Small Project Challenges of CMMI in Large Organizations

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Agenda

- Introductions
- Overview of Our Company
- Describe the Challenges we faced
- Describe how we categorized projects
- Show how we tried to “Address the challenges”
- Closing comments
Our Company – Concurrent Technologies Corporation (CTC)

• An independent, nonprofit, applied research and development professional services organization
• Staff of 1,500+ professionals
• More than 35 locations
• Approximately 900,000 sq. ft., including laboratories and demonstration facilities
• Federally compliant contractor
• Concurrently certified to ISO 9001/14001 in August, 1998
• Assessed at Maturity Level 3 of the Capability Maturity Model Integration Systems Engineering/Software Engineering (CMMI-SE/SW®), Version 1.1 in March, 2003 for systems and software engineering activities
• Certified to AS9100 in April, 2005 for aerospace activities
**CTC Locations**

**CTC location**
Annapolis Junction, MD • Bremerton, WA • Charleston, SC* • Columbia, SC • Crystal City, VA • Dayton, OH • Fayetteville, NC • Fort Leonard Wood, MO • Greenville, SC • Hamilton, ON, Canada • Harrisburg, PA • Jacksonville, FL • Johnstown, PA • Largo, FL • Panama City, FL • Pensacola, FL* • Pittsburgh, PA* • San Diego, CA • Stuttgart, Germany • Washington, DC*

*CTC location and CTC on-site location*

**CTC on-site location**
Albany, GA • Alexandria, VA • Camp Lejeune, NC • Fort Bragg, NC • Fort Dix, NJ • Indiana, PA • Lackland AFB, TX • Morgantown, WV • Mountain Home AFB, ID • New Carrollton, MD • Norfolk, VA • Philadelphia, PA • Shalimar, FL • Tampa, FL • Tobyhanna, PA • Virginia Beach, VA • Warner Robins, GA • Wright Patterson AFB, OH
Our Growth Profile

Employees

I started here
Staff Make-up

Staff Disciplines

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical &amp; Mechanical Engineering</td>
<td>14%</td>
</tr>
<tr>
<td>Computer Science &amp; Mathematics</td>
<td>21%</td>
</tr>
<tr>
<td>Communications Technology</td>
<td>23%</td>
</tr>
<tr>
<td>Environmental &amp; Chemical Engineering</td>
<td>9%</td>
</tr>
<tr>
<td>Metallurgical &amp; Materials Engineering</td>
<td>3%</td>
</tr>
<tr>
<td>Engineering &amp; Science</td>
<td>9%</td>
</tr>
<tr>
<td>Business &amp; Others</td>
<td>21%</td>
</tr>
</tbody>
</table>
Selected Services and Capabilities

• Advanced Coatings and Coatings Removal
• Advanced Distributed Learning
• Advanced Materials and Processes
• Automation, Controls, and Data Acquisition
• Command and Control Systems
• Communications and Outreach
• Corrosion Prevention and Control
• Environmental Technology Demonstration and Validation
• Fuel Cell Test and Evaluation
• Information Assurance
• Intelligence Analysis
• Logistics Optimization
• Management Systems
• Manufacturing Improvement
• Modeling and Simulation
• Supply Chain Integration
• Sustainability
• Systems Design and Analysis
• Systems Integration
• Systems/Software Engineering
• Technology Management
• Visualization
Challenges We Face

CTC Project make-up

- Number of People: 1500
- Number of Projects: 230
- Average Project Size 5 FTEs
- Typical Large Program: 35 FTEs
- Typical Small Program: 1 FTE

So What?

- Although it looks Large
- it’s small
- Processes need to tailor to projects of varying size
- We realized this impacts how we do business
Challenges We Face
Multiple Disciplines

- Disciplines
  - Engineering
  - Sciences
  - Construction Management
  - Communications
  - Education and Training
  - Business (program management and other)

- Variety of tools and templates required to support
- Different terminology used in each field

So What?

- Broad types of projects
- Intelligent staff with strong opinions
- **Not practical** to implement **one size fits all**
- We realized this impacts how we do business
Challenges We Face
Multiple Standards

- ISO 9001
- AS 9100
- ISO 14000
- VPP – Voluntary Protection Program
- CMMI – across the company

So What?

- Underestimated effort required to train staff
- Large effort required to manage and maintain
- **Not practical** to implement *as multiple quality systems*
- We realized this impacts how we do business
Current Procedure Presentation

- Sequential Listing based on old ISO 9001:1996 sections
- Additions for each new standard
- Need to improve usability of the system
- Numbering scheme not structured to handle new procedures added over time
How we categorized projects

Quality Management System Environmental Health and Safety (QMS/EHS)

- Quality Planning Checklist asks
  - “Is the project designated as a Systems Development project?”
- Systems Development QA Lead determines if project is a system development or service.
  - Below the Threshold - 2100 hours
  - Projects are of two distinct types:
    - Service Projects
    - Systems Development Projects
What happened

• System definition was misunderstood by staff and management
  - Only for software types
• Projects mixed services and systems
  - Lacked guidance on how to decide
  - People reverted to what they knew to get things done
• Created auditing confusion for staff
Addressing the Challenges
What is the starting point

• Analysis of internal records showed we have a variety of types and sizes of projects

• Took a step back and said “What is CTC concerned with?” – **Quality product that meets or exceeds the Clients needs.**
  - Within Budget
  - Controlling Risk

• Reviewed Technical Management Literature on Project Classifications

• Decided to implement a Project Classification Framework based on size and risk
Basis for Framework

• Technical Management research conducted by Wesley J. Howe School of Technology Management, Stevens Institute of Technology
  – Dr. Aaron J. Shenhar
• Ohio State CIO Office
  – http://oit.osu.edu/projmanage/PDF_files/OSUP_MFrmwk_1.00.pdf
### Sizing Matrix

<table>
<thead>
<tr>
<th>Project Class</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>$W</td>
</tr>
<tr>
<td>2</td>
<td>$W+1</td>
<td>$X</td>
</tr>
<tr>
<td>3</td>
<td>$X+1</td>
<td>$Y</td>
</tr>
<tr>
<td>4</td>
<td>$Y+1</td>
<td>$Z</td>
</tr>
<tr>
<td>5</td>
<td>$Z+1</td>
<td>Infinity</td>
</tr>
</tbody>
</table>
## Risk Matrix

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Low (0)</th>
<th>Medium (1)</th>
<th>High (2)</th>
<th>Very High (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Size</td>
<td>&lt;5</td>
<td>5-9</td>
<td>10-14</td>
<td>&gt;15</td>
</tr>
<tr>
<td># Work Groups</td>
<td>1-2</td>
<td>3-4</td>
<td>5-6</td>
<td>&gt;7</td>
</tr>
<tr>
<td>Technology / Technique / Process</td>
<td>Expert</td>
<td>Familiar</td>
<td>New to CTC</td>
<td>Cutting Edge Rocket Science</td>
</tr>
<tr>
<td>Complexity</td>
<td>Well defined no problems</td>
<td>Known Some problems</td>
<td>Multiple approaches</td>
<td>Unknown or vaguely defined</td>
</tr>
<tr>
<td>Political Profile / Impact</td>
<td>Small Impact</td>
<td>Medium Impact</td>
<td>Large Impact</td>
<td>Very Large Impact</td>
</tr>
</tbody>
</table>
Project Classification - Risk Adjustment

- Risk adjustment
  - 0 to 10 $\rightarrow$ no affect
  - 11 to 13 $\rightarrow$ Increase 1 level
  - 14 to 15 $\rightarrow$ Increase 2 levels

- Size Matrix + Risk adjustment = Project Class
Phases of the “System”

- Proposal Development
- Contract Award
- Planning
- Execution
- Closeout
# Configuration Management – Planning (1)

<table>
<thead>
<tr>
<th>Planning</th>
<th>Project Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5</td>
</tr>
<tr>
<td>Develop Configuration Management Approach</td>
<td></td>
</tr>
<tr>
<td>Version Control - Documents</td>
<td>X  X  X  X  X</td>
</tr>
<tr>
<td>Version Control - Hardware</td>
<td>X  X  X  X  X</td>
</tr>
<tr>
<td>Internal CCB</td>
<td>X  X  X</td>
</tr>
<tr>
<td>Client Linked CCB</td>
<td>X  X</td>
</tr>
<tr>
<td>Formal Configuration Control with CCB</td>
<td>X</td>
</tr>
</tbody>
</table>

*Note: X indicates the presence of the item in the project class.*
Configuration Management – Planning (2)

• Completes the work started in the proposal
• Addresses changes from proposal to award
• Orient the entire team on the process and procedures to be used
• Scaled requirements from simple version control to full up configuration management
Configuration Management – Execution (1)

- Maps back through planning and proposal development
- Provides specific Project Class Activities
- Links directly to the procedures that are applicable
- Informs the project what is assessable and auditable
# Configuration Management - Execution

<table>
<thead>
<tr>
<th>Project Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Execution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify/Monitor Risks</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Maintain Risks in Risk Radar</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Configuration Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan Versioning</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan Configuration Management</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage Baselines</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Version Control of Work Products</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Closing Remarks

- Process must be organized and tailored to suit the needs of the project (within CTC’s business processes)
- No one size fits all
- Many approaches to process activities – focus on what your company needs
- Classify based on size and risk
- Focus on the amount of process rigor that is needed for the class level of the project
Questions?
Small to medium organizations, those with staff between 25 and 250 people (<Lessons Learned from Adopting CMMI for Small Organizations>, Slide 6), represent unique challenges when trying to adopt the tenets of the Capability Maturity Model Integration. Some of these challenges have been documented in initial studies conducted by the SEI and its partners. However, no attention has been given to organizations composed of many functional disciplines that have a large overall work force but operate projects supported by smaller working organizations. These types of organizations present unique challenges to adopting many of the process areas in a quantitatively and qualitatively managed manner. To be successful, CTC’s approach was to recognize that different functional disciplines might require multiple procedures to complete the tasks, possibly different tools, and definitely different terminology.
The process areas of Configuration Management, Risk Management, and Project Planning are key areas that *CTC* has found that cross these functional disciplines. These areas provide insight into critical differences between sub-organizations. Within CM, several challenges exist even with decades of written works on the subject. What is important under one discipline or within one project may not be in another; how do you define the standards to identify what should be managed? Within Project Planning, how does an organization identify the roles and responsibilities clearly, when they change from contract to contract? Do you force one size to fit all or highlight the unique needs of each functional discipline? Risk Management is standard, but how does a company that has over 280 projects with over 1400 employees that do not have many similarities organizationally analyze them for improvement? The presentation will provide recommendations on how to successfully approach these unique challenges.
Submitted Abstract (3)

- *CTC* is a nonprofit, applied research and development professional services organization with 35 offices.