Measuring the Impact of RD andREQM CMMI Process Areas

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Agenda

- Introduction
- CMMI Appraisal Results
- Methodology to Measure economic Benefits
- Conclusions
Why do Defects Occur?

- Poorly defined requirements - approx 55%
- Poor design - approx 25%
- Coding issues - approx 15%
- Other - approx 5%

- Poor specification, scoping, and communication of release requirements is the number 1 failure point in making quality, customer-centric software

Patton, R. (2001), Software Testing, SAMS Publishers, USA
Reduce the effort and cost of defect removal activities after system verification by 30% in Manufacturing Solutions Department.

The above business objective guided the scoping of the CMMI internal SAS appraisal.

- The CMMI appraisal was focused on CMMI Level 2 process areas.
- After conducting the appraisal, it became evident that a primary source of defect generation were the RD and REQM process areas.
Chronology of Events
RD Specific Goals/Practices - Appraisal Results

**SG2**
Develop Product Requirements

- **SP 2.1** Establish product and product component requirements
- **SP 2.2** Allocate product component requirements
- **SP 2.3** Identify interface requirements

**SG1**
Develop Customer Requirements

- **SP 1.1-1** Collect and elicit stakeholders needs
- **SP 1.2** Develop the customer requirements

**SG3**
Analyze and Validate Requirements

- **SP 3.1** Establish operational concepts and scenarios
- **SP 3.2** Establish definition of required functionality
- **SP 3.3** Analyze requirements
- **SP 3.4** Analyze requirements to achieve balance
- **SP 3.5** Validate requirements with comprehensive methods

Requirements Development PA Specific Practices
REQM Specific Goals/Practices – Appraisal Results
RD Specific Goals/Practices – Enhanced Process
REQM Specific Goals/Practices – Enhanced Process
RD - Before and After

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REQM - Before and After

Requirements Management PA

SG1 Manage Requirements

SP 1.1 Obtain an understanding on requirements
SP 1.2 Obtain commitment to requirements
SP 1.3 Manage requirements changes
SP 1.4 Maintain bi-directional traceability of requirements
SP 1.5 Identify inconsistencies between project work and requirements

Requirements Management PA

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New RE Process
MA Process Area

- Measurement Objective
  - To measure the defect removal effort in hours spent by software developers to fix defects identified, documented, and categorized in the SAS DEFECTS system

- Measures
  - # of defects in each category associated with RD andREQM
  - Actual development time associated with fixing each defect. Time includes developers’ time and also subsequent tester’s time to review the fixes
  - Cumulative time that accounts for all defect types across the whole project.
MA Process Area

- Measurement Data Collection
  - Defects are identified by test team and documented in the DEFECTS database
  - Defect types are defined in a collaborative fashion between testers and developers
  - Time associated with defect removal will be recorded by developers in time-sheet database
  - Time associated with reviewing defect removal by testers will be recorded in time-sheet database

- Analysis of Measurement Data
  - Measurement data will be analyzed using the RE Economic Benefit Calculation explained later
Reporting of Measurement Data

- Three primary reports will be generated
  - Histogram that presents the number of defects within their types at time t1 and at time t2
  - Cumulative defect removal time graphics for each defect type for time t1 and time t2
  - Histogram of total time and cost for all defect removal for time t1 and time t2
Defect Types Associated with Requirements Development

- Market Requirements Document (MRD)
  - Requirement not documented in MRD
  - Requirement not properly specified in MRD
  - Requirement creep in MRD
  - Development misunderstood requirement in MRD

- Product Requirements Specification (PRS)
  - Requirement not documented in PRS
  - Requirement not properly specified in PRS
Defect Types Associated with Requirements Management

- Change in requirement not documented in MRD
- Change in requirement not documented in PRS
- Change in requirement not properly documented in MRD
- Change in requirement not properly documented in PRS
## Compare Defect Removal Effort and Cost

### Timeline

<table>
<thead>
<tr>
<th>Timeline</th>
<th>End of Q1 2006</th>
<th>Beginning Q2 2006</th>
<th>Beginning of Q3 2006</th>
<th>End of Q1 2007</th>
<th>Beginning Q2 2007</th>
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</thead>
<tbody>
<tr>
<td><strong>Process</strong></td>
<td></td>
<td><strong>RE * (MRD-PRS-Change Mgmt)</strong></td>
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<tr>
<td><strong>SWA 3.6</strong></td>
<td>Process Improvement Activity</td>
<td>Release</td>
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<tr>
<td><strong>SWA 4.0</strong></td>
<td>MRD PRS SWA 4.0 Development</td>
<td>Verification and Defect Classification</td>
<td>Defect Removal and Track Time Employed</td>
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</tbody>
</table>

**Compare Effort and Cost of Defect Removal between SWA 3.6 and SWA 4.0**
RE Economic Benefit Calculation

\[ t_1(k) = \text{time to fix defects of type "k" at time } t_1 \]

\[ t_2(k) = \text{time to fix defects of type "k" at time } t_2 \]

\[ t_1(k,i) = \text{time to fix defect of type "k" at time } t_1 \text{ and at occurrence } i \]

\[ t_2(k,j) = \text{time to fix defect of type "k" at time } t_2 \text{ and at occurrence } j \]

\[ C = \text{hourly average cost of development} \]

\[ \Delta T = \text{time differential between fixing all defect types at time 1 and at time 2} \]

\[ t_1(k) = \sum_{i=1}^{n} [ t_1(k,i) ] \]

\[ t_2(k) = \sum_{j=1}^{m} [ t_2(k,j) ] \]

\[ \Delta T = \sum_{k=1}^{s} [ t_{1,k} - t_{2,k} ] \]

Expected Economic Benefit = \( \Delta T \times C \)
Conclusions

- Having a quantitative business objective guiding the internal CMMI appraisal and process improvement activity is essential
- Use the Measurement and Analysis PA as a basis for measurement
- Start “small”
- Find “high impact” area that shows a “large” benefit