Supplier Assessments by OEMs

Capability Levels in Automotive Software Development

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BMW Group

Supplier Assessments by OEMS.
Capability Levels in Automotive Software Development.

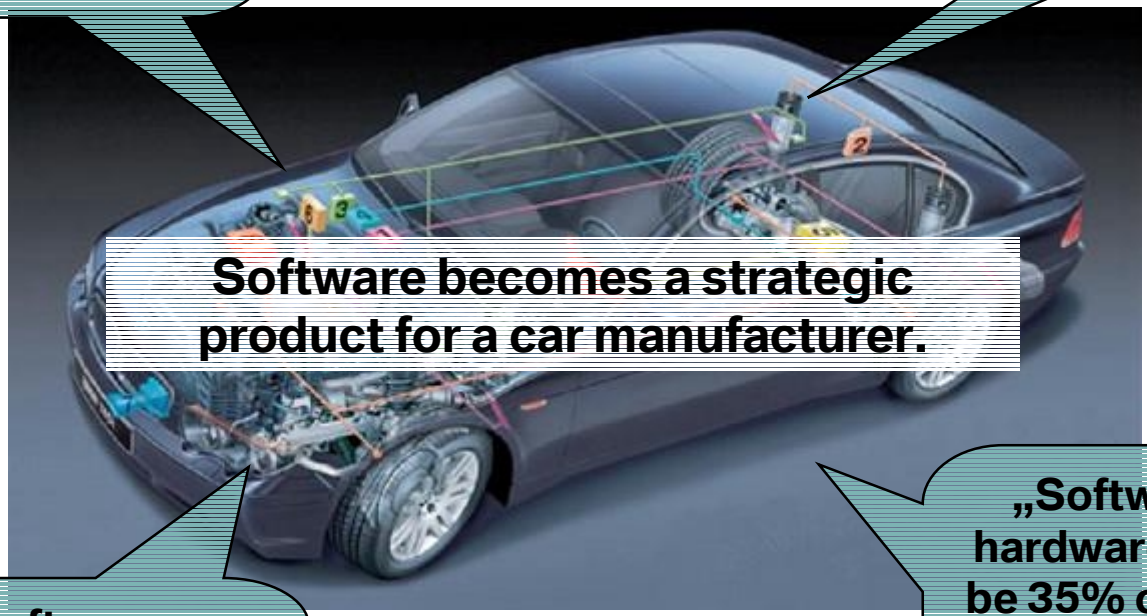
Content

Motivation.

Position of Electrics/Electronics in Car Development.

„90% of future innovations are based on software“

„Size of software doubles every 2-3 years“



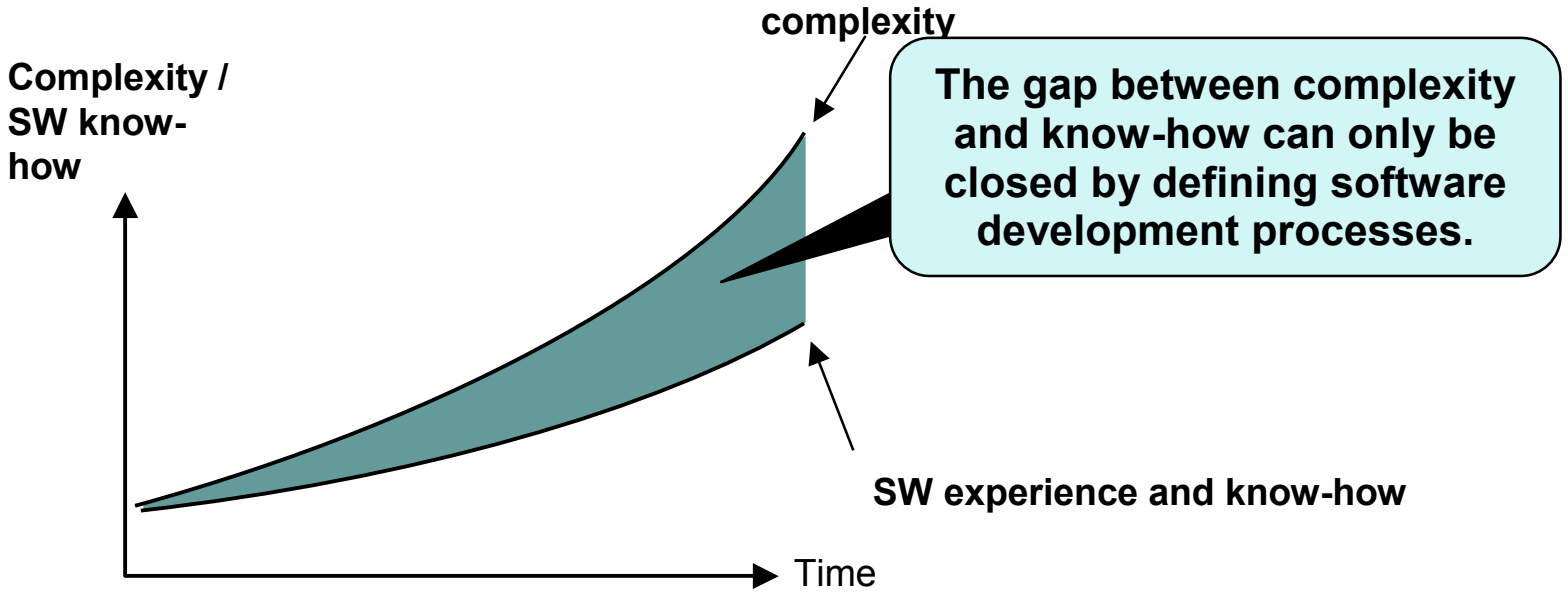
Software becomes a strategic product for a car manufacturer.

„Software development cost are 50 - 70% of the total development cost for ECUs“

„Software and hardware cost will be 35% of the total cost of production (2010)“

Motivation.
Increasing Complexity in Automotive Industry.

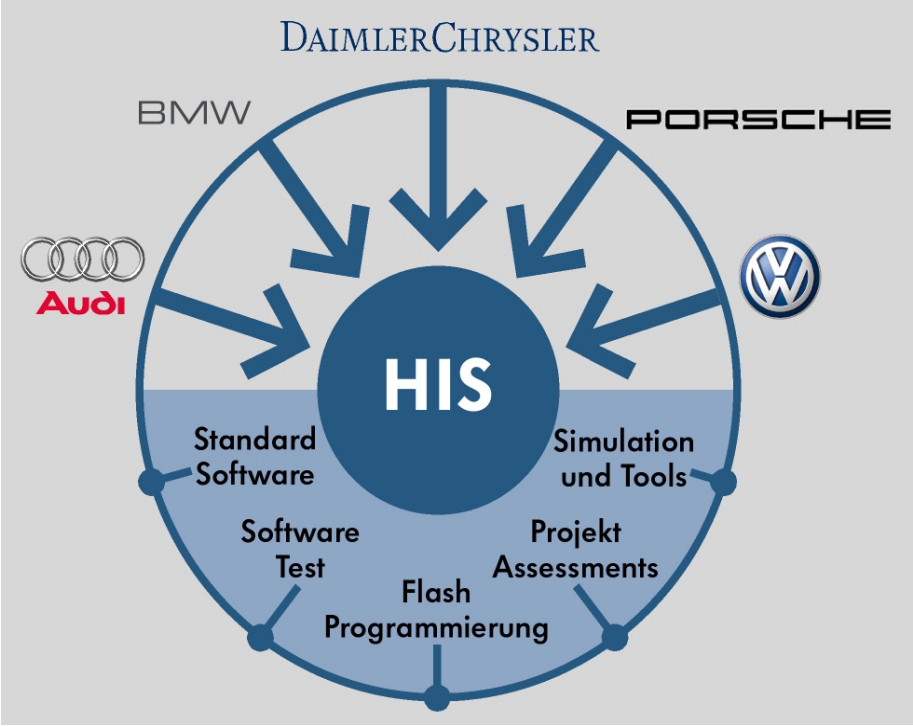
- Increasing complexity of automotive software systems.
- Relative small software experience in automotive industry.
- Defined software development processes have not yet been established until today.



- **To ensure well defined quality of software development processes, supplier assessments are performed.**

Manufacturer Interest Group Software HIS.
Motivation, Scope and Members.

- Members: Audi, BMW Group, DaimlerChrysler, Porsche, Volkswagen (agreement of the “E-Leiter” (= heads of development) in 2000).



- Goal: development of common standards to avoid heterogeneous requirements for suppliers.

HIS Working Group Assessments.
Objectives (1/2).

- Selection of a standardized assessment method which
  - is most appropriate to determine suppliers' software development process capability in automotive industry,
  - can be tailored in order to select a subset of processes most relevant to automotive industry and related to the sub-models of the V-model,
  - is based on an international standard and widely used in software community,
  - allows assessments for projects and organizations.

- Definition of a framework for exchanging assessment results in order to
  - objectively compare the capability of software development processes within divisions or product lines/areas (e.g. comfort product line) at the suppliers,
  - minimize or at least reduce the effort needed to perform an assessment for both OEMs and suppliers.

HIS Working Group Assessments.
Objectives (2/2).

- Definition of requirements for assessor qualification focused on automotive software (e.g. to accept 3rd party assessments).
- Transfer of experience and results of the HIS and its members to international working groups (AutomotiveSPICE) for further developments.

Introduction to ISO 15504 (“SPICE”).
Development of Software Maturity Models.

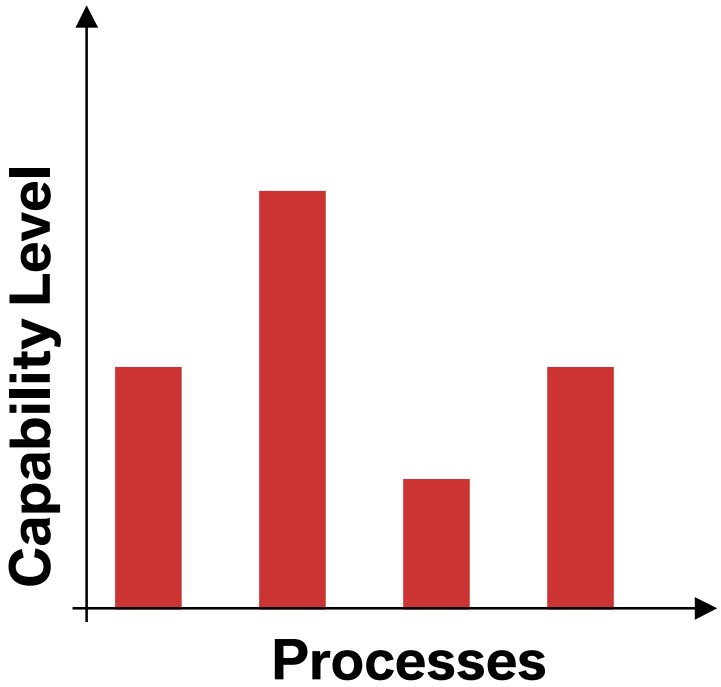
1987	ISO 9001 published Humphrey / Sweet Report from SEI
1990	Esprit Project No 5441, BOOTSTRAP started
1991	CMM version 1.0 published ISO requests a study on process assessment
1993	ISO accepts new work item on process assessment SPICE (Software Process Improvement and Capability Determination) Project started
1995	SPICE Documents (Working Draft) published
1997	BOOTSTRAP version 3.0 published
1998	ISO 15504 published
1998	CMMI first draft published
2001	CMMI stable version 1.1 published

Introduction to SPICE.
2-Dimensional Rating Scheme (1/2).

The reference model is two dimensional:

- **Process dimension**
  Describes processes grouped in categories (closely linked to ISO/IEC 12207).

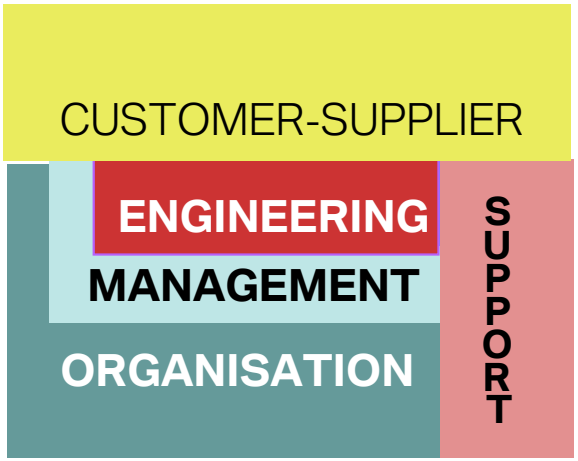
- **Capability dimension**
  Allows the capability of each process to be measured independently.



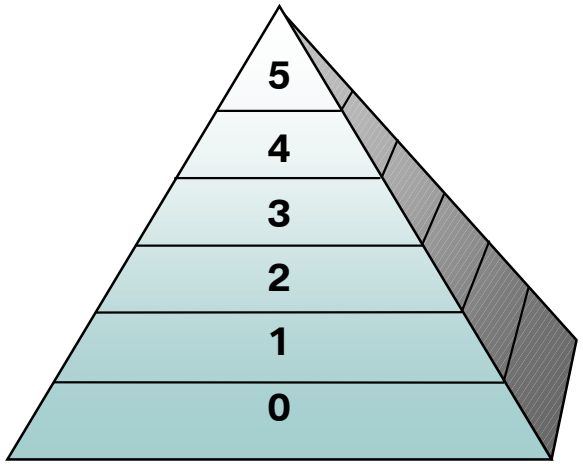
Introduction to SPICE.
Two-Dimensional Rating Scheme (2/2).

A two-dimensional rating scheme is used in ISO 15504 (SPICE) to determine the capability levels:

Process Dimension

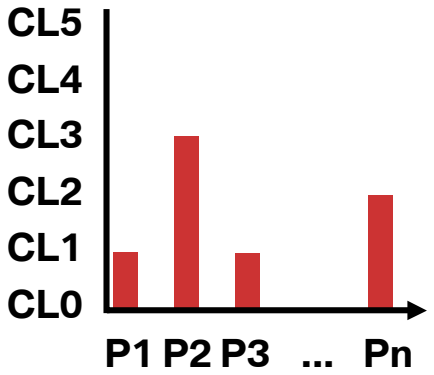


Capability Dimension



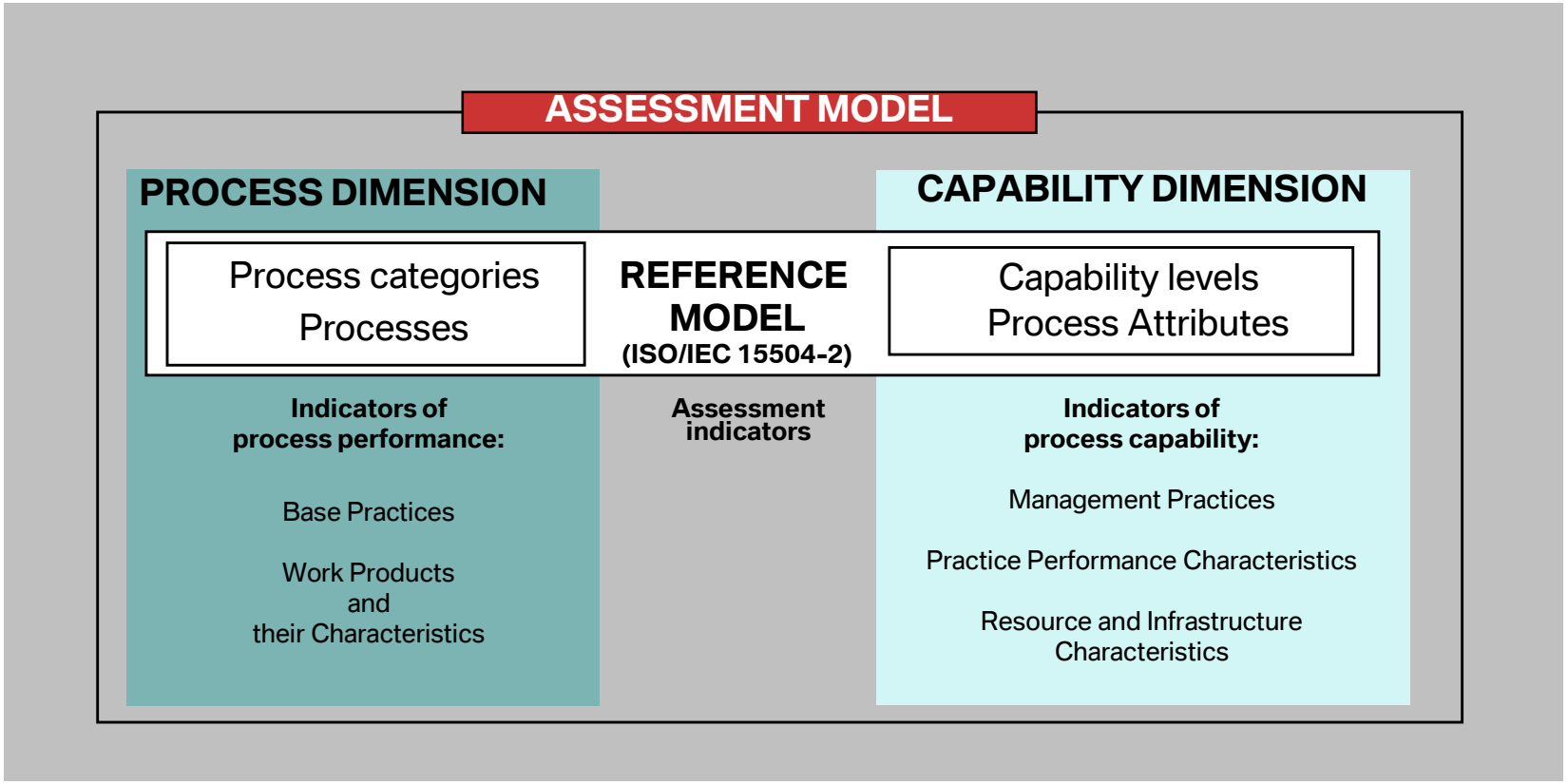
5: optimizing
4: predictable
3: established
2: managed
1: performed
0: incomplete

Two-dimensional Rating



Process Models in ISO 15504.

Assessment Model Enhances Process Reference Model.



- Process Reference Model of ISO 15504:1999 is now used as Reference Model in ISO 12207.
- Process Reference Model of ISO 15504:2004 is compatible with ISO 12207 AMD1/FDAM2.

ISO 15504 Process Dimension.

Overview of Defined Processes.

PRIMARY LIFE CYCLE PROCESSES

CUS.1	Acquisition
CUS.1.1	Acquisition Preparation
CUS.1.2	Supplier selection
CUS.1.3	Supplier monitoring
CUS.1.4	Customer acceptance
CUS.2	Supply
CUS.3	Requirements elicitation
CUS.4	Operation
CUS.4.1	Operational use
CUS.4.2	Customer support

ENG.1	Development
ENG.1.1	System requirements analysis and design
ENG.1.2	Software requirements analysis
ENG.1.3	Software design
ENG.1.4	Software construction
ENG.1.5	Software integration
ENG.1.6	Software testing
ENG.1.7	System integration and testing
ENG.2	System and software maintenance

SUPPORTING LIFE CYCLE PROC.

SUP.1	Documentation
SUP.2	Configuration management
SUP.3	Quality Assurance
SUP.4	Verification
SUP.5	Validation
SUP.6	Joint Review
SUP.7	Audit
SUP.8	Problem Resolution

ORGANISATIONAL LIFE CYCLE PROCESSES

MAN.1	Management
MAN.2	Project Management
MAN.3	Quality Management
MAN.4	Risk Management

ORG.1	Organisational alignment
ORG.2	Improvement process
ORG.2.1	Process establishment
ORG.2.2	Process assessment
ORG.2.3	Process improvement

ORG.3	Human resource management
ORG.4	Infrastructure
ORG.5	Measurement
ORG.6	Reuse

ISO 15504 Process Dimension.
HIS Process Scope.

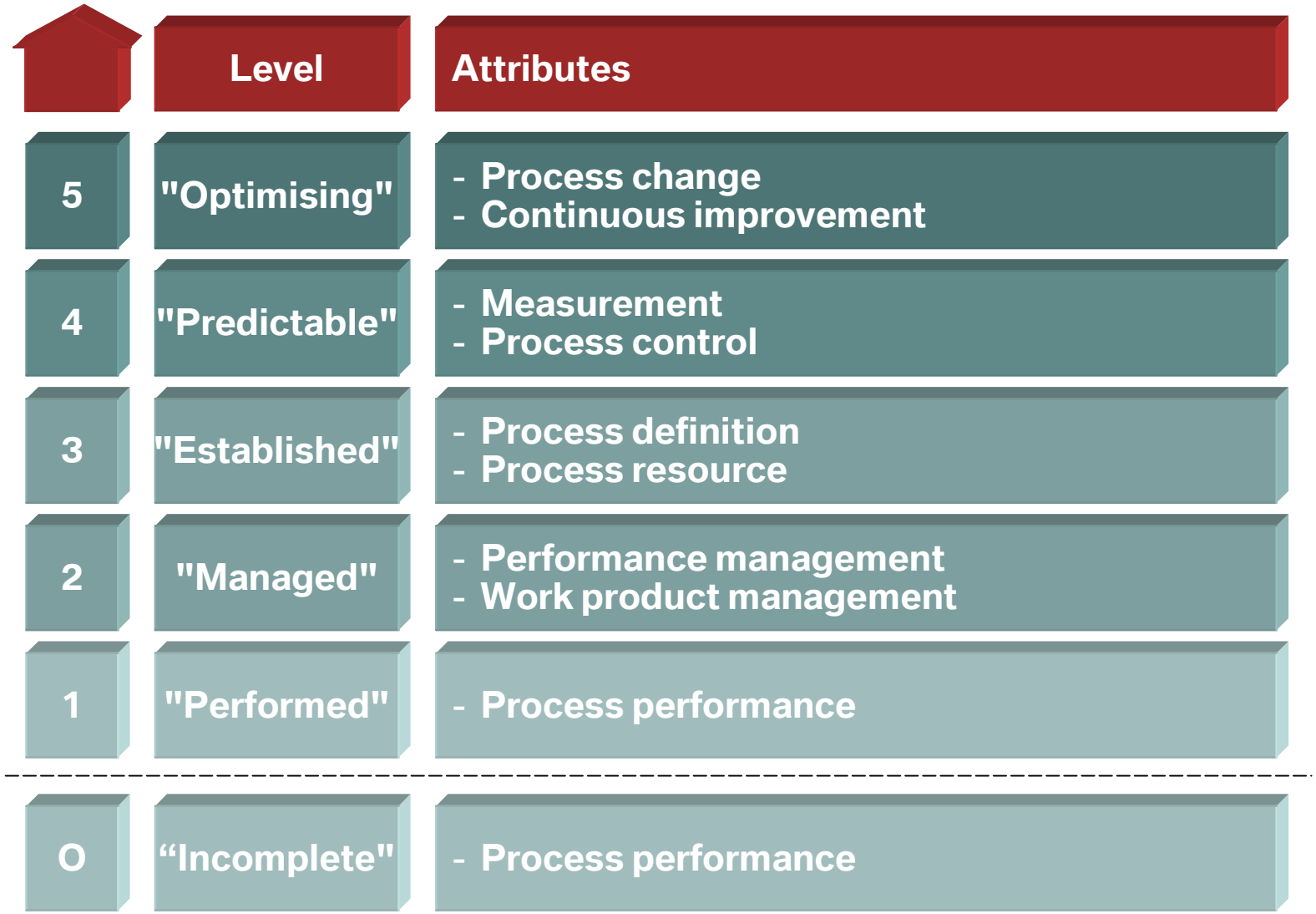
The following processes and sub-processes (agreed within HIS) are always assessed:

- ENG Engineering
  - ENG.1.1 System Requirements Analysis and Specification
  - ENG.1.2 Software Requirements Analysis
  - ENG.1.3 Software Design
  - ENG.1.4 Software Construction
  - ENG.1.5 Software Integration
  - ENG.1.6 Software Testing
  - ENG.1.7 System Integration and Testing
- MAN Management
  - MAN.2 Project Management
- SUP Support
  - SUP.2 Configuration Management
  - SUP.3 Quality Assurance
  - SUP.8 Problem Resolution
- CUS Customer-Supplier
  - CUS.1.3 Supplier Monitoring (optional)

Further processes from the ENG, SUP, MAN, ORG and CUS areas can be evaluated, if required.

ISO 15504 Capability Dimension.

Process Attributes serve the Assessment of Capability Levels.

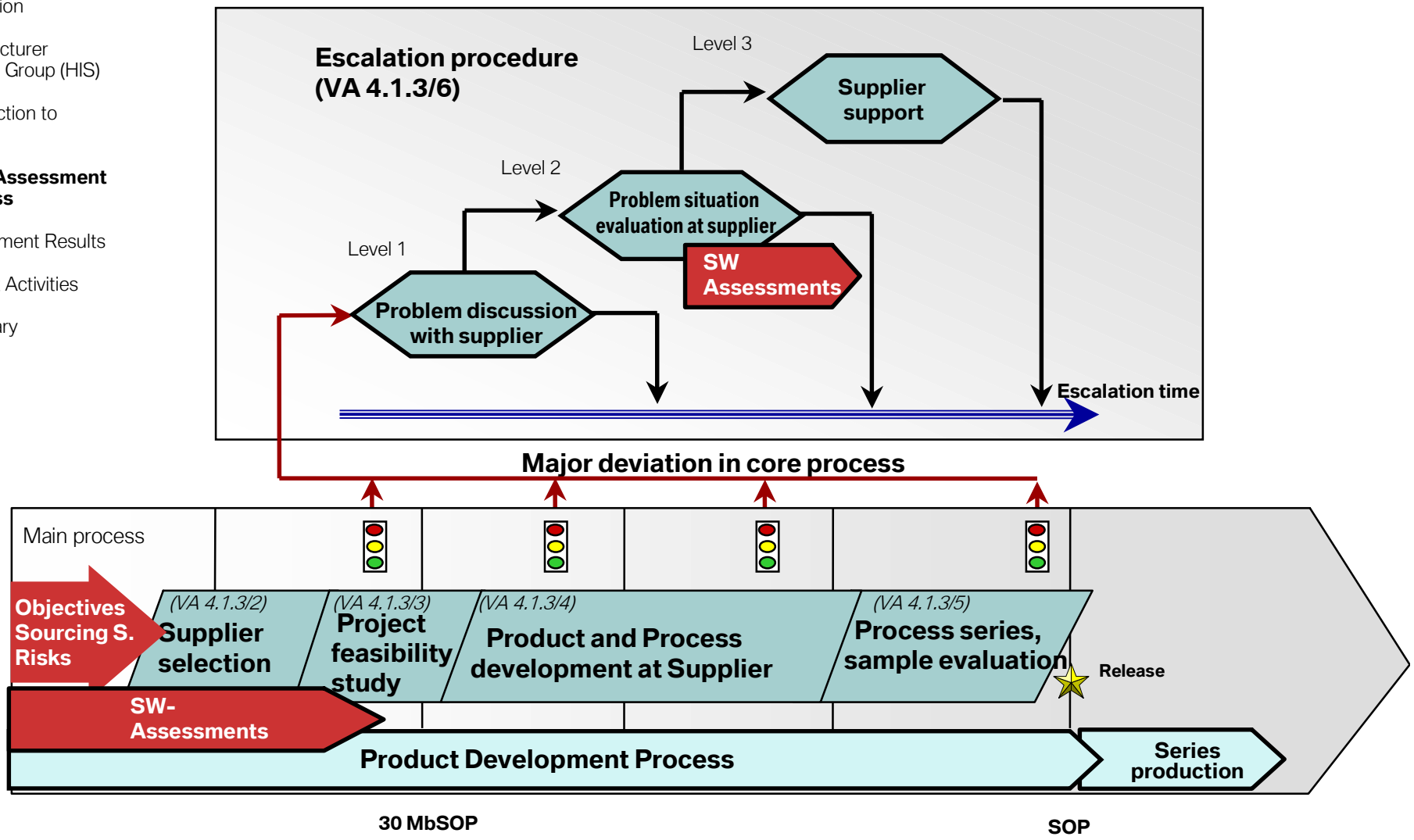


BMW Assessment Process.
Objectives.

- Assessment of the supplier software development processes based on a standardized method.
- Ongoing projects are used to assess the present processes of a supplier's organisational unit.
- Assessment results are used
  - for identification of potential improvement in the assessed project (short term),
  - as one indicator for supplier selection (development of components or sub-systems) in new projects,
  - for the future strategic positioning of suppliers in the BMW Group partner network management.

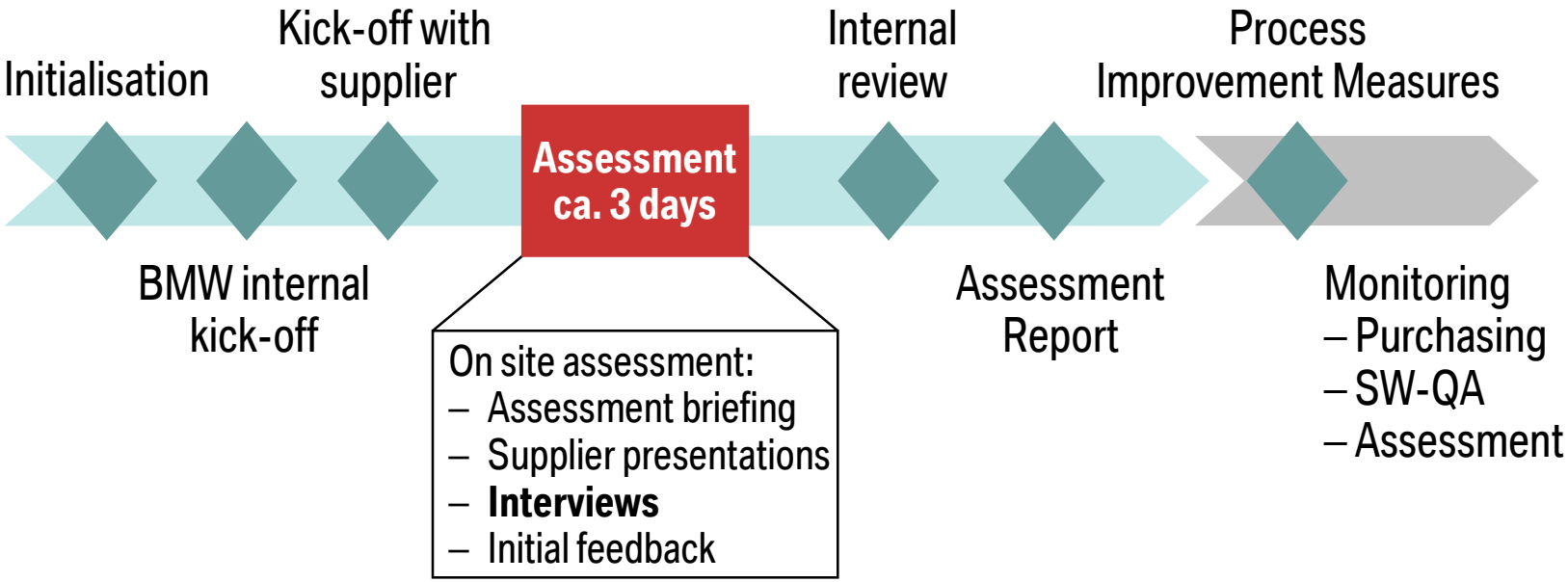
BMW Assessment Process.

Integration in BMW Group Supplier Parts Management.



BMW Assessment Process.

Steps in the Assessment Process.

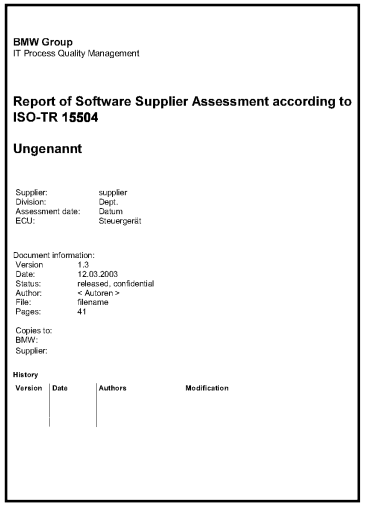


Assessment Prerequisites:

- Non disclosure agreement
- Data analysis
- Assessment schedule

Software assessments: Results (1)

Detailed Assessment Results in the Assessment Report



BMW Group
IT Process Quality Management

Report of Software Supplier Assessment according to ISO-TR 15504

Ungenannt

Supplier: supplier
Division: Dept.
Assessment date: Datum
ECU: Steuergerät

Document information:
Version 1.2
Date: 12.03.2003
Status: released, confidential
Author: < Autoren >
File: filename
Pages: 41

Copies to:
BMW:
Supplier:

History

Version	Date	Authors	Modification

- **Detailed information** provided for each assessed process:
  - Strengths and weaknesses.
  - Deviations from the assessment model requirements taking into account base and management practices.
- **Summary**
- **Staged evaluation of the capability levels:**
  - Assessment of each specific base and management practice using the NPLF-Logic.
  - Evaluation of process attributes.
  - Achieved capability levels.

Software Assessments: Results (2)

Capability Level of the Assessed Processes

	Maturity Level	1	2		3		4		5	
	Process attribute	PA 1.1	PA 2.1	PA 2.2	PA 3.1	PA 3.2	PA 4.1	PA 4.2	PA 5.1	PA 5.2
MAN.2	Project Management									
ENG.1.1	System Requirements Anal. and Dev.									
ENG.1.2	Software Requirements Analysis									
ENG.1.3	Software Design									
ENG.1.4	Software Construction									
ENG.1.5	Software Integration									
ENG.1.6	Software Testing									
ENG.1.7	System Integration and Testing									
SUP.2	Configuration Management									
SUP.3	Quality Assurance									
SUP.8	Problem Resolution									
CUS.1.3	Supplier Monitoring									

Capability level:
0: incomplete
1: performed
2: managed
3: established
4: predictable
5: optimizing

PA 1.1: Process Performance
PA 2.1: Performance Management
PA 2.2: Work Product Management
PA 3.1: Process Definition
PA 3.2: Process Resource

PA 4.1: Measurement
PA 4.2: Process control
PA 5.1: Process change
PA 5.2: Continuous improvement

F: fully (86% - 100%)
L: largely (51% - 85%)
P: partially (16% - 50%)
N: not achieved (0% - 15%)
[ ]: not assessed

Software Assessments: Results (3)

Evaluation of Process Attributes (Example)

	Maturity Level	1	2		3		4		5	
	Process attribute	PA 1.1	PA 2.1	PA 2.2	PA 3.1	PA 3.2	PA 4.1	PA 4.2	PA 5.1	PA 5.2
MAN.2	Project Management	L	L	L						
ENG.1.1	System Requirements Anal. and Dev.	L	L	L						
ENG.1.2	Software Requirements Analysis	F	F	F	P	N				
ENG.1.3	Software Design	L	L	L						
ENG.1.4	Software Construction	F	L	F	N	P				
ENG.1.5	Software Integration	L	L	P						
ENG.1.6	Software Testing	F	F	L						
ENG.1.7	System Integration and Testing	P	P	P						
SUP.2	Configuration Management	P	P	N						
SUP.3	Quality Assurance	P	P	N						
SUP.8	Problem Resolution	L	N	N						
CUS.1.3	Supplier Monitoring	F	L	F	N	P				

Capability level:
0: incomplete
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PA 1.1: Process Performance
PA 2.1: Performance Management
PA 2.2: Work Product Management
PA 3.1: Process Definition
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PA 4.2: Process control
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PA 5.2: Continuous improvement

F: fully (86% - 100%)
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[ ]: not assessed

Software Assessments: Results (4)

Base and Management Practices

Example: ENG.1.4 – Software construction

Rating of base practices:

	Base Practices		Rating
	ENG.1.4.BP1	Develop software units.	L
	ENG.1.4.BP2	Develop unit verification procedures.	F
	ENG.1.4.BP3	Verify the software units.	F
	ENG.1.4.BP4	Establish traceability.	L
	Total rating of base practices		**F**

Rating of management practices:

Process Attribute	Rating	Management Practice		Rating
PA 1.1		MP 1.1.1	Identification of work products	F
		MP 1.1.2	Identify scope of work	F
		MP 1.1.3	Ensure base pratices	F
	F			F
PA 2.1		MP 2.1.1	Identify objectives	L
		MP 2.1.2	Plan Process	L
		MP 2.1.3	Assign resposibilities	P
		MP 2.1.4	Tracking performance	P
	L			L
PA 2.2		MP 2.2.1	Identify requirements	L
		MP 2.2.2	Manage configuration	F
		MP 2.2.3	Identify dependencies	F
		MP 2.2.4	Manage Quality	F
	F			F
PA 3.1		MP 3.1.1	Identify standard process	P
		MP 3.1.2	Tailor standard process	P
		MP 3.1.3	Gather performance data	N
		MP 3.1.4	Establish understanding	P
		MP 3.1.5	Refine process	N
	N			N
PA 3.2		MP 3.2.1	Identify Roles, Responsibilities	P
		MP 3.2.2	Identify Infrastructure	L
		MP 3.2.3	Provide Resources	P
		MP 3.2.4	Provide Infrastructure	P
	P			P

Experiences gained in past Assessments.
Typical Results.

- **Engineering processes:**
  - "Traceability" is almost never implemented.
  - Unit tests are not in the scope of Software Construction.
  - Mostly detailed design is incomplete, e.g. only available for complex or new units.
- **Project management:**
  - Planning is performed on a very rough level.
  - Project tracking is very informal.
  - Often weaknesses in the coordination of sub-projects.
  - Mostly only a milestone "planning" is established, the planning of resources is often missing.
- **Software Quality Assurance:**
  - Implemented only by few suppliers.
  - Software Quality Assurance is not in the scope of the traditional Quality Assurance.
- **Configuration Management:**
  - Project file structure inadequate to project size.
  - In the majority of cases only source code is under configuration management.
  - Baselines are hardly ever planned.

Present Activities of OEMs.
Exchange of Assessment Results in HIS.

- The HIS members signed an agreement in February 2004 for exchanging abridged assessment results.
- Exchange process:
  - An abridged assessment report is handed over to the assessed supplier. It only contains the NPLF rating of base practices, management practices and process attributes and the capability levels of each assessed process.
  - Only the supplier is allowed to pass on the abridged assessment report to other HIS members. The decision is up to the supplier.
  - The HIS members exchange their assessment plans on a regular basis.

Present Activities of OEMs.
Definition of AutomotiveSPICE User Group.

- A new assessment model is under development in the AutomotiveSPICE User Group based on ISO 15504:2004 (Core members: AUDI, BMW Group, DaimlerChrysler, Fiat, Porsche, PSA, Volkswagen, Volvo).
- The Process Reference Model is going to be published soon.
- The Process Assessment Model is under review. A guideline to AutomotiveSPICE with tailoring hints will be prepared.
- A proposal is under discussion with the VDA-QMC regarding how to include the VDA in the work of the AutomotiveSPICE User Group. Possible topics are e.g.
  - Preparation of a German Version of AutomotiveSPICE,
  - Training for suppliers.

AutomotiveSPICE Process Reference Model.

Process Dimension based on ISO 15504:2004.

PRIMARY PROCESSES

Acquisition Group

ACQ.1	Acquisition preparation
ACQ.2	Supplier selection
ACQ.3	Supplier monitoring
ACQ.4	Customer acceptance
ACQ.10	Contract agreement
ACQ.11	Technical requirements
ACQ.12	Legal and administrative requirements
ACQ.13	Project requirements
ACQ.14	Request for proposals
ACQ.15	Supplier qualification

Supply Group

SUP.1	Supplier tendering
SUP.2	Contract establishment
SUP.3	Software release
SUP.4	Software acceptance support

Engineering Group

ENG.1	Requirement elicitation
ENG.2	System requirements analysis
ENG.3	System architectural design
ENG.4	Software requirements analysis
ENG.5	Software design
ENG.6	Software construction
ENG.7	Software integration
ENG.8	Software testing
ENG.9	Software installation
ENG.10	System integration
ENG.11	System testing
ENG.12	System & software maintenance

Operation Group

OPE.1	Operational use
SUP.2	Customer support

SUPPORTING PROCESSES

Configuration Control Group

CFG.1	Documentation management
CFG.2	Configuration management
CFG.3	Problem management
CFG.4	Change request management

Quality Assurance Group

QUA.1	Quality assurance
QUA.2	Verification
QUA.3	Validation
QUA.4	Joint reviews
QUA.5	Audit

Product Quality Group

PRO.1	Usability
PRO.2	Product evaluation

ORGANISATIONAL PROCESSES

Management Group

MAN.1	Organizational alignment
MAN.2	Organization management
MAN.3	Project management
MAN.4	Quality management
MAN.5	Risk management
MAN.6	Measurement

Process Improvement Group

PIM.1	Process establishment
PIM.2	Process assessment
PIM.3	Process improvement

Reuse Group

REU.1	Asset management
REU.2	Reuse program management
REU.3	Domain engineering

Resource and Infrastructure Group

RIN.1	Human resource management
RIN.2	Training
RIN.3	Knowledge management
RIN.4	Infrastructure

Supplier Assessments by OEMS.
Summary.

- Supplier assessments are performed by almost all manufacturers.
- Assessments results are used for supplier selection and supplier classification.
- Assessment results point out that software development processes have been ignored by most suppliers in the past.
- An agreement signed between the HIS members allows the exchange of abridged assessment reports through the assessed supplier.
- AutomotiveSPICE is soon going to be released:
  - The Process Reference Model is about to be published.
  - The Process Assessment Model is available as second draft.

Thank you for your attention.