similar Observations
Benefits and Similar Observations

- Implementation perspectives
- Alternate Practices and Waived Process Areas
- Things We Got Right
- Lessons Learned
- Benefits
Implementation Perspectives

Process Decomposition Into Elements

More General

Organization

Project

More Detailed

Implement a Task

A1 Plan
A2 Do the Work
A3 Deliver
A4 Close out the Task

Procedures
Practices

Modified from a briefing developed by the Software Productivity Consortium NFP, Inc.
Alternate Practices and Waived PAs

- SP 3.2 Perform Configuration Audits (CM)
- Some Verification and most Validation performed by external group
- Supplier Agreement Management
- SP 1.3-3 Establish Product Integration Procedures and Criteria (PI)
Things We Got Right

- Practiced what we preached
- Set up the infrastructure before working the details
- Leveraged existing processes
- Engaged a consultant as objective third party
- Used measures at all stages to determine progress and justify all requests for resources and support
- Conducted a Class C, then a Class B before the Class A (with variation)
Lessons Learned

- Focusing on measures is worth the effort
- Including infrastructure early pays off
- Manual works, but automated is much better (action items, change management, version control)
- Consistent documentation standards make a difference in creating, documenting, tailoring, referencing and using processes
Benefits

- Quality control improvements
- Information sharing and communication among team members
- Clarification of roles and responsibilities
- Improved use of measures to make decisions
- Significant additional business opportunities
Quality Control Improvements

Average Number of Defects found in IV&V Before (Pre QC) and After (Post QC) Implementation of Quality Control Procedures

- Pre QC: 25 defects
- Post QC: 2 defects
Information Sharing

- Diversity on the process action teams
- Cross-organization membership on the Engineering Process Group including ISO organizations
- Cross-organization membership on the internal process audit teams
Clarification of Roles and Responsibilities

- Roles and Responsibilities defined in a matrix
- Combined separate tasks by process/lifecycle phase, roles and process tailoring by size
- Created summary cards for certain roles
## Roles and Responsibilities Matrix

### Project Duration, Size and/or Value Threshold:
- ≤3 months or ≤$150,000 or ≤3 FTE staff resources and Risk and Criticality to Client Operations is Low or Medium

### Governing Statement:
Those responsible for creating work products must ensure that appropriate staff provide input, review and approve content

<table>
<thead>
<tr>
<th>Process or Process Artifact</th>
<th>Comment</th>
<th>Due Date (if applicable, unless overridden by the contract)</th>
<th>Related Resources</th>
<th>Role and Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Award</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Tailoring or Alternate Practice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Risk Form</td>
<td>A</td>
<td>Used when funds are not available but work is required.</td>
<td>C, R, A</td>
<td></td>
</tr>
<tr>
<td>Statement of Work or RFP</td>
<td>A</td>
<td>Customer/client generates this document</td>
<td>NA</td>
<td>R, R, R, R</td>
</tr>
<tr>
<td>SOW/RFP Proposal (including cost proposal)</td>
<td>A</td>
<td>By due date</td>
<td>C, I, I, I, A</td>
<td></td>
</tr>
</tbody>
</table>

### Project Management Process

<table>
<thead>
<tr>
<th>Comment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is accomplished by the Project Setup Form. This can be delegated to PMs for pre-award work under $20K, is optional for work defined under existing T&amp;M, FFP contracts and maintenance. Form goes to Finance. The At</td>
<td></td>
</tr>
</tbody>
</table>
Improved Use of Measures to Make Decisions

- Decision Analysis for selecting technical implementation options, pilots and training for process change requests
- Setting measurement goals to guide analysis efforts
- Risk management
- Escalation of process audit results
Questions

It's QUESTION TIME!!