Controlling Project Performance by Using a Defect Model

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Overview

- Business Needs
- Project Defect Model
- Experiences
- Conclusions

Product quality and process effectiveness
Ericsson, The Netherlands

- Market Unit Northern Europe & R&D Center
- R&D: Value Added Services
  - Strategic product management
  - Marketing & technical sales support
  - Development & maintenance
  - Customization
  - Supply & support
- +/- 1300 employees, of which +/- 350 in R&D
Business Need for Quality

- Multimedia functionality
- Stability & Performance
- Customizations, flexibility
- Outsourcing
Target

Business: Increased R&D Efficiency

- R&D Scorecard
- Lead-Time, Cost & Quality

Quality: Lower Fault Slip Through (FST)

FST = Number of defects detected in integration & customer test that should have been detected earlier

“Should” implies that the defect is more cost effective to find earlier. The test strategy defines what is cost effective.
Measurement Values

Use Available Data over Collecting More
Analyze over Measuring
Give Feedback over Micro Managing
Take Actions over Reporting
Required

Control of Quality:
- Clear requirements
- Quality planned & tracked.
- Fact based decisions
- Known release quality
- Deliver on time
- Lower maintenance
Project Defect Model

Why?
- Control quality of the product during development
- Improve development/inspection/test processes

Business Benefit:
- Better planning & tracking
- Early risks signals
- Save time and costs
- Happy customers!
Measuring quality

**Insertion:** Where are defects made? How to prevent?

**Detection:** Where are defects found? Early/economic removal?

**Quality:** How many defect are left in the product at release?
Quality Management

- **Plan**
  - Documents/code (nr defects made)
  - Inspection & Test effectiveness (% detection rate)
    - Quality consequence of project approach

- **Track**
  - Actual nr. defects found
  - Estimate remaining defects
    - Quality status, steer daily work
    - Project decisions, early escalation

- **Steer**
  - Toll Gates, Quality Doors, Product Release
    - Product Quality figures, quantitative decisions
Project Status Deviation Report regarding Quality

Analysis of current situation

Targets – ………………………
Fact – ………………………
Reason – ………………………
Consequence – …………………

Corrective actions  (Mandatory for targets with Minor or Major deviations.)

<table>
<thead>
<tr>
<th>What</th>
<th>When (due date)</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>……………………………………</td>
<td>200y-mm-dd</td>
<td>xxxxx</td>
</tr>
<tr>
<td>……………………………………</td>
<td>200y-mm-dd</td>
<td>xxxxx</td>
</tr>
<tr>
<td>……………………………………</td>
<td>200y-mm-dd</td>
<td>xxxxx</td>
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History

- **2001** Defined, pilot project started
- **2002** Evaluated, 2 new projects
- **2003** Industrialized, used in all major projects
- **2004** Integrated in Project Steering Model
- **2005** Corporate process, Pilot Cost of Quality
- **2006** Corporate Good Practice
- **2007** R&D Efficiency, reduce Fault Slip Through, Agile
Functional Test

- Project:
  - Incremental
  - Function Test Team
  - Weekly analysis

- Functional Testing: More defects than estimated

- Root Cause Analysis:
  - Missed Inspection
  - Design Rules
Improve Inspections

- Re-introduce Design Rules
- Coach Inspections
- More defects inspection
- Additional defects in test

> Improved Inspection and Function Test
Release defect prediction

**Definition: Defects predicted at GA / Actual defects (%)**

- Number of defects predicted at release (General Avail.)
- Actual defects tracked in first 6 months of operation
- Accuracy:
  - Mostly within 150% range
  - Only 1 product > 100% off
  - Only 1 product more defects

- Maintenance dimensioning
- Reduce Cost of Poor Quality

<table>
<thead>
<tr>
<th>Product</th>
<th>Release</th>
<th>Expected GA</th>
<th>Actual GA</th>
<th>GA Estimate Accuracy</th>
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<tbody>
<tr>
<td>A</td>
<td>R1</td>
<td></td>
<td>105%</td>
<td></td>
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<tr>
<td></td>
<td>R2</td>
<td></td>
<td>178%</td>
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<td>B</td>
<td>R7</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>R1</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>R1</td>
<td></td>
<td>600%</td>
<td></td>
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<tr>
<td>E</td>
<td>R2.1</td>
<td></td>
<td>120%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R3</td>
<td></td>
<td>76%</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>R2.2</td>
<td></td>
<td>162%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R3.0a</td>
<td></td>
<td>146%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R3.0b</td>
<td></td>
<td>100%</td>
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<td></td>
<td>R3.0c</td>
<td></td>
<td>100%</td>
<td></td>
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<tr>
<td></td>
<td>R3.0d</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>R1</td>
<td></td>
<td>161%</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>R2a</td>
<td></td>
<td>100%</td>
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<tr>
<td></td>
<td>R2b</td>
<td></td>
<td>100%</td>
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</table>
Agile Approach

- Planning game:
  - Analyze Quality
- Demo:
  - Deliver
- Network test:
  - Verify
- Team meeting:
  - Feedback

- Balance Quality - Time – Costs
- Early Risk signals
- Optimized process

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Agile experiences

- **Planning game:**
  - Investigate solutions
  - Define Test strategy
  - Agree with Product Manager
  - Estimate remaining defects
  - Reduce Quality risks

- **Team feedback:**
  - Root Causes: Test coverage, configuration problems
  - Process update: Inspection, test strategy, delivery test
Key Success Factors

- Management Commitment
- Everybody involved
- Defect classification
- Frequent feedback
### Management Targets

<table>
<thead>
<tr>
<th>Target</th>
<th>Target Owner</th>
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</thead>
<tbody>
<tr>
<td>GA Defects</td>
<td>Strategic Product Manager</td>
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<tr>
<td>Defect Detection Rate</td>
<td>Project Office Manager</td>
</tr>
<tr>
<td>Fault Slip Through</td>
<td>Design Manager</td>
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</table>
Bridging the gap

Start

Pre-study

Execution

Finish

Target Setting

Defect Modelling

Estimation

Target Commitment

Data Collection

Analysis

Design

Test

Report

Bridging the gap process diagram with steps and relationships.
Defect Classification

Fault Slip Through: Could have been found?

- Orthogonal Defect Classification
- Test Matrices
- Discipline maps

Agree & deploy consistently
Feedback

- Frequent, short
- At the workplace
- All data available
- Design/test leaders

Feedback: Collected data delivered to the people that have done the work, in order to support understanding of the situation and help them to take needed actions

Show data
ask questions
form conclusions
take needed actions
Benefits

Qualitative
- Earlier risk signals: Deliver on time
- Incremental Development: Collaboration design-test
- Better decisions: Release quality
- Process adherence: Increased efficiency
- Less defects after release: Maintenance Reduction
- Less disturbances: Employee motivated

Quantitative
- Higher quality
- Reduced lead time
- Lower costs

ROI 5:1
Learnings

- Estimation & analysis with Design & Test Leaders: Valuable quality feedback

- All defect information in 1 excel sheet: Detailed insight, easy root cause analysis.

- Feedback sessions with project members: Essential for analysis, conclusions, and actions.

- Quality data next to planning and budget.

- Deployment and optimizing processes & methods.

Risks reduced: delivery date, budget & quality!
Quality Prediction

- **Current Model: Estimation**
  - Extrapolate past performance
  - Based on inserted/detected defects
  - Plan & track

- **Wanted: Prediction**
  - Causes of defects
  - What if Scenarios
  - Decision taking

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All models are wrong
Some models are useful

*Deming*
Quality Factor Model
- Expert opinion, with data
- Quick Quality Scan
- Rough Prediction
- Improvement Areas

Defect Prediction Model
- Data, tuned with expert opinion
- Detailed Prediction
- Improvement Business Case

Process Inputs and outputs
Influencing factors
Measurement

Design Process
- Competence, skills
- Tools, environment

Test Process
- Competence, skills
- Test Capacity
- Tools, environment

Defects Inserted
(documentation, code)

Defects Detected
(Inspection, test)

 Resident Defects in Design Base

Defect Density
Detection Rate
Fault Slip Through
Defect Classification

Defects Inserted
(documentation, code)

Defects Detected
(Inspection, test)

Resident Defects in Design Base

Defect Level

Resident Defects in Delivered Product

(U)happy customers

Process Inputs and outputs
Influencing factors Measurement
Pilot Agile: Prevention

- **Determine defect insertion & detection costs**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Quality Factor</th>
<th>Detected defects</th>
<th>Defects left</th>
<th>Cost</th>
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<tr>
<td>Req</td>
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<tr>
<td>Arch</td>
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<tr>
<td>Impl</td>
<td>5.1</td>
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<tr>
<td>Total development</td>
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<tr>
<td>Total</td>
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- **Predict savings due to less defects inserted**

<table>
<thead>
<tr>
<th>Phase</th>
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<td>Impl</td>
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<td>Total</td>
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<td>56%</td>
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Conclusions

- Quality has Business Value
- You can Measure & Manage Quality
- Estimate, Analyze, and Feedback:
  - Prevention
  - Early detection
  - Risk Management
- Why not start today?
  - Inspections & test
  - Release & maintenance
  - Agile
Further reading

References
- Managing the software process. Watts Humphrey.

Papers
- Controlling Product Quality During Development with a Defect Model, in Proceedings ESEPG 2003 & ESEPG 2004 conferences
- Make what’s counted count, in Better Software magazine march 2004
- A Proactive Attitude Towards Quality: The Project Defect Model, in Software Quality Professional Dec 2004 (with Hans Sassenburg)
- Controlling Project Performance Using the Project Defect Model, in Proceedings Practical Software Quality & Testing 2005 conference

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