Design Collaboration Between OEMs and Electronics Suppliers.

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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
Design Collaboration Between OEMs and Electronics Suppliers.

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- Partnering with the BMW Group
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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**

<table>
<thead>
<tr>
<th>Development and Production</th>
<th>Development</th>
<th>Self-provided Service</th>
<th>Complex Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Tasks</td>
<td>Single Tasks</td>
<td>Integration Package</td>
<td>Completed Vehicle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE-Supplier</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>e.g. Part design,</td>
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<tr>
<td></td>
<td></td>
<td>scheduling, simulation</td>
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<td></td>
<td></td>
<td>e.g. Rear lights</td>
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<tr>
<td></td>
<td></td>
<td>e.g. Axles, Cockpit,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Door Panel</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Package Placing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Development Service (EDL)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e.g. Chassis Suspension,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Steering Module,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Body Packages</td>
<td></td>
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<td></td>
<td></td>
<td>e.g. Passive Safety</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Complete - Vehicle-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>placing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e.g. X3</td>
<td></td>
</tr>
</tbody>
</table>

**External Service**

- Includes Integration Volume E.S.
Partnering with the BMW Group.
Partner Nomination.

Sourcing Strategies

Strategy
- Initial Phase
- Early Phase
- Series Development
- Production

Caption:
- Nomination
- Development
- Delivery

- Strategic Partner / Innovation Model
- Development Partner / Classic Model
- Market Supplier / Competition Model

! use entire spectrum!
Partnering with the BMW Group.
Supplier Integration: Nomination Process.

- ‘Dual request’ sent
- ‘Dual request’ received
- Possible repeated request for all suppliers on the basis of alternative requirements
- New offer
- Spec. ‘ready for series dvlpmt’
- Decision-making group/circular template complete and agreed
- Formal supplier decision
- Contract signed

‘Ready for request’ Specification
Partnering with the BMW Group.
Innovation Management.

Maximum
„Idea Density“

external : internal

BMW Group Suppliers

Potential Automotive Suppliers

Non-automotive Branches

Research Institutes

Start-Ups ....

„Effective Selection Management“

Pre-development Development

Research

Local Purchasing

International Purchasing

Virtual Innovation Agency

Scouting

New Projects and Products

Prioritization in

Innovation Councils

Maximum „Idea Density“

„Effective Selection Management“

Partnering with the BMW Group.
Innovation Management.

External Suppliers

Potential Automotive Suppliers

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Internal

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Maximum „Idea Density“

„Effective Selection Management“
Partnering with the BMW Group.
Future Trends: Tightening of the Market.

Number of independently operating companies

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

Source: Mercer Management Consulting 2004
Partnering with the BMW Group.

- 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

Source: Mercer Management Consulting 2004

Quelle: Mercer FAST-2015-Studie
© 2004 Mercer Management Consulting in www.mercermc.com
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)

Increase of 4.5 billion €

Decrease of 30.2 billion €

Source: Mercer Management Consulting 2004
Partnering with the BMW Group.

<table>
<thead>
<tr>
<th>Part</th>
<th>2002 OEM</th>
<th>supplier</th>
<th>2015 OEM</th>
<th>supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
<td>23%</td>
<td>77%</td>
<td>15%</td>
<td>85%</td>
</tr>
<tr>
<td>Drive-train</td>
<td>37%</td>
<td>63%</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Engine units</td>
<td>50%</td>
<td>50%</td>
<td>36%</td>
<td>64%</td>
</tr>
<tr>
<td>Body structure</td>
<td>96%</td>
<td>4%</td>
<td>59%</td>
<td>41%</td>
</tr>
<tr>
<td>Body exterior</td>
<td>55%</td>
<td>45%</td>
<td>29%</td>
<td>71%</td>
</tr>
<tr>
<td>Interior</td>
<td>16%</td>
<td>84%</td>
<td>14%</td>
<td>86%</td>
</tr>
<tr>
<td>Electrics/electronics</td>
<td>18%</td>
<td>84%</td>
<td>18%</td>
<td>84%</td>
</tr>
</tbody>
</table>

Source: Mercer Management Consulting 2004
# Design Collaboration Between OEMs and Electronics Suppliers.

## Agenda.

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- Ensuring EMC Conformance
- Mutual Expectations
International Co-operation.

BMW Group International Production Network.
International Co-operation.
BMW Group Development Network.

BMW Group Car IT
BMW Group Forschungs- und Innovationszentrum (FIZ)
BMW M
BMW Motorrad
BMW Motorsport
BMW Group Forschung und Technik
BMW Group Designworks
Engineering and Emission Test Center
BMW Group Technology Office Palo Alto
BMW Group Technology Office Tokyo
International Co-operation.

BMW Group International Purchasing Network.

BMW AG, Munich

BMW France S.A.
Paris

BMW Italia S.p.A.
Milano

BMW Iberica S.A.
Madrid

BMW (UK) Manufacturing Ltd, Oxford

BMW Manufacturing Corp., Spartanburg

BMW Motoren GmbH, Steyr

BMW de Mexico S.A. de C.V., Mexico City

BMW Thailand Ltd., Rayong

BMW South Africa, Rosslyn

BMW Japan Corp., Tokyo

BMW Asia Pte. Ltd., Singapore

Wentech GmbH
Consulting Office, Budapest

Fatec
Consulting Office, Istanbul

JV BMW Brilliance
China, Shenyang

BMW China Trading
Peking

Operative Purchasing Function

International Purchasing Office (IPO)
International Co-operation.
Highest Growth Rates in Asia & Eastern Europe.

- Asia: +88%
- America: +22%
- Eastern Europe: +56%
- Western Europe: +5%

Total Market: +38%

Data Source: Global Insight 2006
International Co-operation.

Wages.

Average Direct Wages per Region in 2006 [€ per Hour]

<table>
<thead>
<tr>
<th>Region</th>
<th>Direct Wages [€/Hour]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>26.6</td>
</tr>
<tr>
<td>USA</td>
<td>18.6</td>
</tr>
<tr>
<td>Poland</td>
<td>4.0</td>
</tr>
<tr>
<td>Turkey</td>
<td>3.8</td>
</tr>
<tr>
<td>North Africa</td>
<td>2.5</td>
</tr>
<tr>
<td>Mexico</td>
<td>1.9</td>
</tr>
<tr>
<td>China</td>
<td>1.0</td>
</tr>
<tr>
<td>India</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Source: BMW Group
International Co-operation.
US$ / Euro Exchange Rate.

Source:
OnVista 2008
International Co-operation.
The Particular Importance of NAFTA Sourcing for the BMW Group.

Global Sourcing
Utilization of Global Market Potentials

NAFTA is biggest automotive market

BMW’s US sales growth

US$ exposure (Financial Risk)

Volume growth
Plant Spartanburg

Focus on NAFTA Sourcing
Design Collaboration Between OEMs and Electronics Suppliers.

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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 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.
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.

Benefits.

- OEM overlapping reuse of software modules which are irrelevant to competition
- Functions of competitive nature can be developed separately
- Focus on innovation/ functions
- Standardized certification

- Reduction of version proliferation
- Development partitioning among suppliers
- Increase of efficiency in functional development
- New business models possible

- Common interfaces with development processes
- Seamless, manageable, task optimized (time dependent) tool landscape

- Transparent and defined interfaces enable new business models

An industry standard is established.
Use Case ‘Front Light Management’.

Note: this slide only shows the principal signal flow. It is otherwise based on an outdated 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 Core Partners and Members.

10 Core Partner

48 Associate Member

48 Premium Member

General

OEM

Generic

Tier 1

Standard

Software

Tools and

Services

Semi-

conductors

Up-to-date status see: www.autosar.org
Design Collaboration Between OEMs and Electronics Suppliers.

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<table>
<thead>
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<td>Mutual Expectations</td>
</tr>
</tbody>
</table>
Ensuring EMC Conformance.

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
After successfully testing the component, the supplier provides a test report to BMW.

**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
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.

Source: Dr. Friedrich Haslinger
BMW Group.
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.

- **Supplier**
  - **Component / System**: Lab Tests ok
  - **OEM**
    - **Vehicle Tests ok.**
    - **Vehicle Tests not ok.**
      - **Vehicle sign off**
      - **Vehicle cannot be signed off**

- **Lab Tests not ok**
  - **Redesign**
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Mutual Expectations.
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

Source:
Automotive News 2005
Mutual Expectations.
Important Supplier Assets – Today and Tomorrow.

Current Importance vs. Future Importance:
- Product competence
- Image / size
- Quality
- Cost transparency
- Innovativeness
- Flexibility
- Internationality
- Project management / n-tier-management
- Teamwork capability
- Process competence
- Integration capability
- Price competitiveness
- Quality

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!