Automotive SPICE® 3.0
... the new and the core features

Bernd.Hindel@methodpark.com
Background & History

Basics & Abstractions
Assessments & Learning
Organizations & References
The core features
Migration to Automotive SPICE® 3.0
Summary
Objective:
   Improvement of Product Quality

Hypothesis:
   Product Quality ↔ Quality of the Development Process

are defined by:
   ▪ Capability Levels
   ▪ Best Practices
   ▪ Measurement Framework

Examples:
   ▪ CMM
   ▪ SPICE
## History & Background

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<thead>
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<th>Year</th>
<th>SEI</th>
<th>EU</th>
<th>ISO</th>
<th>HIS</th>
<th>VDA AK13</th>
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<td>Bootstrap</td>
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<td>ISO330xx</td>
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</table>
Agenda

Background & History

**Basics & Abstractions**

Assessments & Learning

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The core features

Migration to Automotive SPICE® 3.0

Summary
Basics & Abstractions

... ASPICE focuses on ...

- Practices
- Traceability
- Guidelines
- Strategies
Basics & Abstractions

Requirements need to be
captured
analyzed
feasibility
testability
impact
criticality
estimation
designed
implemented
tested
Basics & Abstractions

Work Packages need to be

- planned
- estimated
- scheduled
- executed
- reviewed
- done
- re-estimated
- re-scheduled
Basics & Abstractions

Traceability

Practices

Guidelines are needed for

Strategies

Methods

Tools

Safety Culture
Basics & Abstractions

Strategies for:

- Estimation
- Reviews
- Testing

... for everything that cannot be done 100% accurate
Plan – Do - Check – Act

1. Objectives
2. Strategy to achieve the objectives
3. Detailed Planning
4. Implementation of the Plan
5. Monitoring / Reporting
6. Corrective Actions / Escalation
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Basics of Assessments

Assessments compare used practices with recommended practices from standards.

Assessments compare used practices with practices given by a process definition.

Assessments should be of a consulting nature, assigning a maturity level is secondary.

Assessments should be based on discussions and experiences, not on interviews and judgments.

Assessments are baseline mechanisms of a learning organization.
When to assess?

at Milestones or Quality Gates

long enough before releases, such that corrective actions can be implemented before the release date

at least after 1/3 of the planned project duration and before 2/3 of the planned project lifetime is over
Benefits gained from Automotive SPICE® 3.0

List of corrective actions
Harmonization of Terms
Awareness of Practices
Process Acceptance

Know where you are
Know what to improve next
Become a Learning Organization
Learning Organization

- estimate, measure and act
- define processes, tailor and feedback
- define templates, checklists and review

Knowledge
  - to read
  - to listen
ISO/IEC 330xx = ASPICE 3.0

**Optimizing**
Quantitative measures are implemented to continuously improve the process

**Predictable**
Metrics for the measurement and control of process performance and outcomes are applied

**Established**
Defined processes are tailored to specific projects, resources are managed

**Level 0 Incomplete**
Incomplete
Chaotic processes

**Level 1 Performed**
PA.1.1 Process Performance

**Level 2 Managed**
PA.2.1 Performance Management
PA.2.2 Work Product Management

**Level 3 Established**
PA.3.1 Process Definition
PA.3.2 Process Deployment

**Level 4 Predictable**
PA.4.1 Quantitative Analysis
PA.4.2 Quantitative Control

**Level 5 Innovating**
PA.5.1 Process Innovation Implementation
PA.5.2 Process Innovation

**Managed**
Processes and work products are managed, responsibilities are identified

**Perform**
Processes are intuitively performed, incoming and outgoing work products exist
Objectives: become a Learning Organization!

Set Of Standard Processes

Tailoring

Tailoring Criteria

V Model

Improvement Requests for Processes

Measurement Repository

Assessment Results

Feedback Sessions

Project A

Project B

Project C

…

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Process Distribution
Business Unit Body & Security

Continental Automotive Reference Processes

Reference Process
3 Baselines / Year

IBS Process Map
Continuous Improvement

Project Instances BLx
Project Instances BLx+1
Project Instances BLx+2
learning managed by stages of

Flexible Architecture
Hierarchical Processes
Distributed Modeling
Graphical Modeling
Process Visualisation
Consistency Management
Release and Versioning
Compliance Management

Define
Manage
Control
Execute

Reports and Dashboards
Measurement Repository
Compliance Evidence
Unified Work Product Access
Process Tailoring
Integrated Process Execution
User Centric Views
Team Collaboration
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Innovation in modern vehicles is to a great extent realised by software in electronic control units. Therefore vehicle manufacturers must extend their competence in the basics and methods of software design and quality assurance for microprocessor based control units. This has motivated the vehicle manufacturers Audi, BMW, Daimler, Porsche, and Volkswagen to bundle their activities for standard software modules, process maturity levels, software test, software tools and programming of control units. The common goal is to achieve and use joint standards.

source: http://www.automotive-his.de
ISO/IEC 15504 permits to define industry specific process assessments models compliant to the ISO standard

Due to the demand for a standard adapted to the automotive industry, the largest European car manufacturers started the “Automotive SPICE” initiative (1st version published ~2005)

Automotive SPICE is based upon the ISO/IEC 15504 (www.automotivespice.com)
References to Automotive SPICE®

source: http://www.automotivespice.com
Stakeholders of Automotive SPICE®

**SPICE**
- Requirements, Rules, Guidelines and Instructions for Trainings, Certifiers and Assessors
- Working groups
- Support of Domains (e.g. Automotive)
- Verification of compliance (e.g. of Assessments)

**Automotive SPICE®**
- Common steering committee of German Car manufacturers
- Working groups for definition of unique Standards for the Automotive Domain

- Certification of SPICE-Assessors
- Events for SPICE (e.g. SPICE Days)
- GATE4SPICE

- Certification of Automotive SPICE®-Assessors
- further development of Automotive SPICE® by VDA Working Group 13

- Trainings provider for SPICE and Automotive SPICE®, e.g.

- Competence network (Meetings, Workshops, etc.) of the Community
- Working groups i.e. GATE4SPICE
LESSONS LEARNED AUS 10 JAHREN „SPICE“ BEI BMW.
GATE4SPICE-MEETING AM 19.09.2012 IN MÜNCHEN.

Quelle: intacs.info, Gate4SPICE Meeting 19.09.2012
History.

Milestones regarding SPICE®@BMW Group.

- 2002  BMW Group starts using SPICE-Assessments for supplier rating
- 2004  BMW Group published SPICE Level 3 in all processes of the HIS-Scope as goal for suppliers. Agreed improvement measures are mandatory for a nomination without achievement of the prescribed criteria.
- 2005  First release of Automotive SPICE®
- 2006  BMW Group performs assessments with Automotive SPICE® only
- 2007  100th BMW Group SPICE-Assessment
- 2008  German translation of Automotive SPICE® and Assessment-Process published by VDA
- 2009  Mapping of CMMI® → Automotive SPICE® presented by VDA
A correlation between product maturity and SPICE capability at BMW Group.

Examples for goal-oriented product maturity.

- Good example for goal-oriented product maturity
  - 90% of all errors found 11 month before SOP
  - 50% of all errors found 16 month before SOP
  - Goal-oriented product maturity value: 58%

- Bad example for goal-oriented product maturity
  - 90% of all errors found 2 month before SOP
  - 50% of all errors found 8 month before SOP
  - Goal-oriented product maturity value: 25%

Difference in product maturity: 9 month!
Higher process capability increases product maturity.

Result of correlation.

Identified Clusters

- **Cluster 1:** Low process capability, late product maturity.
- **Cluster 2:** Transition phase, project management incomplete, product maturity differs.
- **Cluster 3:** High process capability, early product maturity.

Clear correlation between goal-oriented product maturity and process capability.
Better Processes lead to better Quality

- Identical customer requirements specification
- Identical vehicle program
- Identical and interchangeable ECU
- Simultaneous development

The supplier with the higher process capability had...

- 40% less problems
- 70% lower defect rate
- 40% less severe problems to solve
- 30% less bug-fix releases

Martin Becker and Dirk Milosch, “Processes are Good for You – Beliefs and Facts”, VDA Automotive SYS Conference 2014
Supplier Qualification with SQILs / July 2014
Volkswagen’s rating of known automotive suppliers

- Quality is the key factor for
  - Customer satisfaction
  - Functional safety
  - Automotive security

Software quality is not well established at automotive suppliers for software centered systems
Key Users of Automotive SPICE®

Supplier Rating at the Volkswagen Group

Quality Capability of Supplier

QM-System according to VDA 6.1/ISO/TS16949 Precondition for A-Rating

- Process Audit
- Product Audit
- Evaluation of SW development processes

Rating (A,B,C) according to rating-model

92 – 100 % A – Rating
82 – 91 % B – Rating
0 – 81 % C – Rating

A – capable
B – capable under conditions
C – not capable

Software Assessment

Mapping SPiCE capability level to VW rating
- One process is on level 0 - C
- All processes fulfil level 1 - B
- All processes fulfil level 2 - A

Quality Performance

Deliveries show poor Q-performance (development and/or series)

Technical Revision SW

Classification of Q-performance according to the escalation programs:
“Critical Development Supplier”
“Critical Series Supplier”
“C”-rating at the highest escalation level

Supplier Rating
Key Users of Automotive SPICE®

Improvement Projects – Typical Scenario

- On-Site Reviews
- SW Quality Metrics

- Training
- Hands-on

Coach

Volkswagen SW-QA

Identifies Problems

- SW Assessment
- SW POT
- SW TR

Software Quality Improvement Leader (SQIL)

Selects

Monitor & Controls Improvements

Project Members of Supplier

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- Summary
Level 1: Why do we need a Traceability?

Advantages:

• Analysis of coverage (completeness)
• Information for queries (status of requirements)
• Support of test activities
• Support for the problem resolution (change and configuration management)
• Support for the impact analysis of change requests

Realization:

• Links (in Tools)
• References, Hyperlinks, Naming conventions
• Traceability matrices
1. Purpose

- Extent and granularity of traceability must balance value and maintenance effort.

2. Coverage

- 100% Traceability coverage often is unrealistic.
  - Consider taking a risk-based approach, e.g.
    - Local increase of change requests
    - Complexity
    - New technology
  - Document this as a strategy
  - Prove risk-based approach through metrics

3. Tooling

- Currently there is still no integrated tool solution.
Level 1: Plan – Do – Check – Act
... as part of Quality Assurance

SUP.1.BP1: Develop project quality assurance strategy. A project level strategy for conducting quality assurance is developed. This strategy is consistent with the organisational quality management strategy. [Outcome 1]

SUP.1.BP3: Develop and implement a plan for project quality assurance based on a quality assurance strategy. [Outcome 3]
NOTE 2: Quality assurance plan may contain quality assurance activities, a schedule of activities, assigned responsibilities, resources required, guidelines and quality standards for requirement, design, coding and testing work products.

SUP.1.BP7: Track and record quality assurance activities. Records of quality assurance activities are produced and retained. [Outcome 3, 4, 5]

SUP.1.BP8: Report quality assurance activities and results. Regularly report performances, deviations, and trends of quality assurance activities to relevant parties for information and action. [Outcome 5]

SUP.1.BP9: Ensure resolution on non-conformances. Deviations or non-conformance found in process and product quality assurance activities should be analyzed, corrected and further prevented. [Outcome 5]

SUP.1.BP10: Implement an escalation mechanism. Develop and maintain the escalation mechanism that ensures that quality assurance may escalate problems to appropriate levels of management to resolve them. [Outcome 6]
Level 2: Plan – Do – Check – Act

PA 2.1 Performance management

- It’s a measure of the extent to which the performance of the process is managed.

Generic Practices

GP 2.1.1 Identify the objectives for the performance of the process.
GP 2.1.2 Plan and monitor the performance of the process to fulfill the identified objectives.
GP 2.1.3 Adjust the performance of the process.
GP 2.1.4 Define responsibilities and authorities for performing the process.
GP 2.1.5 Identify and make available resources to perform the process according to plan.
GP 2.1.6 Manage the interfaces between involved parties.
Level 2: Plan – Do – Check – Act

GP 2.1.1 Objectives
GP 2.1.2 Strategy to achieve the objectives
GP 2.1.2 Detailed Planning
GP 2.1.2 Implementation of the Plan
GP 2.1.2 Monitoring / Reporting
GP 2.1.3 Corrective Actions / Escalation
Level 2: Templates, Checklists, Configuration Management, Review Techniques

Definition

PA 2.2 Work product management

- It’s a measure of the extent to which the work products produced by the process are appropriately managed.

Generic Practices

GP 2.2.1 Define the requirements for the work products.
GP 2.2.2 Define the requirements for documentation and control of the work products.
GP 2.2.3 Identify, document and control the work products.
GP 2.2.4 Review and adjust work products to meet the defined requirements.
Relationships inside Automotive SPICE®

**MAN.3** has influence on PA2.1 for all other processes, esp.
- GP 2.1.2 Plan and monitor the performance of the process to fulfill the identified objectives.
- GP 2.1.3 Adjust the performance of the process.
- GP 2.1.4 Define responsibilities and authorities for performing the process.
- GP 2.1.5 Identify and make available resources to perform the process according to plan.

**SUP.8** has influence on PA2.2 for all other processes, esp.
- GP 2.2.3 Identify, document and control the work products

**SUP.1** has influence on PA2.2 for all other processes, esp.
- GP 2.2.1 Define the requirements for the work products.
- GP 2.2.4 Review and adjust work products to meet the defined requirements.
Level 3: Standard Process

Definition

**PA 3.1 Process definition**
- It’s a measure of the extent to which a standard process is maintained to support the deployment of the defined process.

Generic Practices

**GP 3.1.1 Define the standard process** that will support the deployment of the defined process.

**GP 3.1.2 Determine the sequence and interaction** between processes so that they work as an integrated system of processes.

**GP 3.1.3 Identify the roles and competencies** for performing the standard process.

**GP 3.1.4 Identify the required infrastructure and work environment** for performing the standard process.

**GP 3.1.5 Determine suitable methods** to monitor the effectiveness and suitability of the standard process.
Level 3: Defined Process

Definition

PA 3.2 Process deployment

• It’s a measure of the extent to which the standard process is effectively deployed as a defined process to achieve its process outcomes.

Generic Practices

GP 3.2.1 Deploy a defined process that satisfies the context specific requirements of the use of the standard process.

GP 3.2.2 Assign and communicate roles, responsibilities and authorities for performing the defined process.

GP 3.2.3 Ensure necessary competencies for performing the defined process.

GP 3.2.4 Provide resources and information to support the performance of the defined process.

GP 3.2.5 Provide adequate process infrastructure to support the performance of the defined process.

GP 3.2.6 Collect and analyze data about performance of the process to demonstrate its suitability and effectiveness.
Relationships inside Automotive SPICE®

CL 1
Base Practices
Output Work Products

MAN.3
(Project Management)

(Sup Eng. Processes)
ENG.2
ENG.3
...
ENG.10

SUP.1
(Quality Assurance)

SUP.8
(Configuration Management)

CL2
Generic Practices (valid for all processes, i.e. ENG)

Performance Management

Work Product Management

CL3
Process Definition

Process Deployment

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Migration to Automotive SPICE® 3.0

Summary
Current Status (April 2015)

Withdrawn by ISO 03/03/2015
- 15504-2: Performing an assessment
- 15504-7: Assessment of organizational maturity

Withdrawn by ISO 03/03/2015
- 15504-3: Guidance on performing an assessment
- 15504-4: Guidance on use for process improvement capability assessment
- 15504-9: Target Project Profiles

Published by ISO as IS 27/02/2015
- 15504-5: An exemplar process assessment model
- 15504-6: An exemplar system lifecycle process assessment model
- 15504-8: An exemplar assessment model for IT service management

Published by ISO as TR 19/11/2013

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Measurement framework for the assessment of process capability and organizational maturity

**Changes:**

- PA 4.1 Quantitative analysis process attribute *1
- PA 4.2 Quantitative control process attribute *1
- PA 5.1 Process innovation process attribute *1
- PA 5.2 Process innovation implementation process attribute *1
*1 including revised process attribute outcomes

- Optional refinement of the ordinal scale *2
- Three different rating methods *2
- Different aggregation methods *2
*2 depending on the class of the assessment
The ordinal scale may be further refined for the measures P and L as defined below.

**P+ Partially achieved:**

There is some evidence of an approach to, and some achievement of, the defined process attribute in the assessed process. Some aspects of achievement of the process attribute may be unpredictable.

**P- Partially achieved:**

There is some evidence of an approach to, and some achievement of, the defined process attribute in the assessed process. Many aspects of achievement of the process attribute may be unpredictable.

**L+ Largely achieved:**

There is evidence of a systematic approach to, and significant achievement of, the defined process attribute in the assessed process. Some weaknesses related to this process attribute may exist in the assessed process.

**L- Largely achieved:**

There is evidence of a systematic approach to, and significant achievement of, the defined process attribute in the assessed process. Many weaknesses related to this process attribute may exist in the assessed process.

The corresponding percentages shall be:

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<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Percentage Range</th>
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<tr>
<td>P-</td>
<td>Partially achieved-</td>
<td>&gt;15% to ≤32.5% achievement</td>
</tr>
<tr>
<td>P+</td>
<td>Partially achieved+</td>
<td>&gt;32.5 to ≤50% achievement</td>
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<tr>
<td>L-</td>
<td>Largely achieved-</td>
<td>&gt;50% to ≤67.5% achievement</td>
</tr>
<tr>
<td>L+</td>
<td>Largely achieved+</td>
<td>&gt;67.5% to ≤85% achievement</td>
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Source: ISO/IEC 33020:2015
Automotive SPICE® Process Reference Model

The Symmetry in the “V” Model

Probably new HIS Scope, but not confirmed yet

Source: Automotive SPICE® PAM v3.0, July 16th, 2015, © VDA QMC
The “Plug-In” Concept

SYS = System Engineering
SWE = Software Engineering
HWE = Hardware Engineering
MEE = Mechanical Engineering

= developed by VDA, part of Automotive SPICE® 3.0
= not developed by VDA, not part of Automotive SPICE® 3.0 (but by intacs™ Working Groups)

Source: Automotive SPICE® PAM v3.0, July 16th, 2015, © VDA QMC
Consistent Usage of Terms – “Element”, “Component”, “Unit” and “Item”

Source: Automotive SPICE® PAM v3.0, July 16th, 2015, © VDA QMC
Consistent Usage of Terms – “Agree” and “Summarize and Communicate”

BP: „communicate agreed...“

SYS.2
System Requirements Analysis

SYS.3
System Architectural Design

SWE.1
Software Requirements Analysis

SWE.2
Software Architectural Design

SWE.3
Software Detailed Design and Unit Construction

BP: „summarize and communicate...“

SYS.5
System Qualification Test

SYS.4
System Integration and Integration Test

SWE.6
Software Qualification Test

SWE.5
Software Integration and Integration Test

SWE.4
Software Unit Verification

Source: Automotive SPICE® PAM v3.0, July 16th, 2015, © VDA QMC
Consistent Usage of Terms – “Strategy” and “Plan”

Affected Processes:
- SYS.4 System Integration and Integration Test
- SYS.5 System Qualification Test
- SWE.4 Software Unit Verification
- SWE.5 Software Integration and Integration Test
- SWE.6 Software Qualification Test
- SUP.1 Quality Assurance
- SUP.8 Configuration Management
- SUP.9 Problem Resolution Management
- SUP.10 Change Request Management

Source: Automotive SPICE® PAM v3.0, July 16th, 2015, © VDA QMC
“Bidirectional Traceability” and “Consistency”
“Evaluation”, “Verification Criteria”, “Compliance” and “Test”
Who is affected?

Project Teams and Companies/Organisations
- New structure of engineering processes
- Textual changes in all process descriptions
- Compliance to PAM(s)
- Sponsor decision

Assessors and Instructors
- Knowledge update
- Assessment competence
- Evaluation and mapping of evidences
- Training updates and timeline
Timeline for Certification and Qualification

- **Automotive SPICE(R) PAM v3.0 Release**: 16/7/2015
- **VDA Blue-Gold-Book with PAM Guidelines**: 30/9/2016
- **End of Transition Period**: 30/9/2017

**2015**
- **intacs PAM v3.0 Upgrade Course**
- **Updated intacs Assessor Courses**
- **Assessments with PAM V2.x accepted by VDA-QMC**: 1/1/2015 - 30/9/2017

**2016**
- **Assessments with PAM v3.0 accepted by VDA-QMC**: 17/7/2015 - 31/12/2017

**2017**
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Migration to Automotive SPICE® 3.0

Summary
Objectives of Automotive SPICE®

Developing products, which are
- traceable tested and which are
- managing the complex linkage of mechanic design, hardware and software
  (= „Systems“)

Processes which are
- really used and which are
- based upon best practices shared within the whole organization
  (= „Learning Organization“)

A product developing organization which is
- achieving measurable performance objectives and
- can react early on deviations

An optimized management of complex system releases.

Stable and faultless products which operate well.

Systematic and professional system and software engineering organization!
Level 3
PA.3.2 Process Deployment

Mindset to remember and reuse whatever was good

Level 2
PA.2.2 Work Product Management

Mindset to improve the project results

Level 1
PA.1.1 Process Performance

Craftsmanship in Software Engineering

Objectives are identified
Performance is planned and monitored
Performance is adjusted
Responsibilities and authorities are assigned
Resources are identified and made available
Interfaces are managed
Requirements for work products are defined
Requirements for documentation and control are defined
Review and adjust work products
Markets are identified, documented and controlled