Process Improvement via CMMI

Presented by: OST, Inc.
November 17th, 2011
Agenda

- **Case Study I**: Use CAR to reduce the time taken to close critical defects
- **Case Study II**: Use QPM to dynamically manage our program to optimize expected project objectives
- Questions
Using CAR to reduce the time taken to close critical defects
Background

- Mission critical project
- Major release involving complete re-write of 350,000 lines of code
- Process already in place for system testing and logging of defects
- Data Source – Mercury Quality Center
- Daily review of defects opened, fixed, tested and closed
GOAL: Why do a CAR

- Reduce the mean and standard deviation for the time taken to close critical defects
- Identify the root causes that contribute to high mean and variance to close critical defects
**1. Verify Process Stability**

- Use I-MR charts to identify outliers and cause

**2. Identify Cause**

**3. Implement fixes**

- Repeat steps 2 & 3 for each identified phase for the process till all root causes are resolved
### One-way ANOVA: Days to close versus Severity

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity</td>
<td>2</td>
<td>14300</td>
<td>7150</td>
<td>14.01</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>112</td>
<td>57156</td>
<td>510</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>114</td>
<td>71456</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ S = 22.59 \quad R-Sq = 20.01\% \quad R-Sq(adj) = 18.58\% \]

- **Level**
  - Critical: 20, Mean = 48.85, StDev = 33.97
  - Major: 72, Mean = 18.79, StDev = 16.22
  - Minor: 23, Mean = 22.39, StDev = 27.43

*Representative data*

ANOVA test showing significant & statistical difference for fix time for critical defects
First - verify Process is stable: I-MR charts to identify outliers. Outliers turned out to be onetime scenarios.

Divided the analysis into phases to implement the correction for an identified cause, and statistically analyzed the results – iterative process.

Establish targets at every phase (Based on “Half Life metric” developed by Art Schneiderman - also referenced in The Balanced Scorecard by Kaplan and Norton)

* Representative data
The CAR Process

- Brainstorming session
- Fishbone diagram
- Potential root causes identified

* Representative data
Effort vs Impact analysis to identify the priorities of the actions to implement

<table>
<thead>
<tr>
<th>Action</th>
<th>Effort</th>
<th>Impact</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.1. Test builds are not ready at all times. There may be a delay.</td>
<td>Medium</td>
<td>Medium</td>
<td>3</td>
</tr>
<tr>
<td>M.1. Train Testers to classify defect severity correctly</td>
<td>Low</td>
<td>High</td>
<td>1</td>
</tr>
<tr>
<td>M.2. Add priority to test cases</td>
<td>High</td>
<td>Medium</td>
<td>3</td>
</tr>
<tr>
<td>M.3. Ask Testers to test according to priority in functionality</td>
<td>Medium</td>
<td>Medium</td>
<td>2</td>
</tr>
<tr>
<td>P.1. Add priority to test cases according to Severity (Identified in</td>
<td>Low</td>
<td>High</td>
<td>1</td>
</tr>
<tr>
<td>Phase 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Representative data
Pareto Charts to determine the root causes of the problem (that were addressed), monitoring and recording of the data also helped bring about other issues that we were able to resolve quickly.

* Representative data
The mean time to close critical defects is now at **1.6 days** and the standard deviation is at **2.36** – from a mean of 25 days and standard deviation of 32.

* Representative data
Conclusion

- Significant shift in the mean and standard deviation
- Assumptions may not always be true
- Statistical data and analysis = Quantified information
- Increased confidence in the process that was changed and standardized = improved team direction and common goals
- Faster delivery of a quality product = Improved customer satisfaction
Using QPM to dynamically manage our program to optimize expected project objectives
Customer

Government Agencies reconciling asset discrepancies between systems

What triggered the Task

Audit Finds needed to be addressed and resolved with a deadline

Task I - Phase I Objective

Analyze and Validate the existence of 3660 assets and provide a resolution

Schedule

Start Date: 01/29/2010 – End Date: 04/16/2010

Team Size

7 FTEs
Introduction

What?
Model to predict quantity of assets processed

Why?
Increase in project scope by 40%

Who?
Developed by SEPG team and project team

Who?
Project Management and Leadership team

When?
Weekly
Business and Project Goals

High Level Business Goal

- Have all assets analyzed and reconciled in time for the external audit
- Credibility of the client organization was riding on the success of this effort
- Divide and conquer – divide the work amongst various teams

Project Level Goal

- Have all assets assigned to our team processed to meet an internal deadline
- Leave enough time for the customer to review our analysis

Need for the model

- 40% increase in scope at the 50% schedule marker
- Slight delay in receiving the assets
## RISKS / IMPACTS / MITIGATION

<table>
<thead>
<tr>
<th>ID</th>
<th>Risk</th>
<th>Description</th>
<th>Business Impact</th>
<th>Mitigation</th>
<th>Likelihood</th>
<th>Impact Score</th>
<th>Risk Score</th>
</tr>
</thead>
</table>
| 31 | Delays from AFO to provide all work packages by 3/12/2010 may impact OST schedule to meet 4/30/2010 milestone | The work packages from the regional POCs will be provided to OST on 4/1/2010. Our initial understanding was that these work packages will be provided to us for review by 03/12/2010. All work packages will still have to be reviewed and field verification where required has to be completed by 4/15/2010. OST has 420 assets to process as of 3/18/2010 which will be likely be done by 3/24/2010 at which point OST resources will be waiting for work papers for about 4 days. | Schedule: 4/15/10 milestone may not be met  
Cost: OST resources will not be working at full capacity which has a cost impact | AFO Provide total assets remaining 1,496 at the rate of 100 per day (~4/2/10) | High | High | High / Red |
| 33 | AFO may escalate more than 2/3 of assets (1952) which will impact the schedule, the scope and the budget allocated for the tasks | Based on discussion with AFO, OST and AJW-21 we estimated that 2/3 of the assets not resolved by AFO will be processed and resolved by OST. If more than 2/3 of the assets are escalated to OST this may have an impact on the schedule and the budget of Task 1. | Cost | See Next Slides | High | High | High / Red |

11/1/2011
Outcome(s) Predicted and Stakeholder Audience

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- **Outcome predicted**
  - Number of assets processed (with Confidence Interval and Prediction Interval)
  - Data type – Continuous

- **Purpose of the output**
  - Determining optimal number of resources needed that we could propose to the customer

- **Stakeholders**
  - Customer (Government Agency)
  - OST resources (Analysts)
Data Collection:

- 165 data points from Phase I analysis data
- All data analyzed was recorded and stored using SQL Server
- Analyzed data was grouped by resolution (Resolved, Retired, Needs Supporting Documentation, etc…)
- Analyzed data was grouped by analyst

Time period of data collection

Monte Carlo Simulation was used to predict the output (Response).

@Risk simulation software was used.

Output was calculated using the function containing input variables and baseline data.

Histogram for the output is produced after model is run using @Risk.
The Model

Net working Days: 8

New Resources:
- #: 0
- Net New Resource Work Days: 0

Seasoned Resources:
- #: 10
- Net Seasoned Resource Work Days: 80

Results:
- Number of Assets Processed (New Resources): 857.3406469
- Number of Assets Processed (Seasoned Resources): 857.3406469
- Total Assets Processed: 857.3406469

@RISK - Simulated Input: E16

Number of Assets Processed (Seasoned Resources) / Results

5.0% of the data falls between 754.1 and 973.6.
# Risk Mitigation Scenarios presented to the customer

<table>
<thead>
<tr>
<th>Description</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario 1</strong></td>
<td>Meet 4/16/2010 with increase Scope</td>
<td>Meet 4/30/2010 deadline with increase scope</td>
<td>Maintain status quo with increase scope</td>
</tr>
<tr>
<td><strong>Scenario 2</strong></td>
<td>Receive all work papers by 4/2/2010 at rate of 100 / day starting 4/22/2010</td>
<td>Receive all work papers by 4/2/2010 at rate of 100 / day starting 4/22/2010</td>
<td>Receive all work papers by 4/2/2010 at rate of 100 / day starting 4/22/2010</td>
</tr>
<tr>
<td><strong>Scenario 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Assumptions</strong></td>
<td>• &gt; 95% Confidence: Add 9 Team Members</td>
<td>• 95% Confidence: Add 3 Team Members</td>
<td>Continue with current staffing level</td>
</tr>
<tr>
<td></td>
<td>• 60 % Confidence: Add 8 Team Members</td>
<td>• 85% Confidence: Add 2 Team Members</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 6 % Confidence: Add 6 Team Members</td>
<td>• 10% Confidence: Add 1 Team Member</td>
<td></td>
</tr>
<tr>
<td><strong>Action Plan</strong></td>
<td>Cost</td>
<td>Cost / Schedule (15 days – April 30(^{th}) 2010)</td>
<td>Cost / Schedule (40 days – May 17(^{th}) 2010)</td>
</tr>
<tr>
<td><strong>Impact</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results and Benefits

Results

- Increase in staff was authorized
- Contract value increased by 50%
- Contract was changed from FFP to T&M
- Critical customer deadline of 4/30 was met

Benefits

- The ability to make the case statistically provided analytical credibility
- Increase in Client confidence and reputation
- Client began advertising OST’s modeling capability with the entire customer organization
What Worked Well

- Excitement about the potential of modeling
- Generating support for dedicated resources for modeling
- Customer Delight
- Using this as a success story to build 9 more models
Increase in asset analysis scope

Creating model using Montecarlo Simulations to provide confidence levels with different staffing numbers and days

Multiple scenarios were provided to the customer to choose from

OST met the critical customer deadline of 04/30/2011

The ability to make the case statistically provided analytical credibility

Increase in Client confidence and reputation

Other models were created due to its success
Thank You