How Six Sigma Organizations Implement CMMI Level 5

CMMI Technology Conference & User Group
17-20 November 2008

Rick Hefner, Don Corpron, Dave Miner
Northrop Grumman Corporation

Alice Parry, Raytheon Corporation
Background

- CMMI and Six Sigma are two well-known process improvement approaches with strong synergies.

- When an organization knows the tools and methods of Six Sigma, organizational and project implementations take a more customer-focused perspective, and often yield greater value than traditional Level 5 implementations.

- In this presentation, two leading Six Sigma and CMMI Level 5 organizations will share the ways in which Six Sigma has shaped their high maturity practices.
Agenda

• A Tale of Two Organizations
• Six Sigma Approach for Quantitative Management
• Example
A Tale of Two Organizations

Organization A

- 200 people, one building
- 10 projects for 3 clients; all fixed-price; all developing banking SW
- Deployed ML5 practices as a competitive discriminator during organization stand-up

Organization B

- 18,000 people, offices in all 50 states
- 200+ projects for 20+ clients; fixed-price, cost-plus, LOE; SE, SW, HW, services
- CMMI ML5, ISO 9000, AS9100, etc.; continuously re-organizing and acquiring new pieces of the organization

How might their high maturity practices vary?
High Maturity Implementations

**Organization A**
- Organizational goals - make a profit (productivity, low fielded defects)
- Project goals - same as the organizational goals
- Organization builds baselines and models around productivity and defects
- Projects select peer review and testing subprocesses for quantitative management
- Projects follow CMMI practices

**Organization B**
- Organizational goals - satisfy shareholders (growth, stability)
- Project goals - all different because of different domains, different customer needs
- Organization builds baselines and models around productivity and defects
- Projects select a wide variety of subprocesses (e.g., training delivery, action item closure, estimation, field support, etc.)
- Projects follow Six Sigma approach
Focus in a Six Sigma Organization

• Are you measuring the “right things”?

• How do you know what’s right?

• Stay focused on getting your product to your customer as promised!

• Budget and monitor the value-producing processes.
  – The ones that transform inventory into finished product
“Things” flow through a process

“Things” are what customers pay for...

- In manufacturing, materials are the things
- In design and development, requirements are the things
- In services, external Customer needs are the things
- In administration, internal Customer needs are the things

The flow of requirements through the processes is our chief concern
Identify the Project’s Value Stream

- The transformation of requirements into product features and functions for which Customers pay money

Requirements are the “inventory” that transform as they go through the process.
Identify the Measures

For each value-added or value-producing process...

- Identify what constitutes the “inventory”
- Identify how the “inventory” is measured
- Establish the measure for the rate of transforming the “inventory” into “product”
Collect and Analyze

• Collect data for each value-added, value-producing subprocess

• Collect at regular intervals
  - Use voice of the process

• Analyze the data
  - Establish the statistical understanding
  - This is the “Process Performance Baseline”

• Compare against the allocated budget (subprocess capability)
Assess the Overall Ability to Achieve

- Incorporate the data from the “statistical understanding” into the process map
  - The Process Performance Model

- Run simulations to assess the project’s ability to “get there from here”

- Identify needed improvements
  - Use the simulation to make decisions
Example - Discrepancy Reports

Data required:

- Submitted DR’s per time period (arrivals)
- Open DR’s (backlog)
- Resolved DR’s
Categorize DR’s:

1. Complete Failure: **System crashes**
2. Partial Failure: **Required functionality does not work, and no workaround**
3. Partial Failure: **Required functionality does not work, but a workaround exists**
4. Cosmetic: **Defect does not materially affect any functionality**
Collect a time series of measurement data about DR submittals

<table>
<thead>
<tr>
<th>Date</th>
<th>Submittals</th>
<th>Resolved</th>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/6/2007</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4/13/2007</td>
<td>7</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>4/20/2007</td>
<td>6</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>4/27/2007</td>
<td>12</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>5/11/2007</td>
<td>19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analyze the **Submittal** data with a control chart

I Chart of Submittals (Transformed)

**Note:**
Transform counting data with $\sqrt{(c+0.5)}$

Transformed with $\sqrt{(c+0.5)}$
A shift took place about October 26; use current performance

I Chart of Submittals (Transformed)

Stage 1
Stage 2

Individual Value

Date


Actual number is
(2.392)^2 - .5 = 5

\( \bar{X} = 2.392 \)

\( UCL = 4.586 \)

\( LCL = 0.197 \)

Transformed with SQRT(c+.5)
Likewise, analyze **Resolved** with a control chart.

**I Chart of Resolved (Transformed)**

- **Actual number is** \((3.37)^2 - .5 = 11\)
- **A process performance baseline**

Transformed with \(\text{SQRT}(c+.5)\)
Simulate the process using the data

- In other words, Create a “Process Performance Model” using the “Process Performance Baselines”

- Model adjustments may include:
  - “Inventory” arrival rates
  - “Transformation” rates
  - Staff levels and attrition
  - “Standard” work schedule
Analyze the open DR’s with a time series chart

Time Series Plot of Total SVT/IST Open

DR Backlog on 3/25 was 477

Nominal prediction is for a 11/25 finish

This came from a simulation
Simulate the DR work-off

Weeks to Finish

<table>
<thead>
<tr>
<th>Sim #1</th>
<th>Sim #2</th>
<th>Sim #3</th>
<th>Sim #4</th>
<th>Sim #5</th>
<th>Sim #6</th>
<th>Sim #7</th>
<th>Sim #8</th>
<th>Sim #9</th>
<th>Sim #10</th>
<th>Sim #11</th>
<th>Sim #12</th>
<th>Sim #13</th>
<th>Sim #14</th>
<th>Sim #15</th>
<th>Sim #16</th>
<th>Sim #17</th>
<th>Sim #18</th>
<th>Sim #19</th>
<th>Sim #20</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>20</td>
<td>28</td>
<td>31</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>32</td>
<td>31</td>
<td>29</td>
<td>41</td>
<td>23</td>
<td>39</td>
<td>29</td>
<td>34</td>
<td>28</td>
<td>25</td>
<td>31</td>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>
Analyze the results with a CDF

Empirical CDF of Time to Finish

Normal

Mean 30.35
StDev 5.244
N 20

Tied directly to remaining schedule
Predict Outcomes

• If defect arrivals and resolution stay “as is”; defects will not add risk to the end date

• Complete similar analysis for the other value-producing processes
Summary

• Are you “Getting there from here”?

• Understand what produces “value” for the customers

• Set performance budgets

• Measure the value-producing processes

• Model and analyze performance