TPI Automotive – Closing The Software Quality Gap?

Edwin Notenboom
Kugler Maag
TPI® Automotive - Closing the software quality gap?

Edwin Notenboom
1st December 2005
EuroStar 2005 Copenhagen
Vision
First to be asked for software and systems performance improvement.

Mission
We help our customers in mastering the risks associated with developing or acquiring software systems and services while maintaining their speed of innovation.

Facts
Founded 2004, employees with long-term experiences, unique skills, acknowledged experts

A Better Software World
- www.kuglermaag.com -

Industries – Automotive, Telecom, Finance, IT

Customers (extract)

Partners
in Industry and Academia, e.g. Member of ISERC, Partner of SEI/US SEIPartner

Automotive Projects (extract)

Project Control Office (PCO), Quality Management (QM), Assessing and Improving Suppliers’ R&D Processes
Official Partner in “Qualifying R&D Suppliers of Volkswagen AG”

Knowledge Areas
• CMMI®
• SPICE / ISO15504
• PMI / PMBoK
• IEC61508 (Safety)
• Automotive-SPICE
• TPI® Automotive
• People-CMM
• PSM

Service Groups
Process Performance Improvement
• Managing Change for lasting Quality, Productivity, Lead-Time Performance Improvements

Instant Maturity™
• “Off-the-shelf” process performance improvement

Maturity Control
• Improvement Readiness & Health Checks

Training & Enablement
• From Practitioners to Executive Management and Qualifying for 3rd party Assessments

Corporate wide Improvement Program BISS – Bosch Initiative for Software and Systems performance improvement, based on CMM/I

Corporate wide CMMI-based Improvement Program StepUp23
Introducing and operating the Requirement Service Center (RSC) and the Project Support Office (PSO)
Software in cars

Dynamic drive

ABS

DSTC

Drive-by-wire

DSR

Adaptive cruise control

ASC

I-Drive

Active front steering

ASR

Airbag

ESP
TPI® Automotive

- **Test Process Improvement** (1998)
- HIS asks for an automotive specific TPI® (2003)
- **TPI® Automotive** in 2004
Why a special flavor?

- Integration test
- Relation OEM and supplier
- Test environment
- Specific automotive improvement suggestions
- Automotive wording
Closing the quality gap?
Autumn 2003

Der Spiegel (major magazine in Germany) quotes:

Car stays, customer walks

Distribution of the cause of car problems in Germany (%)
Challenges

- Complexity
- Integration
- OEM vs. Supplier
Complexity of Electronic Systems in Vehicles

Signals
Sender/Receiver Interactions
Effort for Calibration and System Integration

System Integration $\sim n^3$
Sender/Receiver Interaction $\sim n^2$
Signals on CAN-Bus $= n$

$\sim 64$
$\sim 8$
1

Comparison E38/E65

Source: BMW 10/2002
E38
E65
next generation
BMW 7 series
Complexity

- Up to 74 ECU and more to come
- Up to 5 Communication networks
- More than 300 KLOC pro ECU
Complexity

ECU communicating via CAN/MOST
Asks for:

- Early involvement of testing
- Clear risk analysis
Early involvement

wishes, law, policy, opportunity, problem

specification

design

realisation

module/unit test

system test

acceptance test

exploitation

expectation

Inspections & Testability review
Think Risks!

- Business perspective
- No risk, no test
- Risk analysis approach
Risk: Definition

- Risk
  - Chance of failure
    - Frequency of use
    - Chance of fault
  - Damage
Integration

 subsystem

 car

 sw hw

 sw sw sw sw

 sw hw

 sw sw sw

 sw sw sw sw
Asks for:

- Integration testing with integration strategy
Integration strategy

An integration strategy is a decision about how the different modules (hardware and software) are integrated into a complete system

- Big bang integration
- Bottom-up integration
- Top-down integration
- Combinations of these three like:
  - Centralised integration
  - Layer integration
  - Client/Server integration
  - Collaboration integration
Integration strategy
Key area ‘Integration testing’

• Level A: Integration identified as a separate and planned process
• Level B: Test strategy for integration
• Level C: Standardized approach for integration
OEM vs. Supplier (Audi view)

Supplier B
- HW
- Function A
- Function B

Supplier C
- HW
- Function C

Supplier A
- HW

SW functions

Supplier D

Supplier E
- HW

Standard SW
Asks for:

- Communication
- Reporting
- Defect Management
- Archiving of test products
- Risk based test strategy

- Methodology to cover cooperation crossing department boundaries
Round up TPI® Automotive
21 Key areas

• Test strategy
• Life cycle model
• Moment of involvement
• Planning and estimation
• Test design techniques
• Static test techniques
• Metrics
• Test automation
• Test environment
• Office and laboratory environment

• Commitment and motivation
• Test functions and training
• Scope of methodology
• Communication
• Reporting
• Defect management
• Testware management
• Test process management
• Evaluation
• Low-Level testing
• Integration testing
‘Normal’ situation automotive

- Test automation and Test environment mature
- Other key areas most of the time at start level
## ‘Normal’ Situation

<table>
<thead>
<tr>
<th>Key area</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Test strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Life cycle model</td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>3 Moment of involvement</td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>4 Planning and estimation</td>
<td></td>
<td>A</td>
<td></td>
<td>B</td>
</tr>
<tr>
<td>5 Test design techniques</td>
<td>A</td>
<td>B</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>6 Static test techniques</td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>7 Metrics</td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>8 Test automation</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>9 Test environment</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>10 Office and laboratory environment</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Commitment and motivation</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>12 Test functions and training</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>13 Scope of methodology</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>14 Communication</td>
<td>A</td>
<td>B</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>15 Reporting</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>16 Defect management</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>17 Testware management</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>18 Test process management</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>19 Evaluation</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>20 Low-level testing</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>21 Integration testing</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>
### ‘Desired’ Situation

<table>
<thead>
<tr>
<th>Key area</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test strategy</td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life cycle model</td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moment of involvement</td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning and estimation</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test design techniques</td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static test techniques</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metrics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test automation</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test environment</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office and laboratory environment</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commitment and motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test functions and training</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scope of methodology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reporting</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defect management</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testware management</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test process management</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-level testing</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration testing</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What is the driving force for changes?

- Quality problems and image problems
- CMMI
- SPICE
- ISO 61508
- Relation OEM supplier
Closing the quality gap?

Not on his own but supports the process of closing the gap!