

Design Collaboration Between OEMs and Electronics Suppliers.



Dr. Julian Weber, BMW Group

IEEE EMC Society

Advances in Automotive EMC Test and Design

International Center for Automotive Research

Clemson University

March 12, 2008

BMW Group



Design Collaboration Between OEMs and Electronics Suppliers.

Agenda.

Partnering with the BMW Group

International Co-operation

Supplier Management

AUTOSAR – Standard System Architecture

Ensuring EMC Conformance

Mutual Expectations

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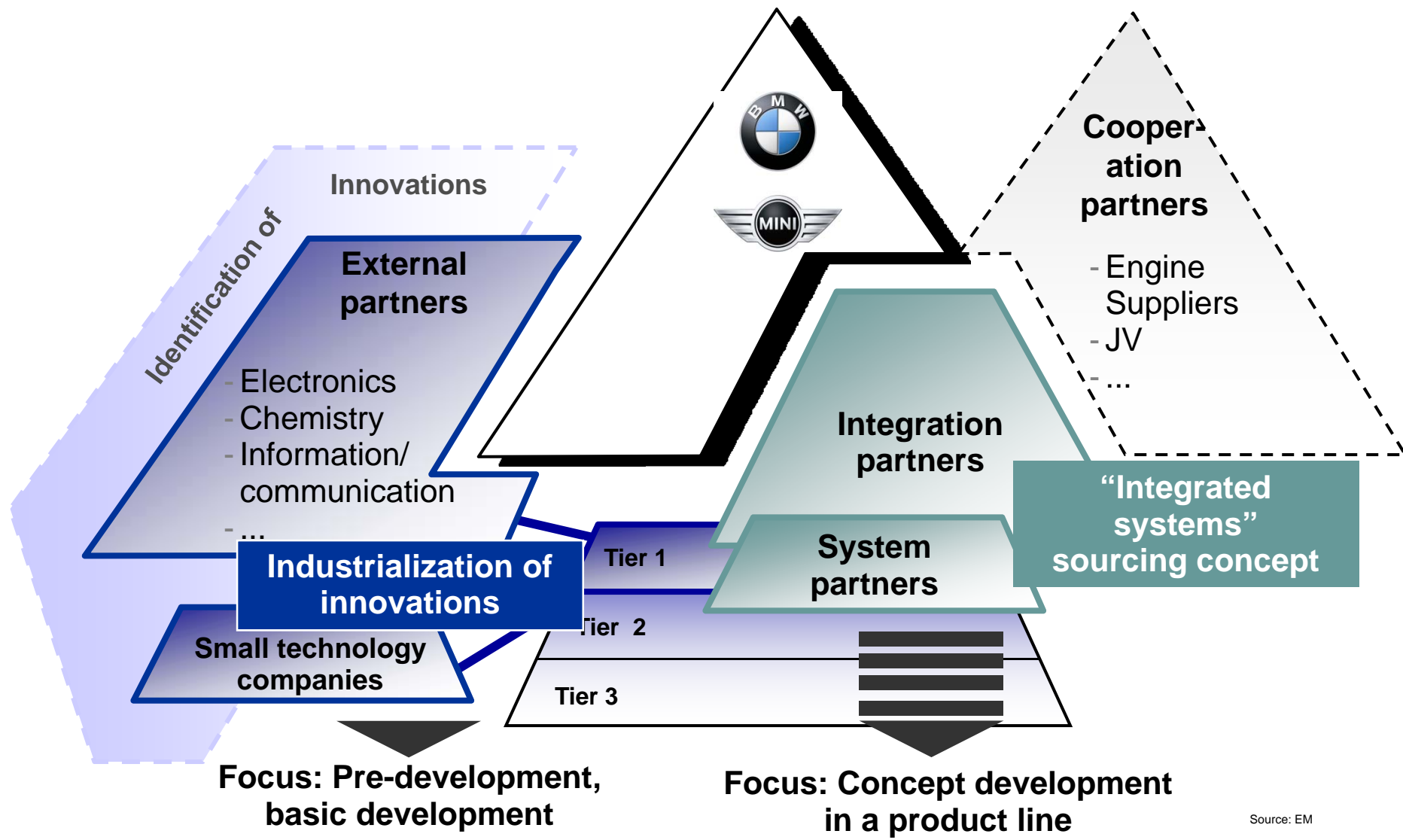
AUTOSAR – Standard System Architecture

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Mutual Expectations

Partnering with the BMW Group.

Models of Co-operation.



Partnering with the BMW Group.

Categories of Suppliers.

1. Core Suppliers

- ▶ Best-in-class in innovation, product development and process control
- ▶ Long-term relationships or common market interests with BMW
- ▶ Ongoing delivery of product and process innovations

2. Concept Suppliers

- ▶ Focus on innovation potential and project management experience
- ▶ Selection based on concept completeness and ability to deliver

3. Series Development Suppliers

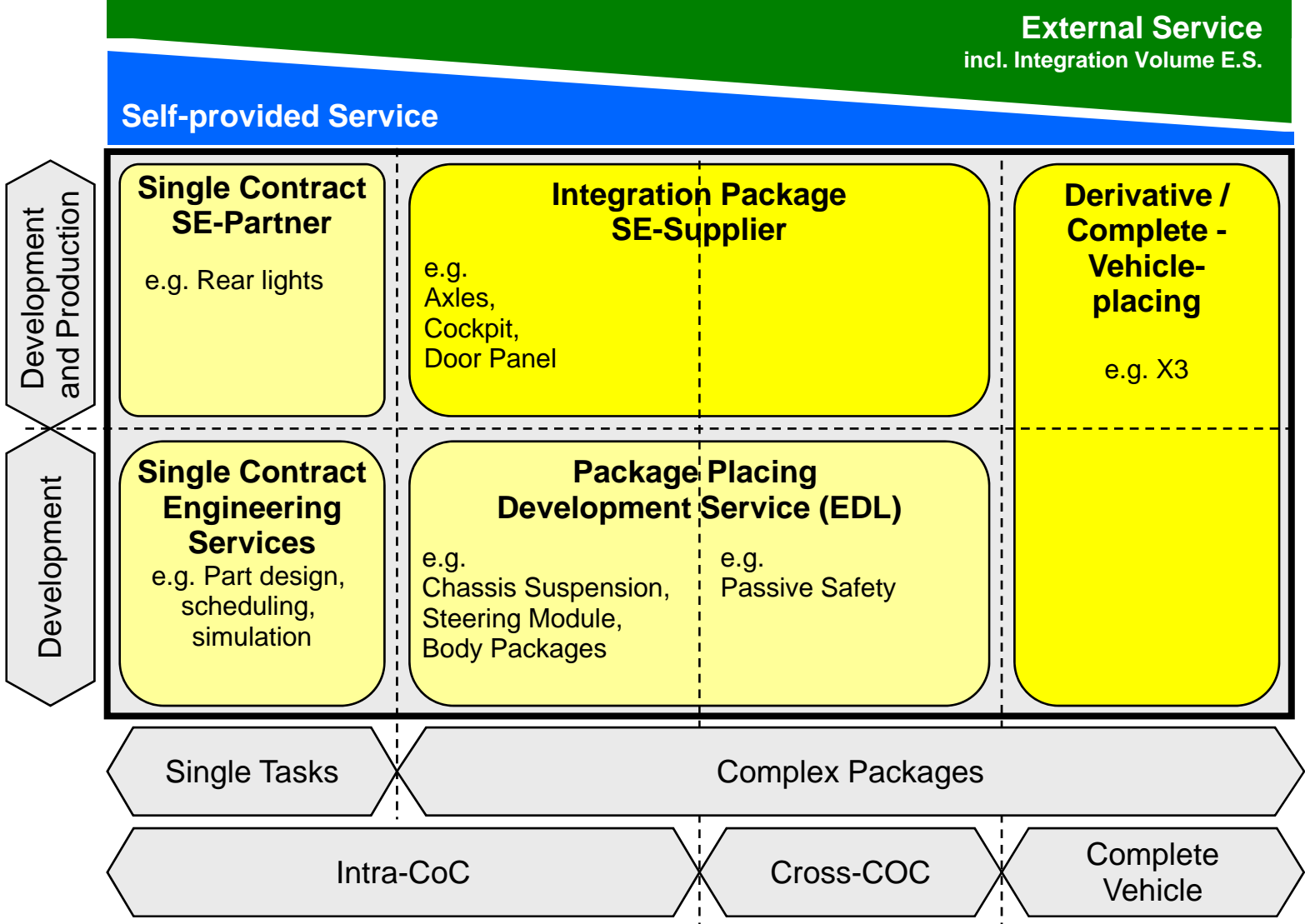
- ▶ Responsible for the successful implementation of existing concepts

4. Market Suppliers

- ▶ Responsible for standard parts
- ▶ Priority on cost leadership

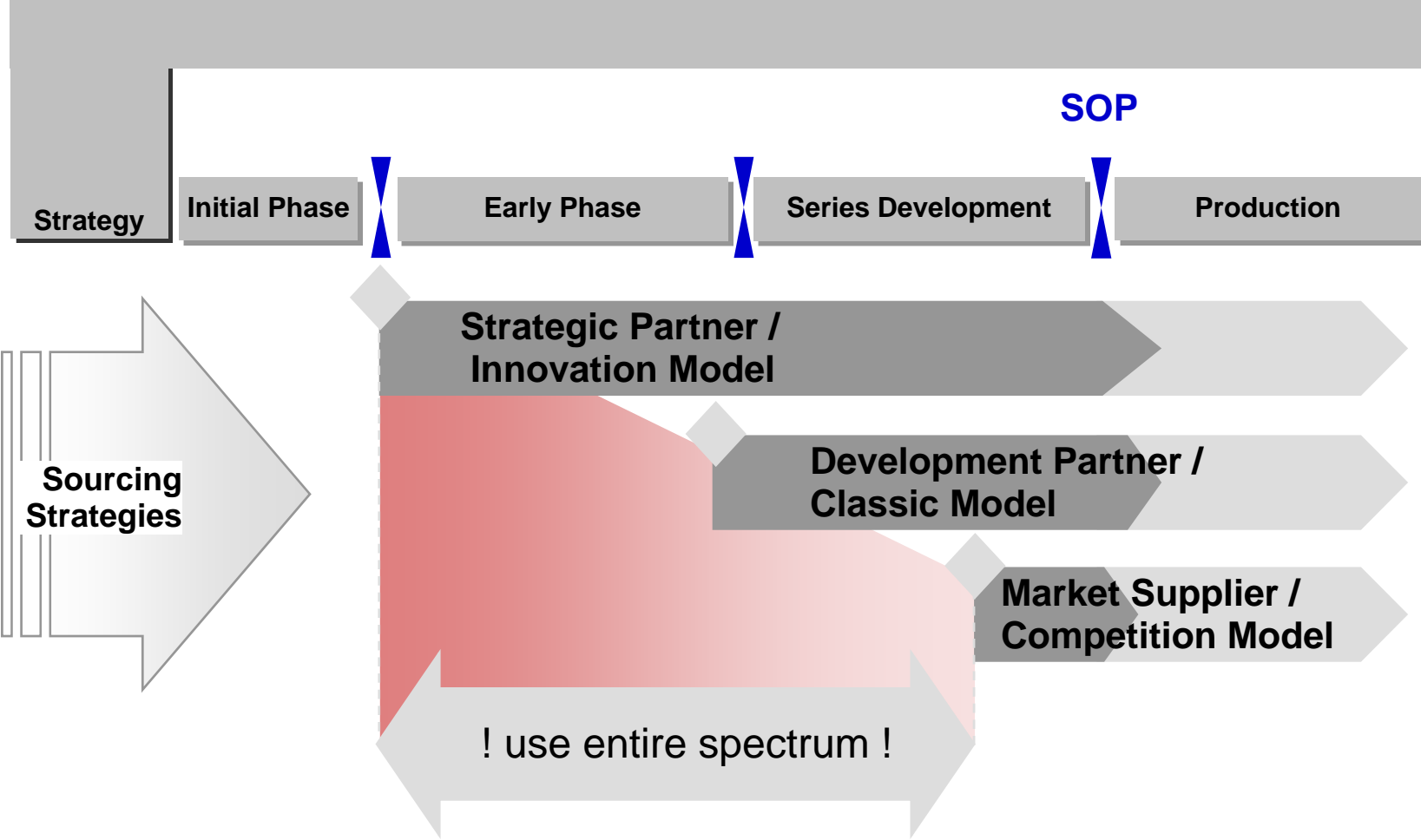
Partnering with the BMW Group.

Categories of Engineering Service Providers.



Partnering with the BMW Group.

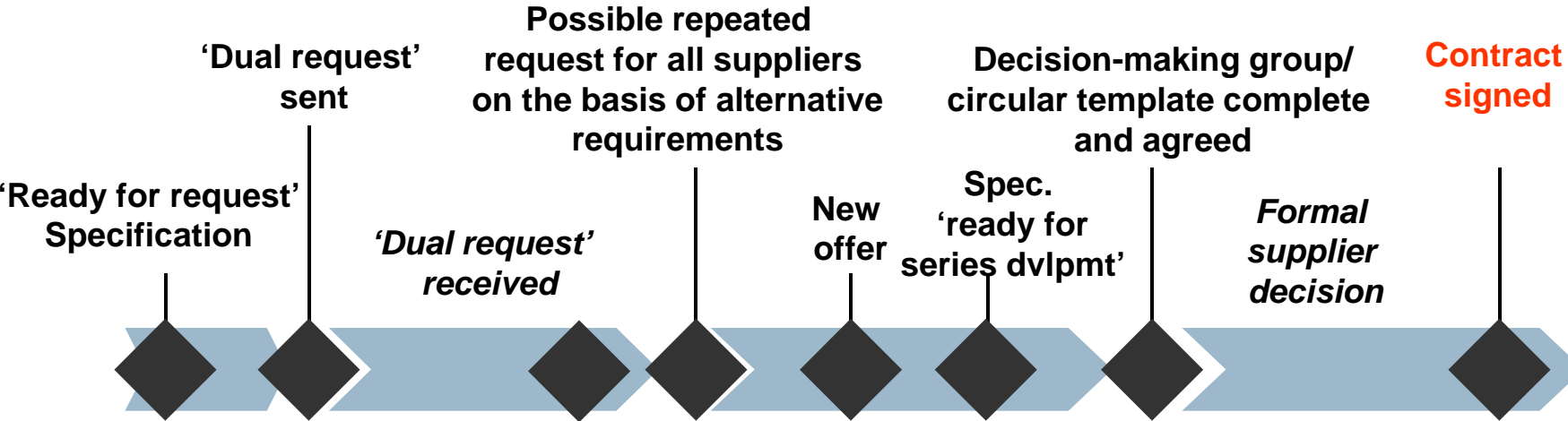
Partner Nomination.



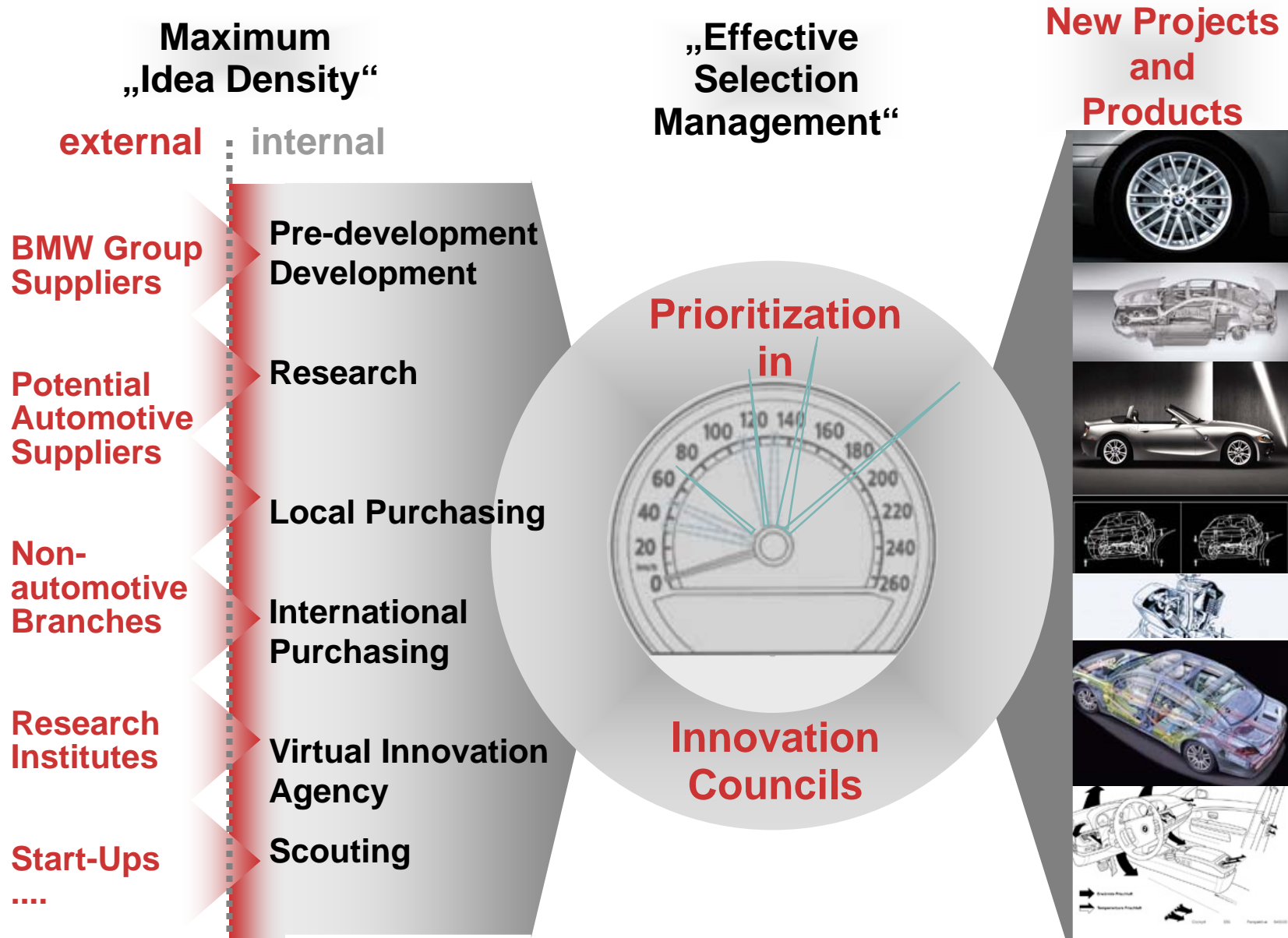
Caption:  Nomination  Development  Delivery

Partnering with the BMW Group.

Supplier Integration: Nomination Process.



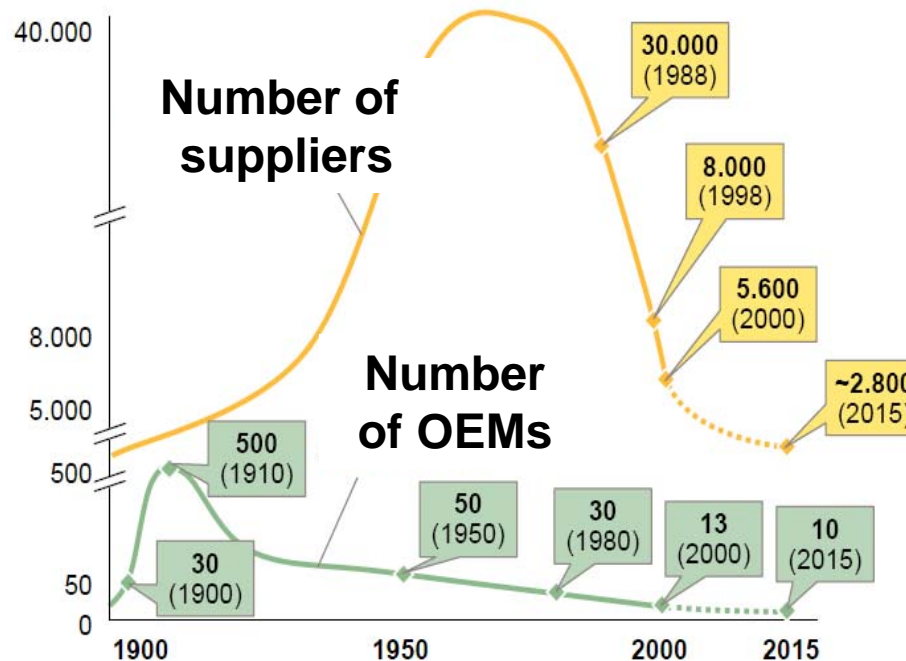
Partnering with the BMW Group. Innovation Management.



Partnering with the BMW Group.

Future Trends: Tightening of the Market.

Number of independently operating companies



Quelle: Automobilproduktion, University of London, Mercer Analyse

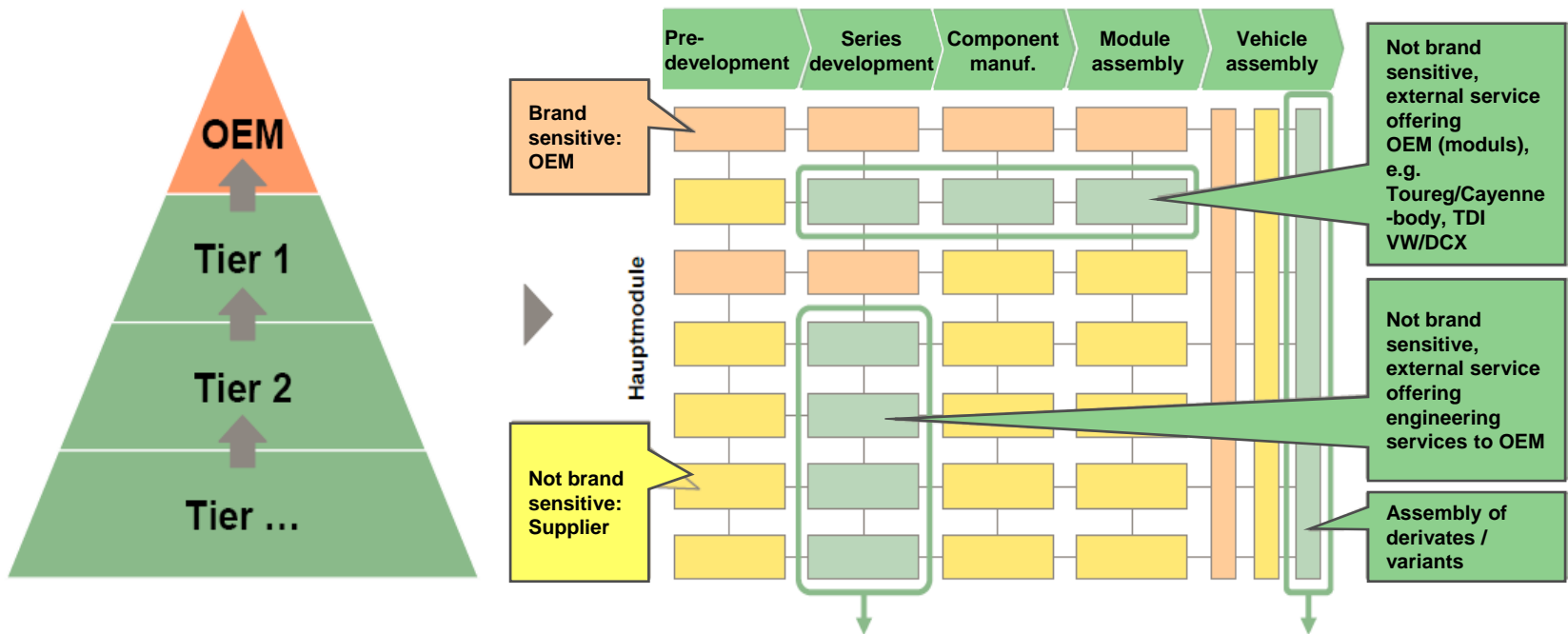
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Comments

- ▶ Balanced market allocation expected (Mega Supplier)
- ▶ Modified placing/demand of OEMs: complete packages / modules for supplier
- ▶ New “quality” demanded from supplier
 - Extended product- and performance spectrum
 - New concepts
 - Additional resources
 - Supraregional business connection
- ▶ Continuous value added strategy for suppliers as well

Partnering with the BMW Group.

Future Trends: New Ways of Collaboration.

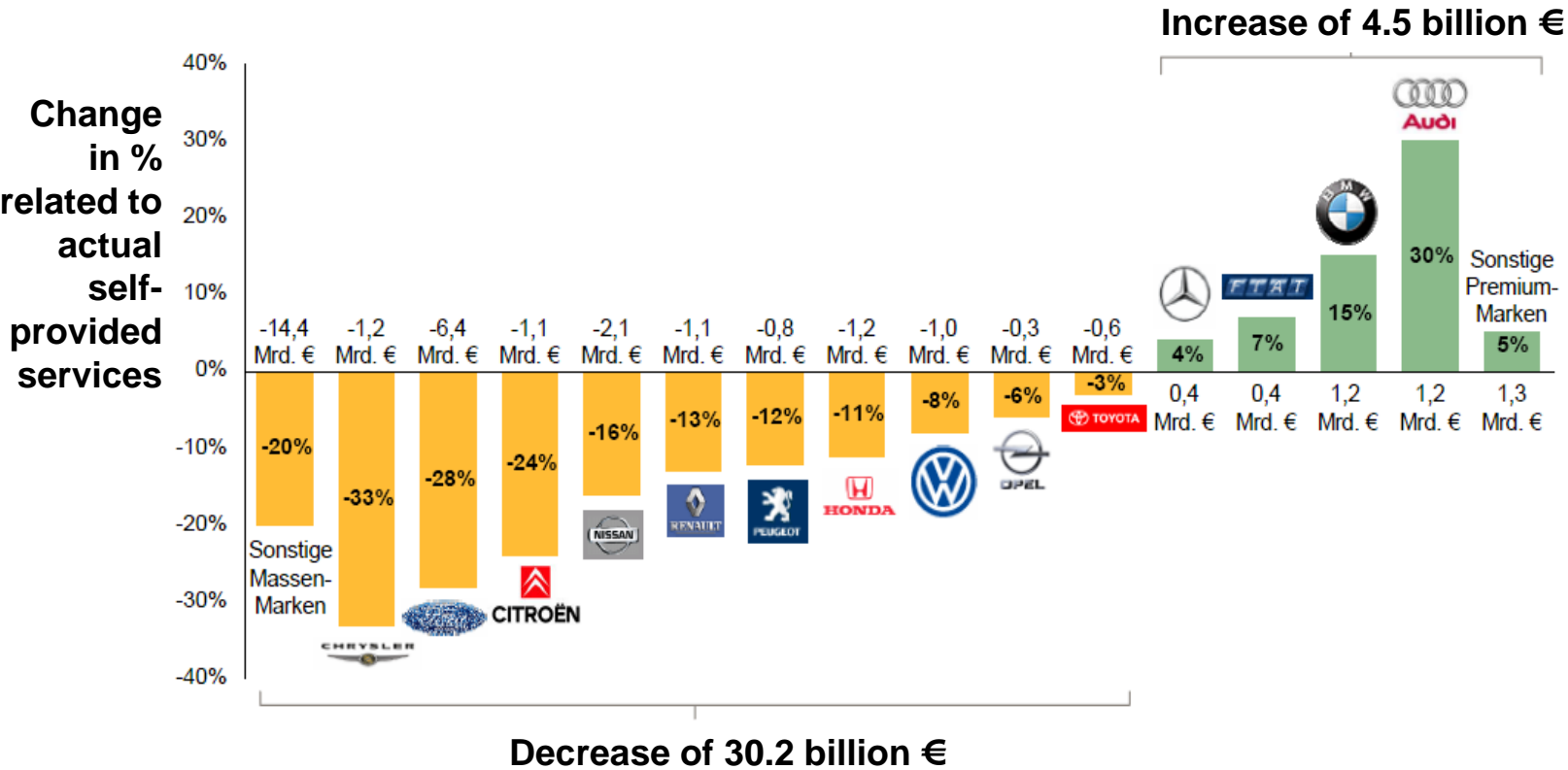


- Output OEM: cars
 - Inflexible, hierarchical value-added process
 - Distinct role allocation OEM - supplier
- Output OEM: cars, modules, services
 - Shared advantages for both partners
 - New roles in cooperation between OEM - OEM, supplier - supplier, supplier - OEM

Partnering with the BMW Group.

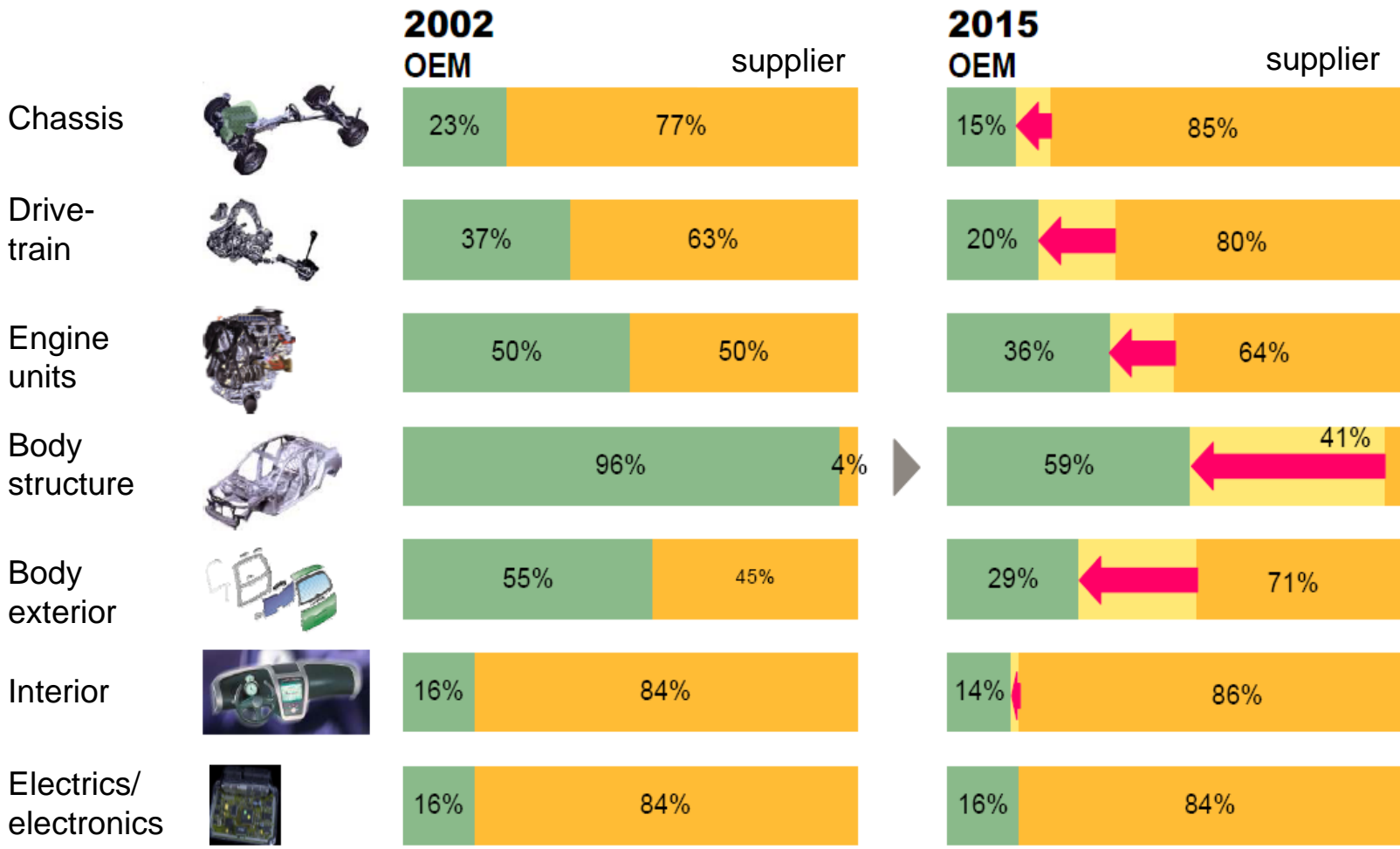
Future Trends: Changes in Internal Activities.

Development (increase/decrease) of self-provided services per brand (total).
(Delta 2015 vs. 2002)



Partnering with the BMW Group.

Future Trends: Shifts in the Value-added Process.



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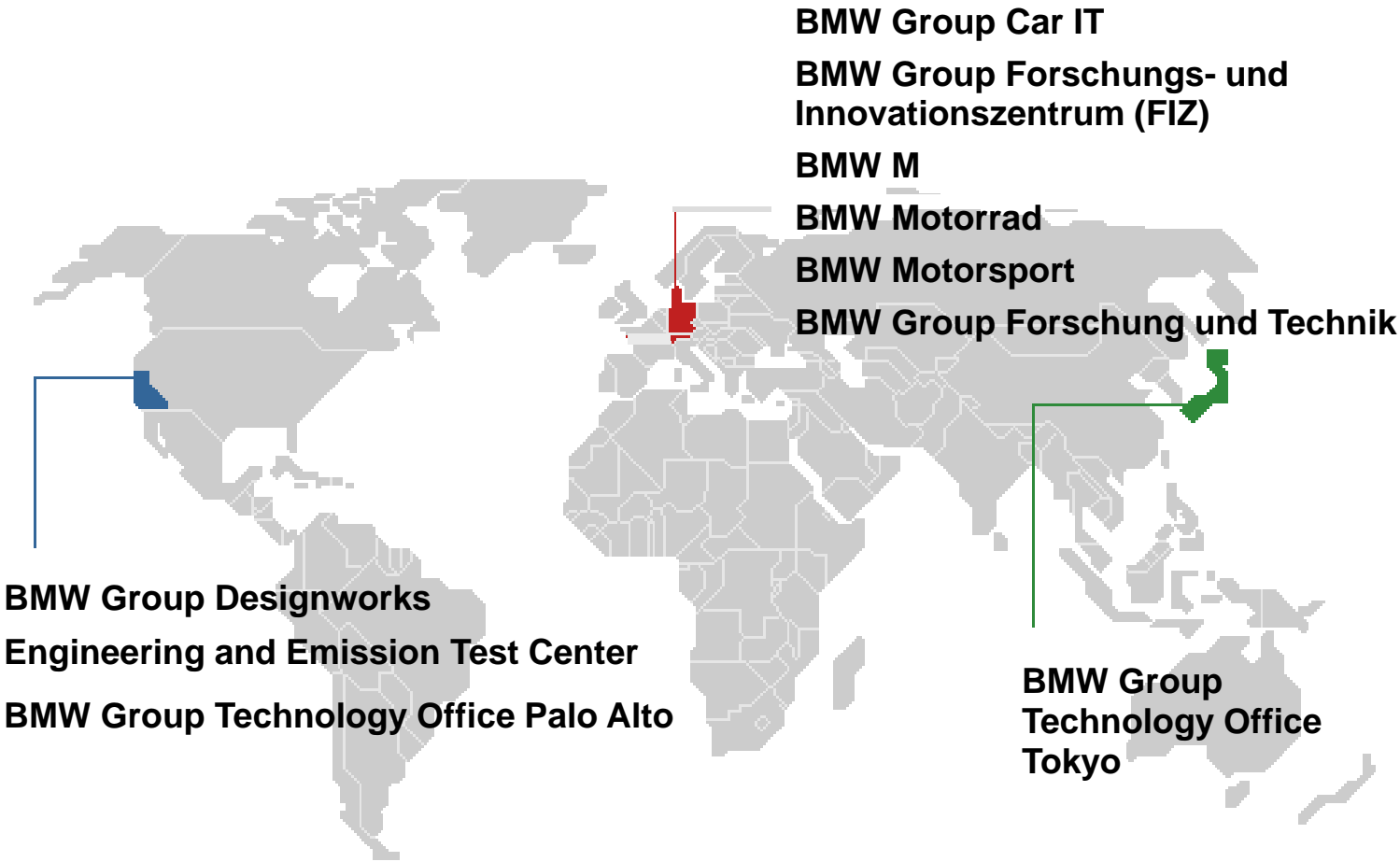
International Co-operation.

BMW Group International Production Network.



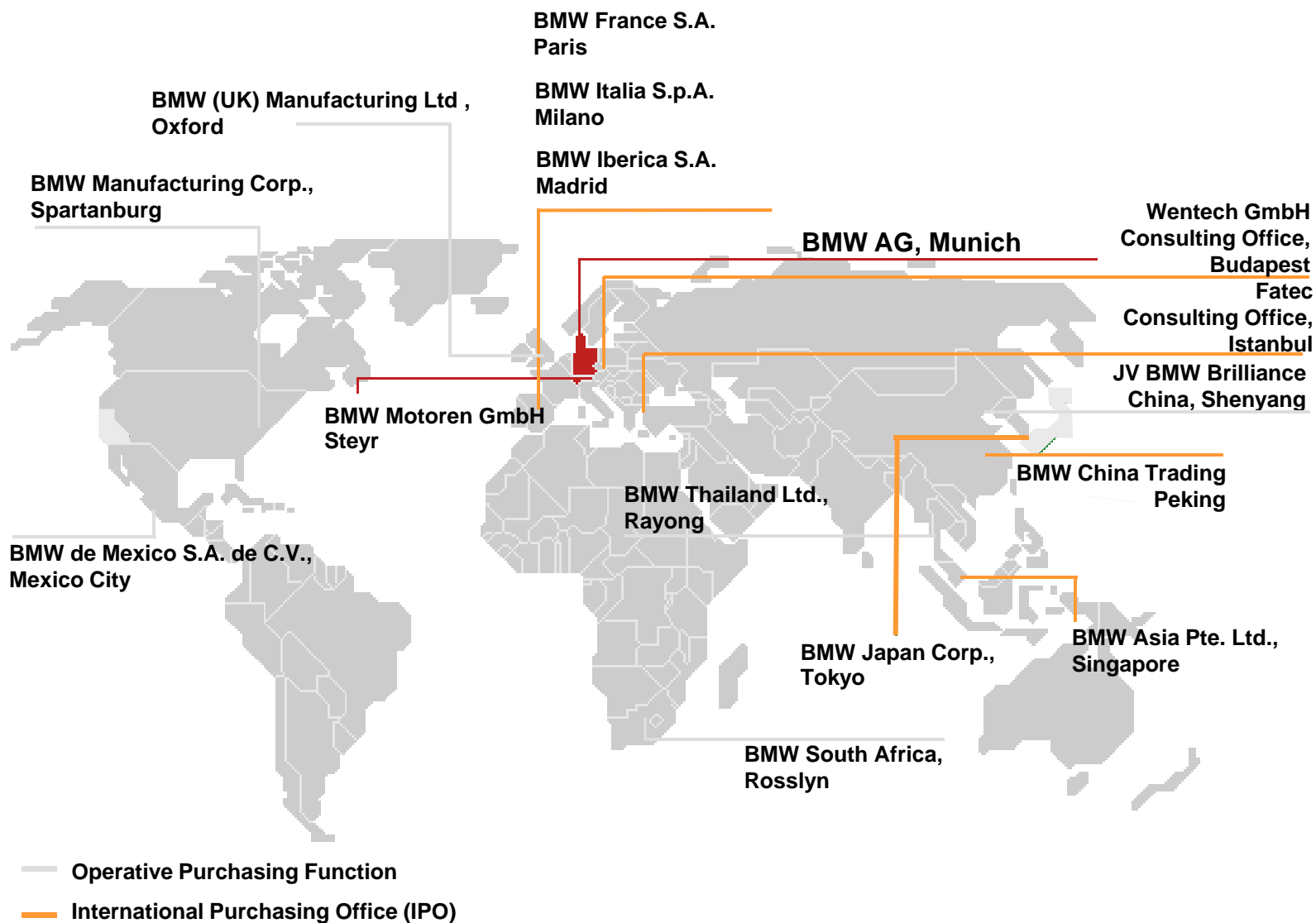
International Co-operation.

BMW Group Development Network.



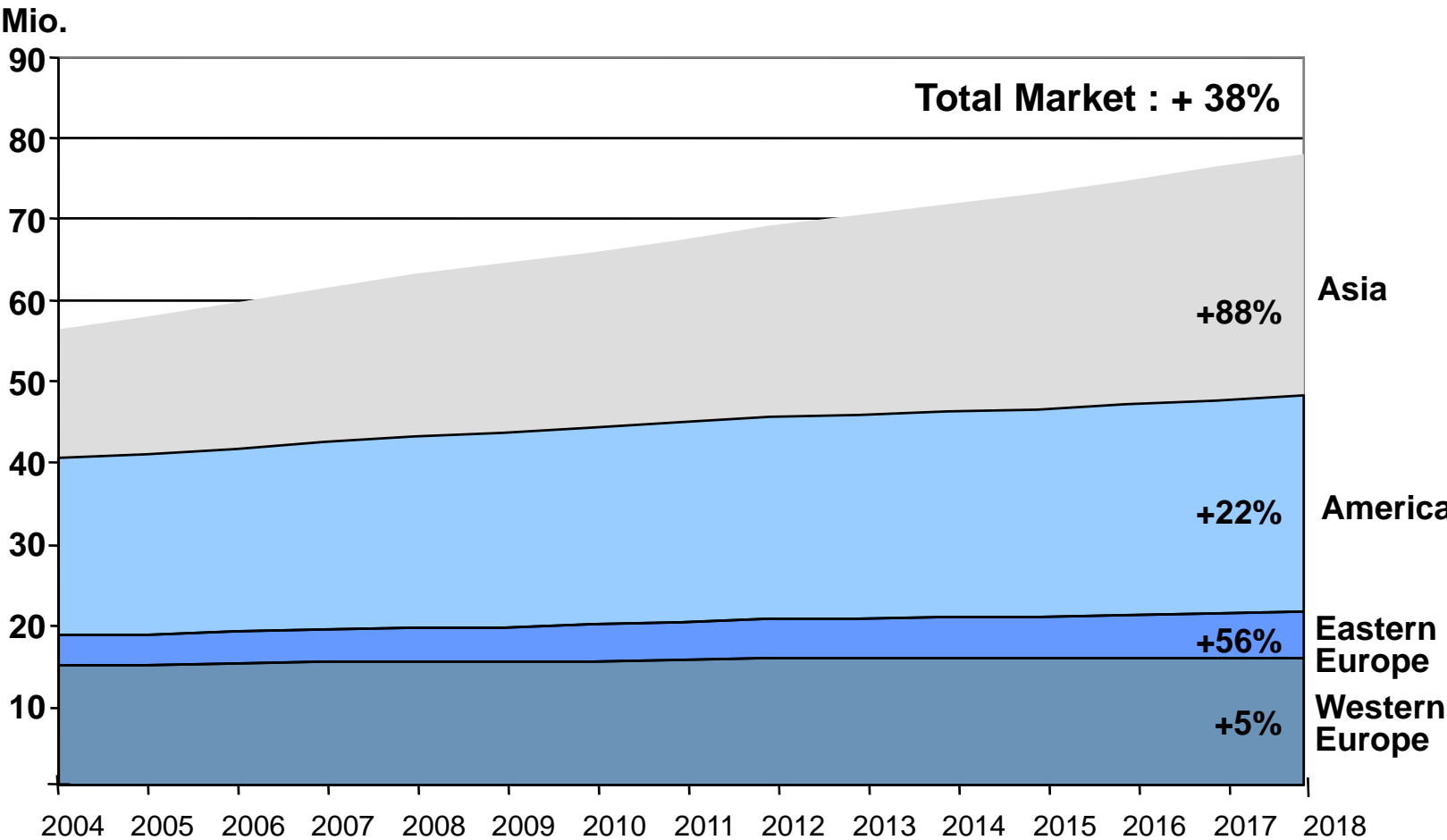
International Co-operation.

BMW Group International Purchasing Network.

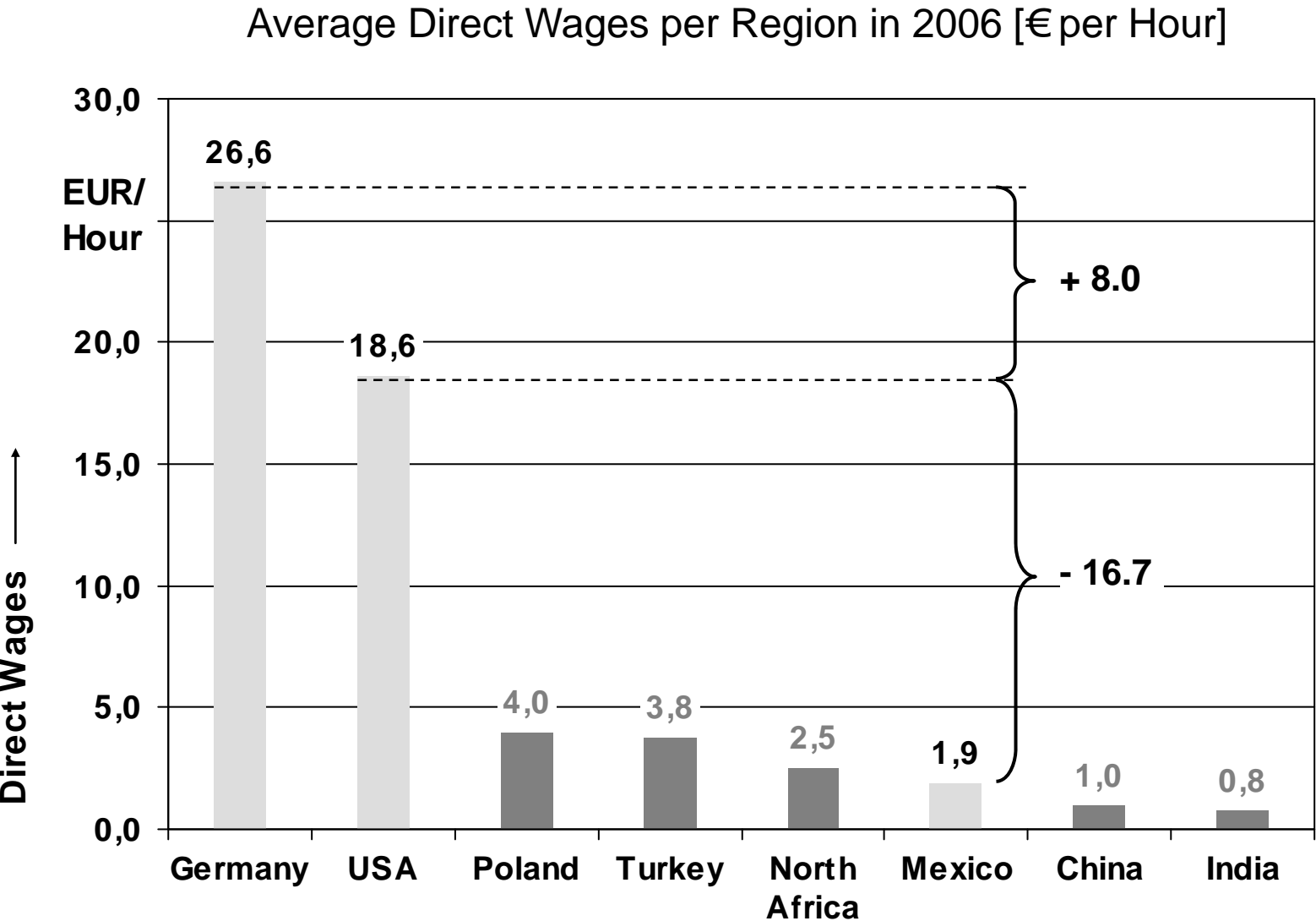


International Co-operation.

Highest Growth Rates in Asia & Eastern Europe.



International Co-operation. Wages.



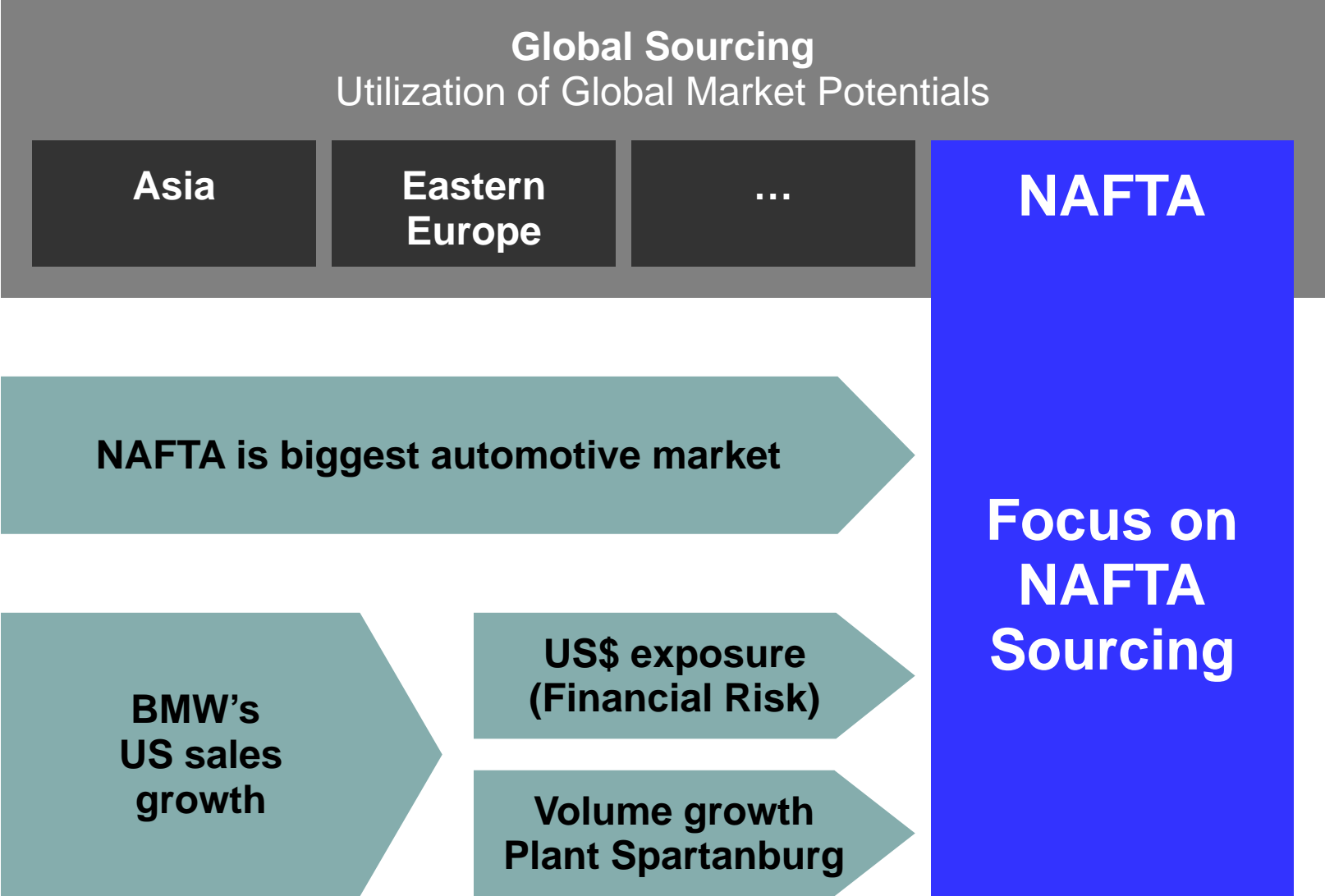
International Co-operation.

US\$ / Euro Exchange Rate.



International Co-operation.

The Particular Importance of NAFTA Sourcing for the BMW Group.



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Supplier Management.

Areas of Supplier Development.

| | | | |
|-----------------------------------|-------------------------------|--------------------|------------------------|
| Results Focus | Process Design | Supplier Support | |
| Project Spanning (Sustainability) | Supplier Expertise | | Continuous Improvement |
| Project Specific (Speed) | Process Benchmark. | Project Support | |
| | | Project Assessment | |
| | Early Phase Before Nomination | Development | Series |

Supplier Management.

Supplier Development Activities.

- ▶ **Process Design:**
Fundamental Improvement of supplier performance in all business processes
- ▶ **Supplier Expertise:**
Comprehensive technical and commercial appraisal of supplier
- ▶ **Process Benchmarking:**
Qualitative and comparative supplier appraisal with rating
- ▶ **Supplier Support:**
Essential boost in supplier performance for every deficient business process, as basis for a stable, long-term, performance contribution

Supplier Management.

Supplier Development Activities (cont.).

- ▶ **Project Support:**
Project specific and disturbance related need for improvement of supplier performance by means of process optimization

- ▶ **Project Assessment:**
Project specific, extensive qualitative project and risk assessment with LOP driven monitoring of corrective actions enabling problem resolution

- ▶ **Continuous Improvement:**
Project specific procured part cost saving using building blocks: productivity, product value analysis, process value analysis and concept redesign

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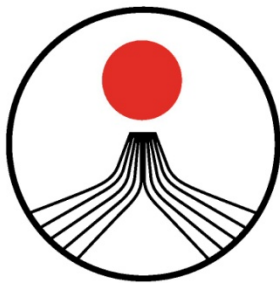
AUTOSAR – Standard System Architecture.

What AUTOSAR is.

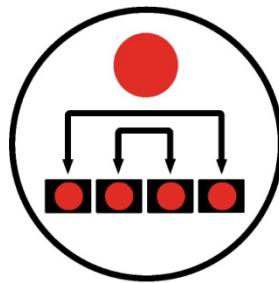


AUTOSAR is an open standards organization created by OEMs and electronics suppliers.

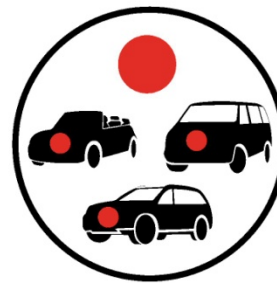
Primary Goal of AUTOSAR is to provide an open standard for automotive architecture for developing vehicular software, user interfaces and management.



Complexity



Reusability



Exchangeability



**Consumer
Electronics**

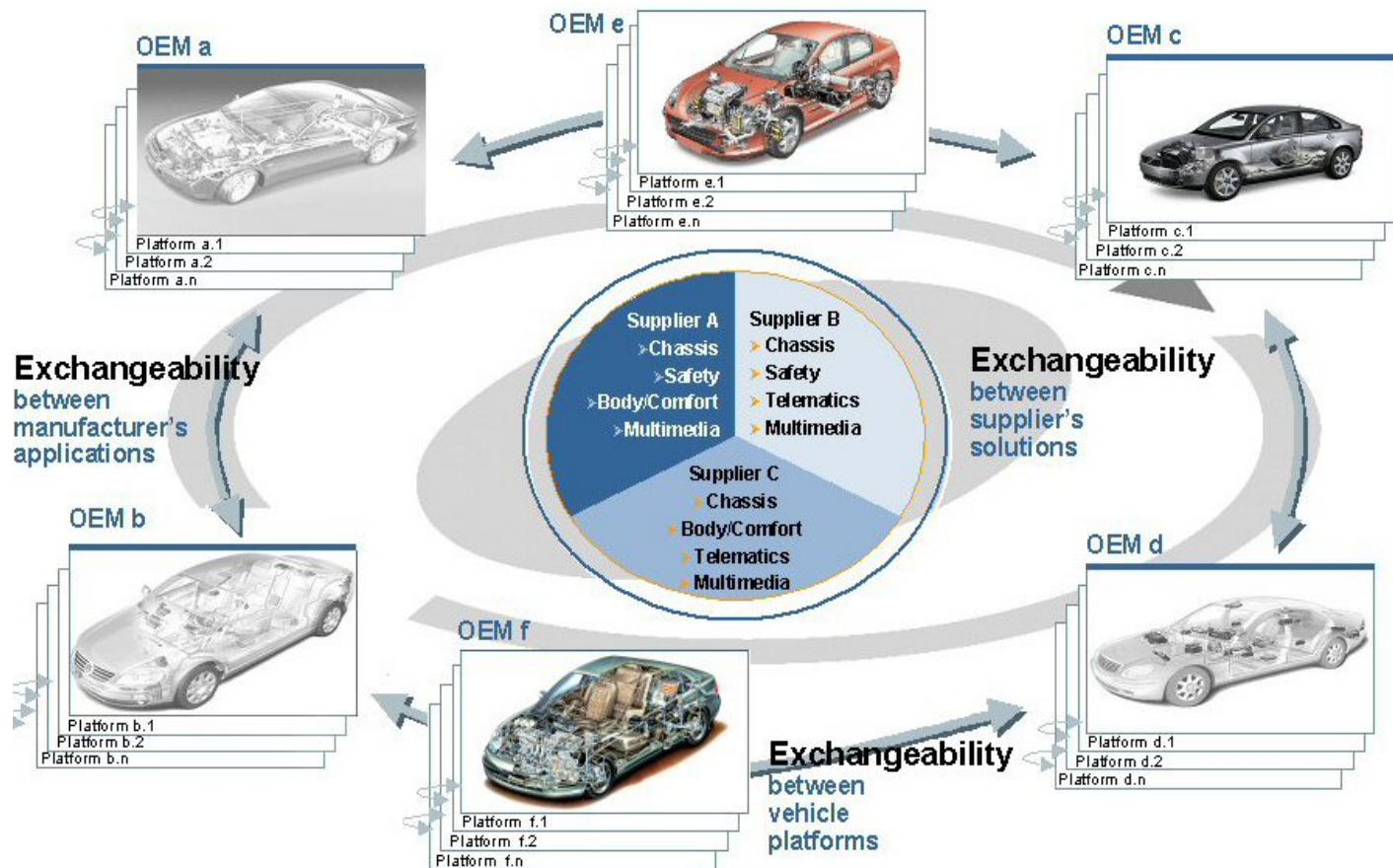


Quality

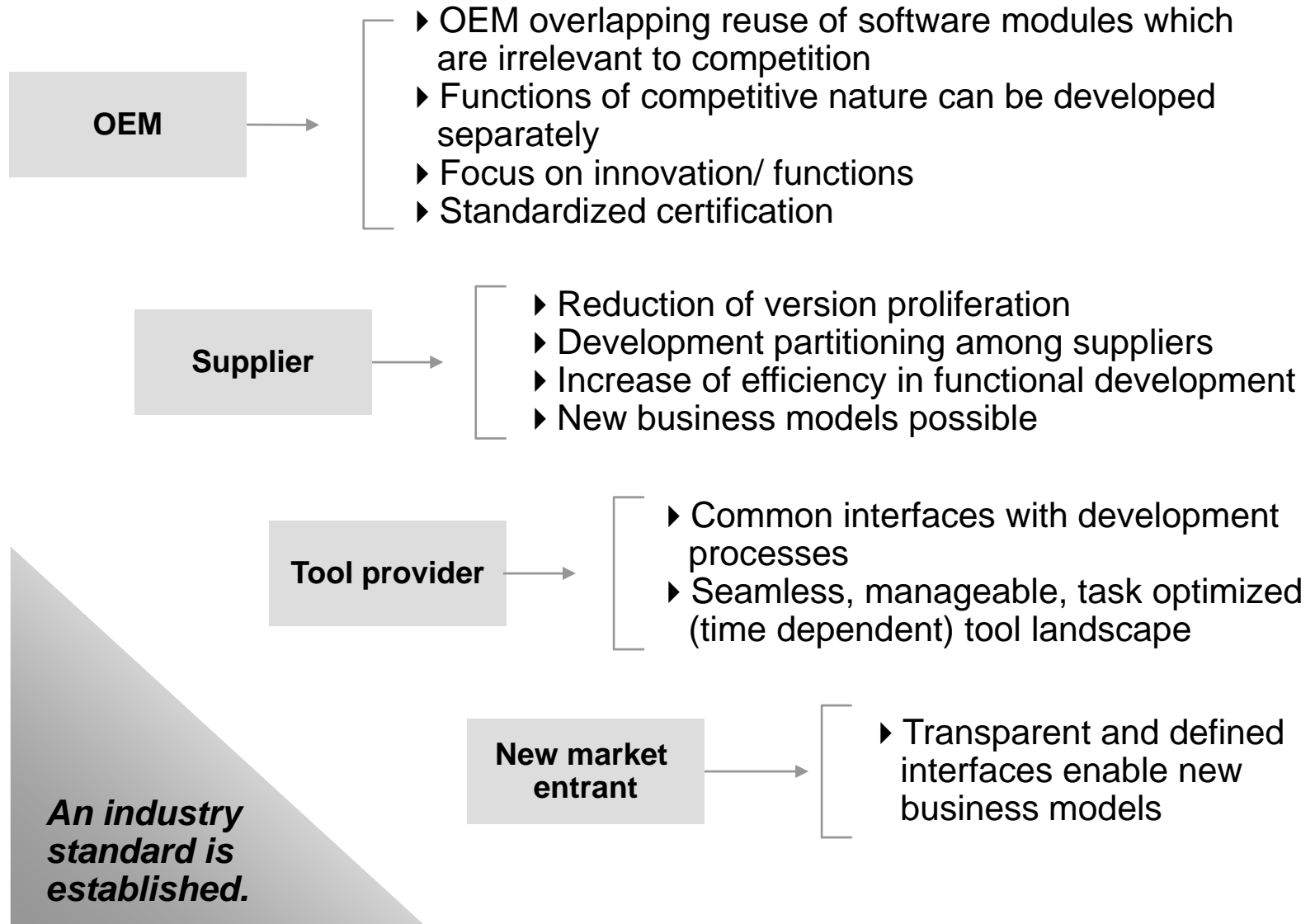
AUTOSAR – Standard System Architecture. Vision.

The Vision of AUTOSAR is ...

... improved complexity management of highly integrated E/E architectures through increased reuse and exchangeability of SW modules between OEMs and suppliers.

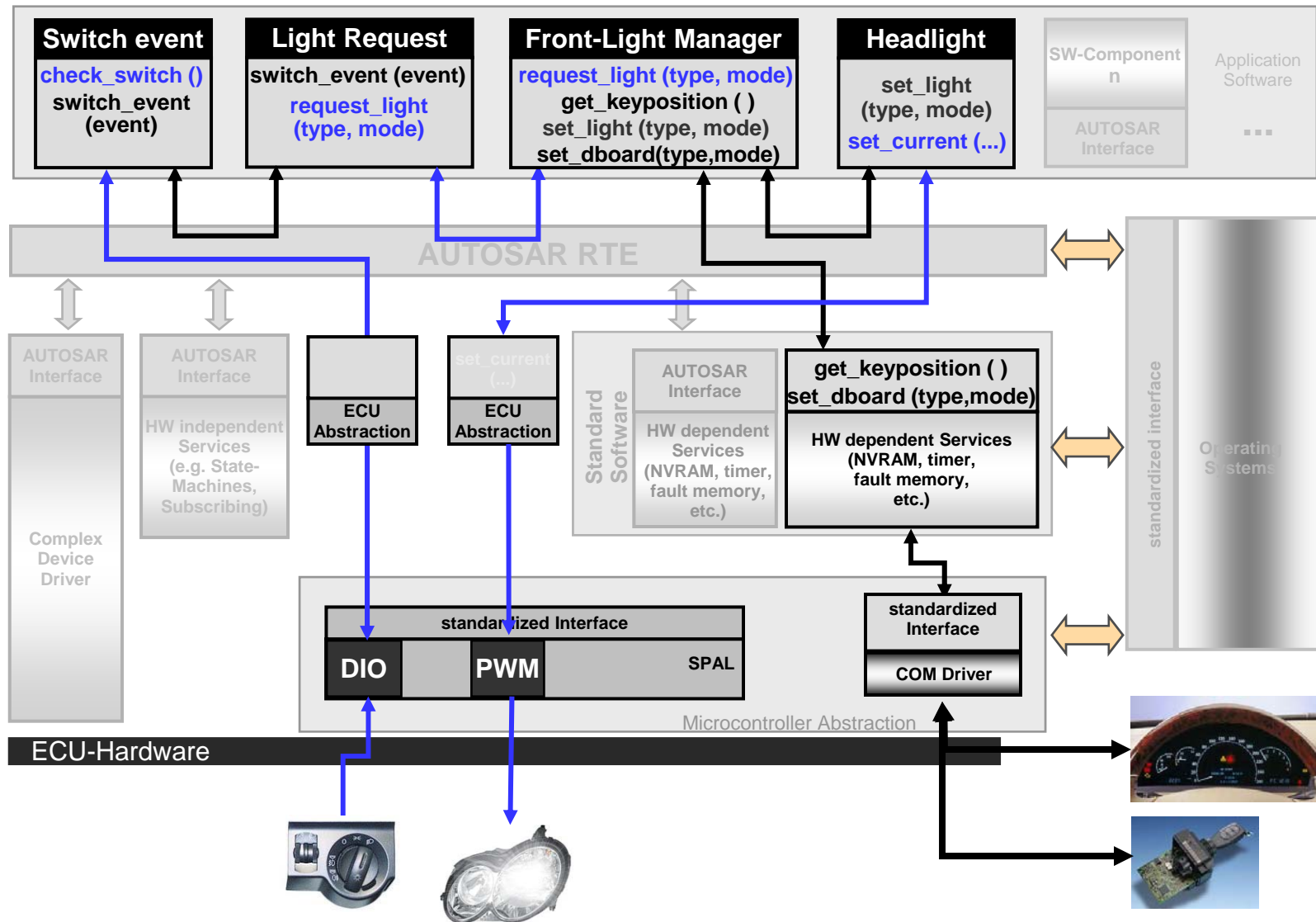


AUTOSAR – Standard System Architecture. Benefits.



AUTOSAR – Standard System Architecture.

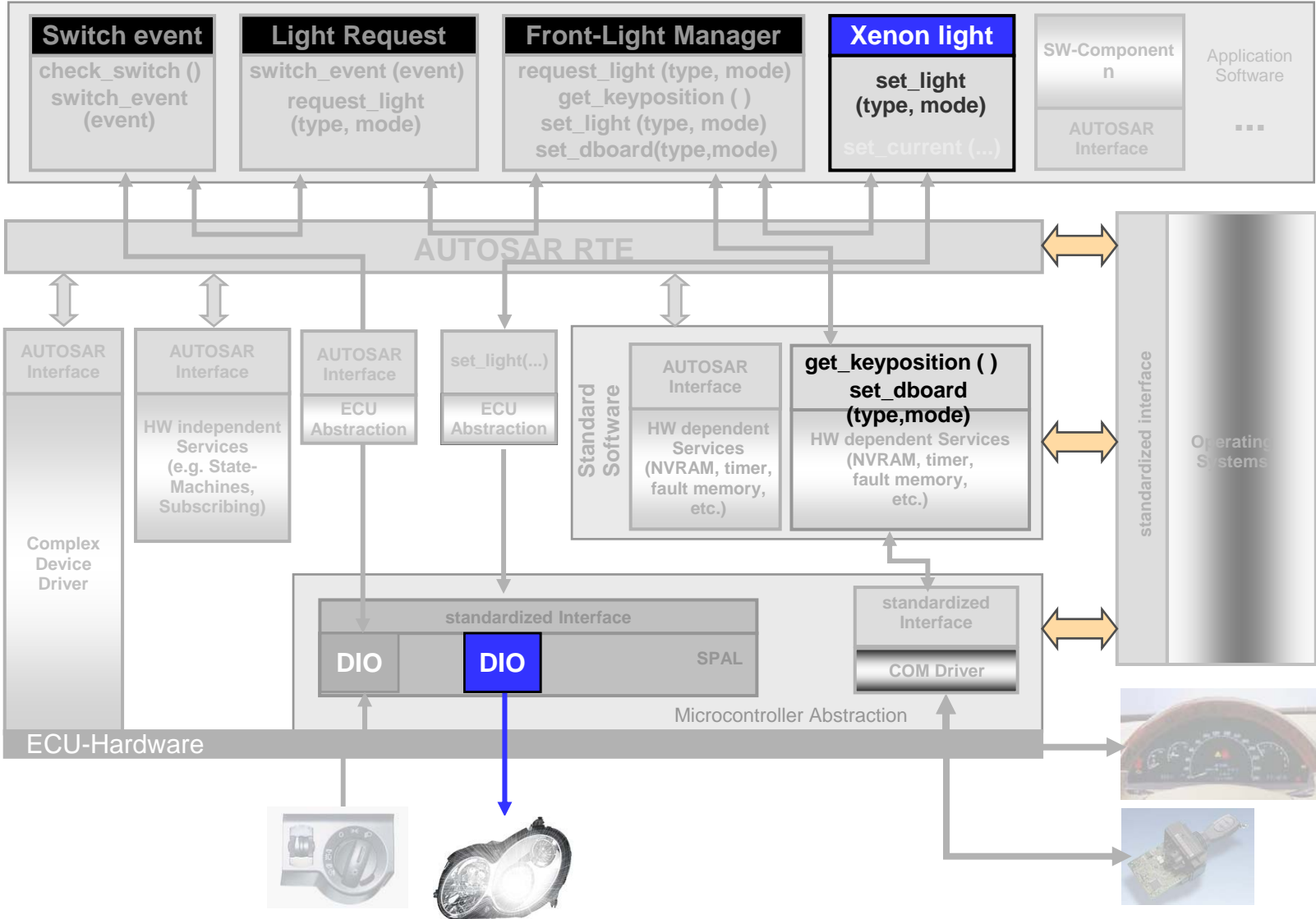
Use Case ‘Front Light Management’.



Note: this slide only shows the principal signal flow. It is otherwise based on an outdated architecture

AUTOSAR – Standard System Architecture.

Exchange of type of front light.



Note: this slide only shows the principal signal flow. It is otherwise based on an outdated architecture

AUTOSAR – Standard System Architecture.

AUTOSAR Core Partners and Members.

10 Core Partner

48 Associate Member

BMW Group



DAIMLERCHRYSLER







VOLKSWAGEN AG





48 Premium Member







































| | | | | |
|----------------|-------------------|----------------------|-----------------------|---------------------|
| General OEM | Generic Tier 1 | Standard Software | Tools and Services | Semi- conductors |
|----------------|-------------------|----------------------|-----------------------|---------------------|

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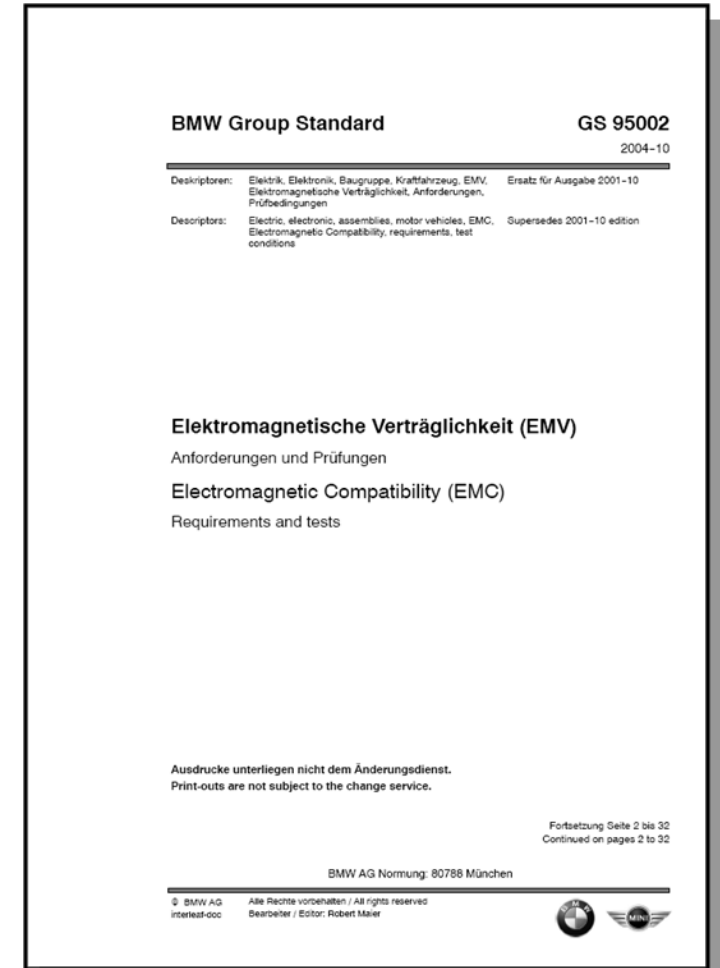
Ensuring EMC Conformance. BMW Group Standard GS 95002 - 2004.

The BMW Group Standard
**GS 95002 Electromagnetic
Compatibility (EMC), Requirements
and Tests** establishes the

- ▶ requirements,
- ▶ test methods and
- ▶ test procedures

to ensure electromagnetic
compatibility in BMW motor vehicles.

The current version GS 95002 : 2004
refers to national and international
standards. BMW is a member in most
EMC related standardization
committees.



Ensuring EMC Conformance.

EMC Test Specification According to GS 95002.

Specification of Component EMC Tests:

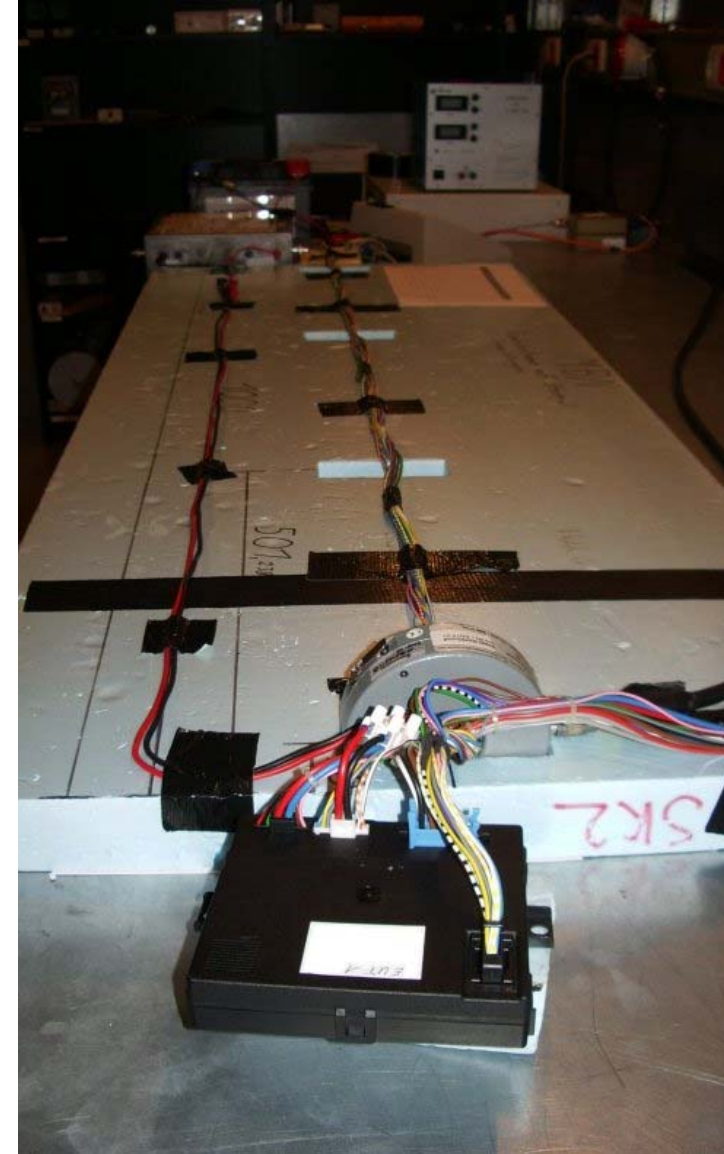
1. For each component, BMW selects the required tests (from GS 95002).
2. For each required test, the supplier submits an EMC Test Plan that includes:
 - ▶ A description of the EUT
 - ▶ The EUT configuration during the test
 - ▶ Failure criteria for the EUT
 - ▶ A block diagram of the actual test set-up

Ensuring EMC Conformance. EMC Component Testing.

EMC component tests are carried through by the supplier according to BMW GS 95002.

Test Methods:

- ▶ Measurement of emissions
- ▶ Immunity test
- ▶ Test of immunity to electrostatic discharge
- ▶ Attenuation of audio frequencies of audio devices with speaker output and gain control



Component EMC Test Report:

- ▶ Results
- ▶ Test information
- ▶ Details of test procedures used
- ▶ Build level of the EUT
- ▶ Detailed description of the actual set-up for each test to ensure reproducibility of performed investigations

| | | |
|------------------|------------------------|--------------|
| BMW Group | EMC Test Report | EG-74 |
|------------------|------------------------|--------------|

EMC - Laboratory tests of components and systems

Verification of EMC requirements in accordance with Group Standard GS95002 Oct 2004

Assembly: _____
System concerned: _____
BMW identification number _____
Hardware No. _____
Software No. _____
Consecutive No. _____
BMW inspector: _____
Supplier manufacturer: _____

| Investigation Required? | | Result | | No | GS 95002 Oct. 2004 | | Type of investigation |
|------------------------------|------|--------|----------|-----|--|------|--|
| Yes*) | No*) | OK*) | Not OK*) | | Part | Page | |
| | | | | 1. | 7.1.1.1 | 7 | Measurement with consideration of the time domain (pulses) |
| | | | | 2. | 7.1.1.2.1 | 8 | Disturbance from electromagnetic components |
| | | | | 3. | 7.1.1.2.2 | 9 | Interference from electronic components |
| | | | | 4. | 7.1.1.3 | 10 | Assessment of the slew rate of clocked signals |
| | | | | 5. | 7.1.2 | 11 | Capacitive measurement using the coupling clamp |
| | | | | 6. | 7.1.3 | 12 | Inductive measurement using the current probe |
| | | | | 7. | 7.1.4.1 | 13 | Measurement using the voltage probe |
| | | | | 8. | 7.1.4.2 | 15 | Measurement using antennas in the anechoic chamber |
| | | | | 9. | 7.2.1 | 17 | Galvanic test |
| | | | | 10. | 7.2.2 | 18 | Capacitive test using the coupling clamp |
| | | | | 11. | 7.2.3 | 18 | Inductive test using the ECU method |
| | | | | 12. | 7.2.4.1 | 19 | Immunity tests using a voltage |
| | | | | 13. | 7.2.4.2 | 20 | Test using antennas in the anechoic chamber |
| | | | | 14. | 7.2.4.3 | 22 | Immunity test using GSM modulation |
| | | | | 15. | 7.3 | 22 | Test of immunity to electrostatic discharge (ESD) |
| | | | | 16. | 7.4 | 23 | Attenuation of audio frequencies of audio devices with speaker output and gain control |
| | | | | | | | |
| *) Tick what is appropriate! | | | | | Comments to the measurements on Page 8 | | |

Evaluation of overall result: _____

Inspector: _____
Date: _____

Page 1 of 8

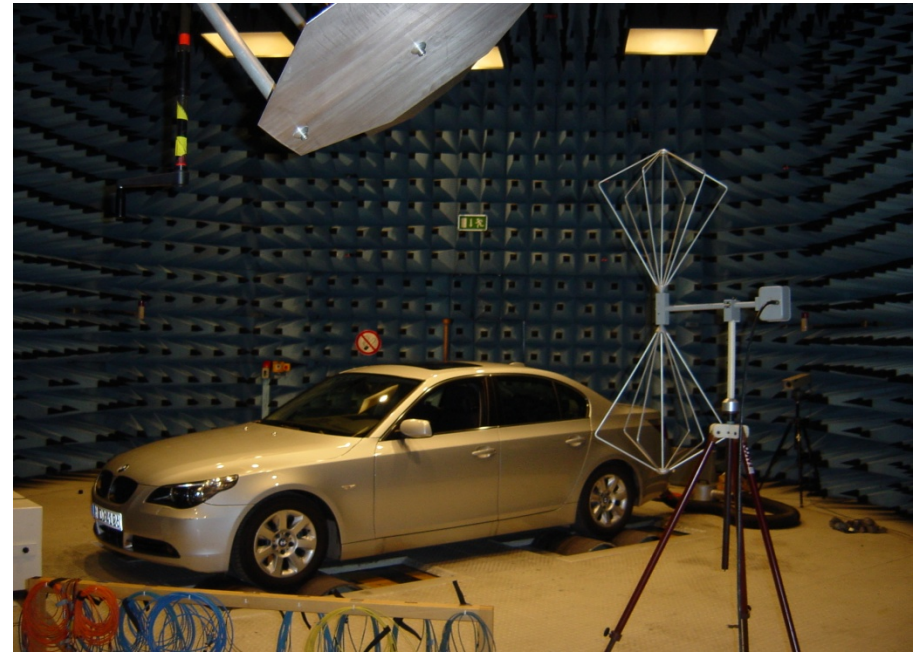
Ensuring EMC Conformance. Complete Vehicle EMC-Testing.

Approximately 2000 h of EMC testing for new vehicles

Late test vehicle availability - debugging very expensive

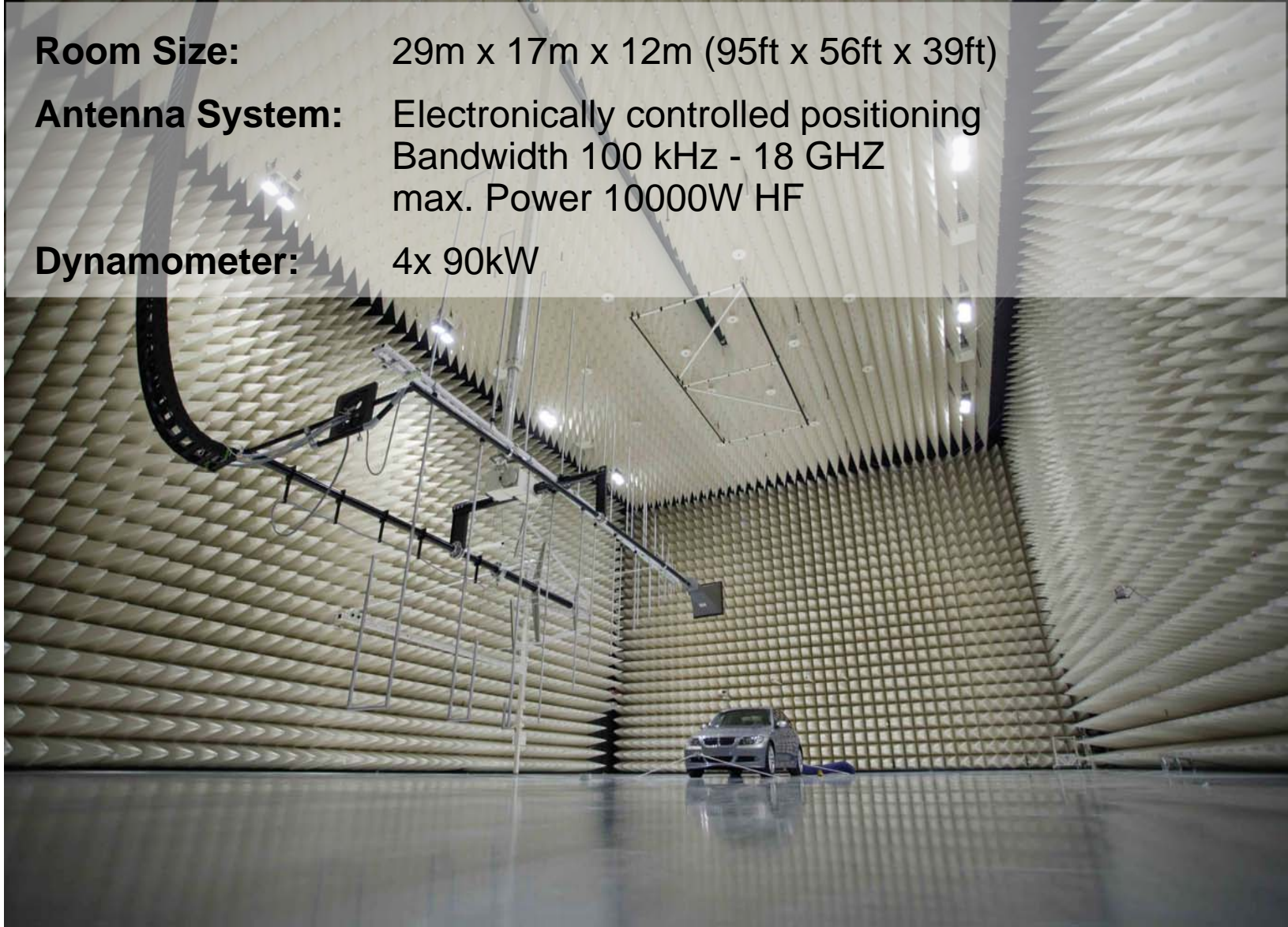
Test Methods:

- ▶ Emission measurement with on-board antenna in an anechoic chamber
- ▶ Radiated susceptibility testing in an anechoic chamber
- ▶ Immunity to interference from on-board radio systems; field intensities of 80 V/m
- ▶ Immunity to electrostatic discharge
- ▶ Quiescent current test under influence of an electromagnetic field



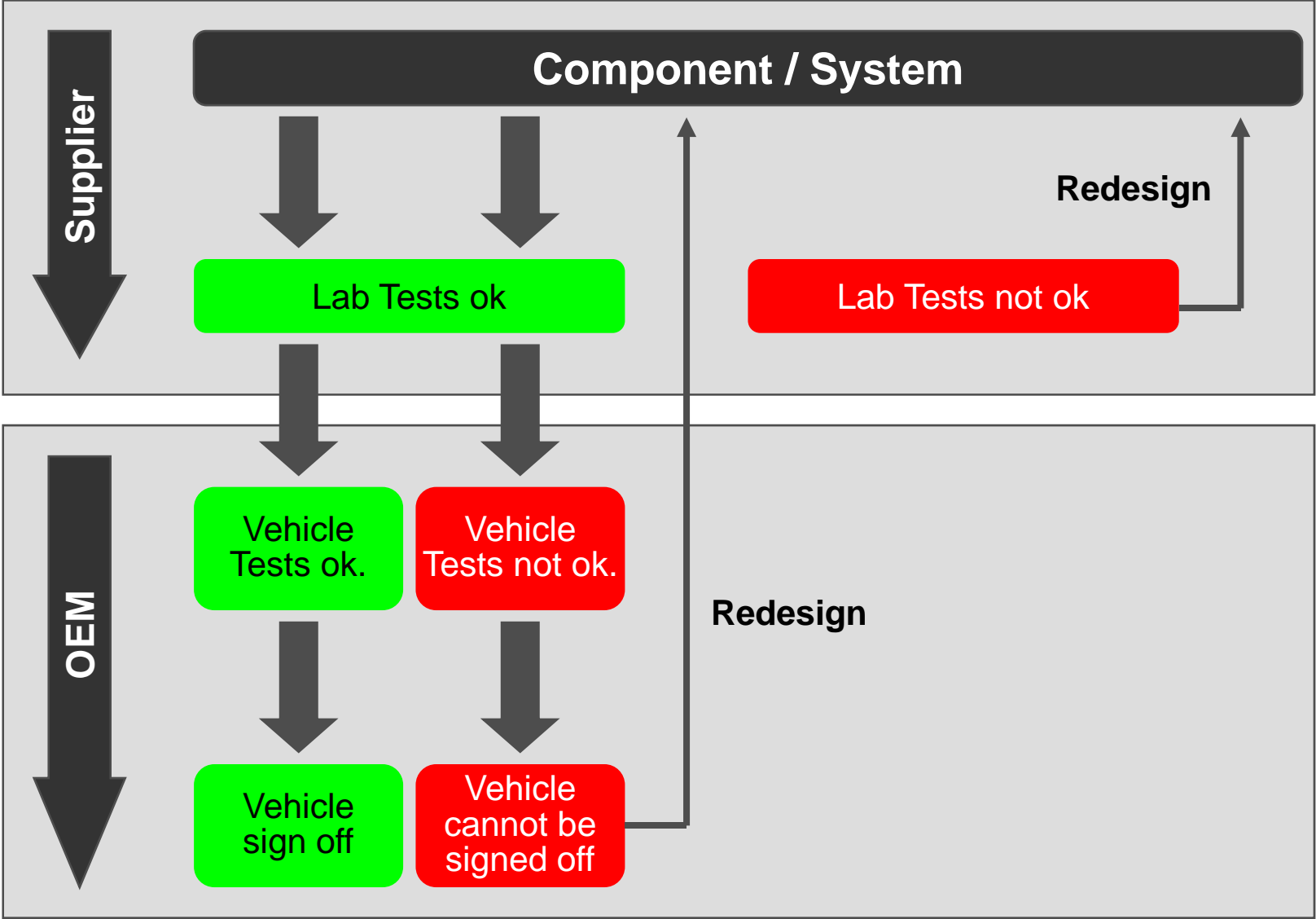
Ensuring EMC Conformance. BMW Group Anechoic Chamber.

Room Size: 29m x 17m x 12m (95ft x 56ft x 39ft)
Antenna System: Electronically controlled positioning
Bandwidth 100 kHz - 18 GHz
max. Power 10000W HF
Dynamometer: 4x 90kW



Ensuring EMC Conformance.

Process Overview.



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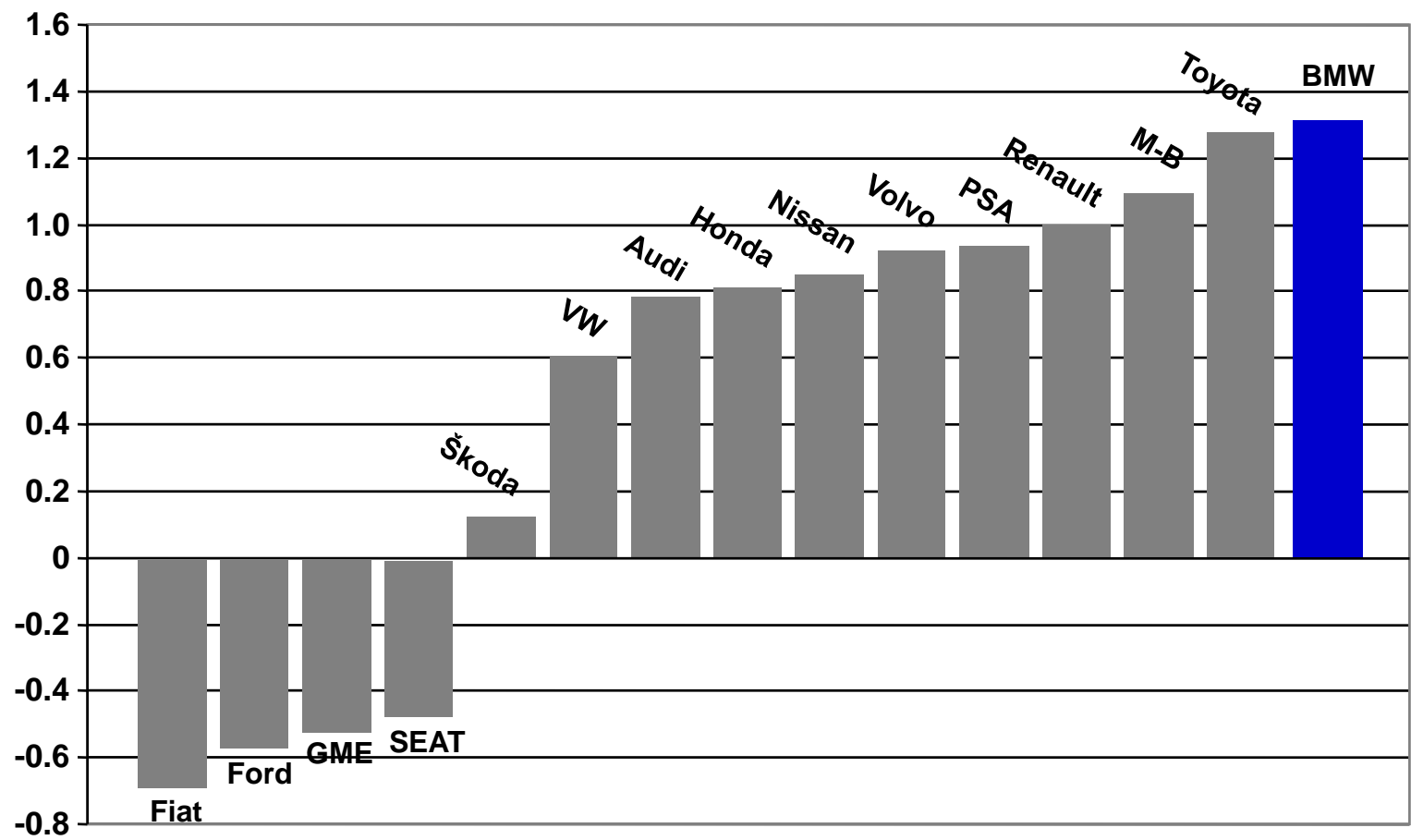
Ensuring EMC Conformance

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BMW Group from the Supplier's Point of View.

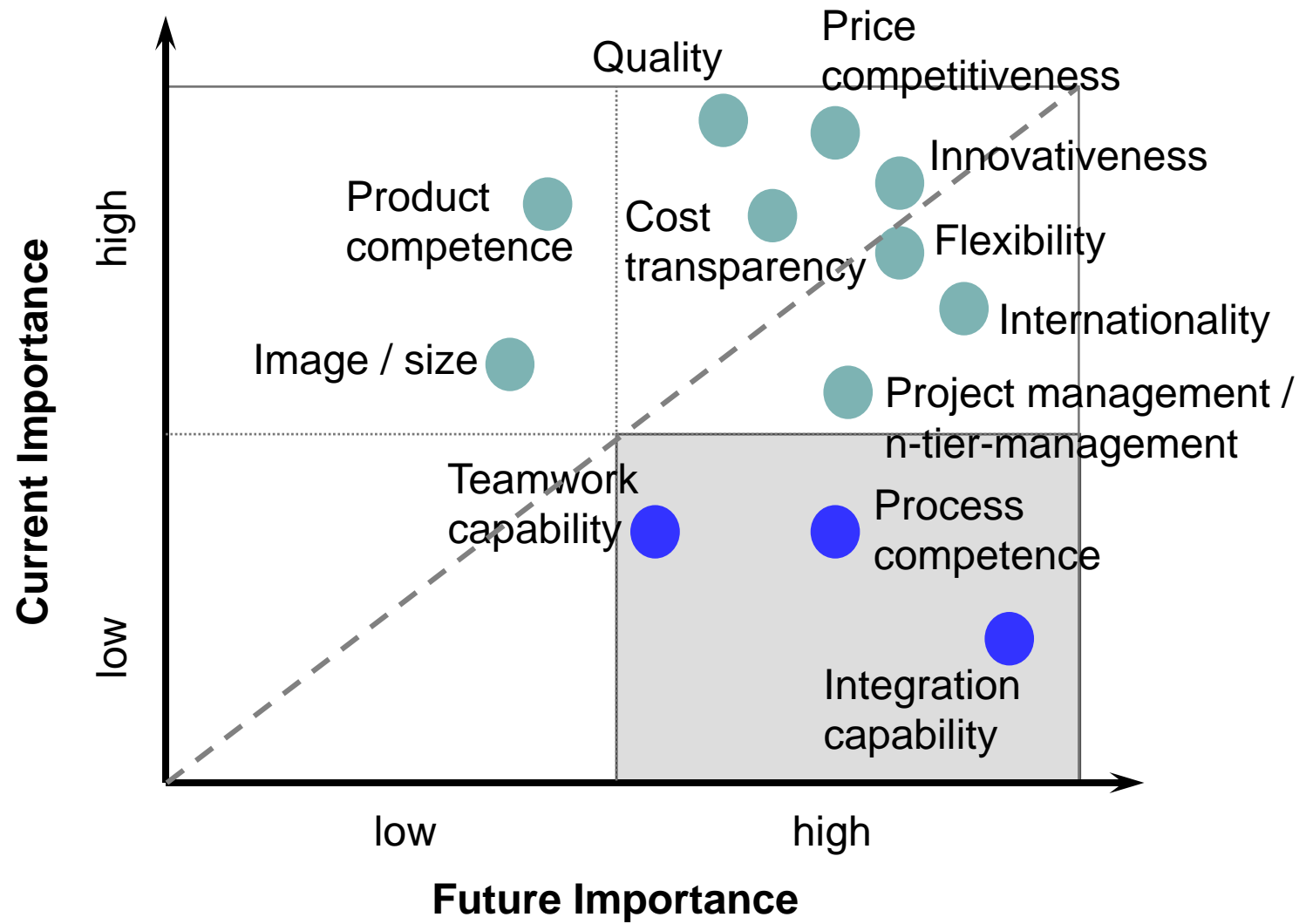
„Which customer is most attractive to do business with?“



Source: OEM-Supplier Relationship Survey 2005 Automotive News Europe/SupplierBusiness.com

Mutual Expectations.

Important Supplier Assets – Today and Tomorrow.



Mutual Expectations.

What BMW Expects from their Partners.

Performance Criteria

- ▶ Innovative and competitive solutions
- ▶ Solid financial basis
- ▶ Premium quality
- ▶ Price competitiveness
- ▶ Environmental and social responsibility
- ▶ ...

Business Philosophy

- ▶ Long-term orientation
- ▶ Transparency and openness
- ▶ Risk sharing
- ▶ “Benzin im Blut”

**Thank you very much
for your attention!**