2.3 Deep-dive Chassis Systems

Dr. Dirk Kesselgruber
President Business Division Chassis Systems

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Dr. Dirk Kesselgruber (45)
President Business Division Chassis Systems

- 1997 – 2000  Brake Systems Development at BMW AG
- 2000 – 2002  Development Steering Acoustics at TRW
- 2002 – 2013  Various leadership positions at TRW
- 2013 – 2017  CTO at TRW Steering Systems
- Since 2017  President Business Division Chassis Systems at Schaeffler
Chassis Evolution
From a mechanical chassis component supplier to a full chassis integrator

Key points
- Schaeffler has a long history in making precision chassis components
- Autonomous driving will see a significant market penetration
- Key contributor to autonomous driving are mechatronic chassis systems for vehicle guidance
- Schaeffler is in the process of transforming its chassis business from a components supplier through mechatronic bridge products towards a full chassis systems integrator

Steer-By-Wire is the key enabler to reach the next level
2.3 Deep-dive Chassis Systems

Vision Chassis – Market shifting towards autonomy

Vision Chassis
Global vehicle production [in mn units]

Source: IHS Autonomy and McKinsey / Values based on Light Vehicles < 6 tons only
L0 = No Automation, L1 = Driver Assistance, L2 = Partial Automation, L3 = Conditional Automation, L4 = High Automation, L5 = Full Automation

Steer-By-Wire Systems
Key growth technology for automated vehicles by allowing the steering wheel to disappear conditionally or being eliminated entirely

<table>
<thead>
<tr>
<th>Automation Level</th>
<th>Definition</th>
<th>Fitment rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L5</strong></td>
<td>Autonomous</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>L4</strong></td>
<td>Fully automated</td>
<td>20 - 30%</td>
</tr>
<tr>
<td><strong>L3</strong></td>
<td>Highly automated</td>
<td>20 - 30%</td>
</tr>
</tbody>
</table>
2.3 Deep-dive Chassis Systems

Vision Chassis – Evolution of steering systems

<table>
<thead>
<tr>
<th>Year</th>
<th>Automation Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>Manual &amp; Assisted (&lt;L3)</td>
<td>Conventional EPS System</td>
</tr>
<tr>
<td>2021</td>
<td>Conditionally Automated (L3)</td>
<td>Conventional EPS System w/ higher reliable electronics</td>
</tr>
<tr>
<td>2023</td>
<td>Highly Automated (L4)</td>
<td>Steer-by-wire w/ full electronics redundancy</td>
</tr>
<tr>
<td>2027</td>
<td>Autonomous (L5)</td>
<td>Intelligent Chassis Corner</td>
</tr>
</tbody>
</table>

Key aspects

- Steer-By-Wire Systems will begin to replace conventional Electric Power Steering (EPS) from 2023 onwards, driven by the high reliability demands of automated driving on steering systems and leading to an interior revolution.
- Schaeffler has acquired a proven by-wire technology to enter the steering market and accelerate the development in addition to establishing a reputation for safety critical chassis products.
2.3 Deep-dive Chassis Systems

Steer-By-Wire – Creating Schaeffler USPs

Schaeffler will focus on Steer-By-Wire, a key growth area and perfect match for the current core chassis business

Paravan’s unique SPACE DRIVE technology is the only Steer-By-Wire System in the market which:

- is road approved (> 500 Mio. Kilometers)
- meets latest safety regulation standards
- can operate also braking and secondary vehicle functions
- can be scaled in to mass production

Schaeffler acquires Steer-By-Wire (SBW) technology from Paravan

Key missions of the JV

- Develop next generation SPACE DRIVE system and support Schaeffler in the industrialization of SBW for mass production
- Support automotive OEMs and new mobility service providers with SPACE DRIVE applications for their autonomous fleets
- Develop chassis solutions for autonomous transportation systems, e.g. people mover
Automotive OEM
Summary and Outlook

Matthias Zink
CEO Automotive OEM

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Summary and Outlook

Mobility for Tomorrow – Detailed Powertrain and Chassis Strategy

**Powertrain Pyramid**

- **System Understanding**
- **Mechatronic Systems**
- **Mechanical Systems**
- **Components**

**Chassis Pyramid**

- **System Understanding**
- **Mechatronic Systems**
- **Mechanical Systems**
- **Components**
Mobility for Tomorrow - Schaeffler Symposium 2018

Schaeffler Symposium

- Every four years since 1978
- Technical presentations with insights into Schaeffler technologies and expertise
- Showing current and future product solutions

Highlights 2018
Baden-Baden and Detroit

- > 600 customers participated
- ~100 exhibits and 50 technical presentations
- 12 world debuts e.g. Schaeffler Mover and modular E-Axle

Schedule 2018

- April 11th – 13th, Baden-Baden, Germany
- September 4th – 6th, Detroit, USA
- October 30th – November 1st, Tokyo, Japan
- November 22nd – 23rd, Shanghai, China
1. Hybridization and further optimization of the conventional powertrain offers significant growth potential in Schaeffler’s classic product portfolio.

2. System understanding, mechanical know-how and integration expertise provide strong customer benefits for future mobility solutions (e.g. E-Mobility and drive by wire-solutions).

3. Robust profitability of the Automotive OEM Division will be preserved for the upcoming future.

Continued profitable growth above market.