Trends in the truck & trailer market

Market study

Munich, August 2018
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## Contents

| A. | Megatrends in the commercial vehicle industry | 5 |
| B. | Truck & trailer market development (spotlight on Europe) | 19 |
| C. | Impact on truck & trailer components (examples) | 33 |
| D. | Roland Berger | 50 |
Management summary

We expect four main trends, new Logistics, Electrification/alternative drives, Autonomous trucks and Digitalization ("LEAD"), to shape the CV industry over the next decade – yet autonomous vehicles (Level 4/5) barely roadworthy before 2023.

These four megatrends, as well as a set of region-specific drivers, are expected to lead to a continued positive development of the truck & trailer market over the coming years.

E.g., on average, Europe's production of medium/heavy duty trucks and buses >8 t is expected to grow by 1.3% p.a. until 2020. The main growth driver will be Eastern European countries.

European Trailer production continuously grew by 5% p.a. until 2017 driven by Western Europe. In the coming years the market is expected to remain rather flat.

CV systems technology upgrade prior to 2023 is expected to be mainly driven by "conventional" business metrics with main drivers being regulatory "push" (increased safety/emission levels) and operator "pull" (TCO improvement).

In future, the largest share of value in tractor trucks will remain with powertrain and cabin, however connectivity solutions and driver assistance systems are expected to gain importance – Demand for ADAS (particularly LDWS, ACC, AEBS) is expected to increase further.

Market growth of related component systems in Europe is expected to outperform the truck and bus production growth rate (CAGR 2016-22E): Market growth p.a. of braking systems: 3.5-4%, powertrain: 7-8%, steering systems: 9-10%, ADAS: 10-12%.

For trailers, analysis of selected components shows a similar pattern – while today, the largest share of value in a standard trailer lies in chassis and structural elements, a clear shift towards connectivity systems is expected.

In this context, a set of key success factors for the truck and trailer market was identified – reputation and customer relationship are most important from the customer perspective for both OESs and OEMs; High product quality and delivery reliability are also important factors, however they are all considered an obligatory condition and a standard qualifier.

As differentiating factors, besides price competitiveness, technical capabilities and power to innovate are considered essential USPs for market players and expected to further increase in importance, given the underlying market trends.
A. Megatrends in the commercial vehicle industry
We expect four main trends to shape the commercial vehicle industry over the next decade

Key trends for the truck and trailer market

- **New Logistics**
  - Changes in the logistics landscape will affect today’s customer structure of truck & trailer OEMs – Further growth of large fleets expected
  - Moreover, new players and business models will evolve as the transport industry continues to change towards a digital platform ecosystem
  - Overall, stronger specialization of players (asset heavy vs. asset light) is expected

- **Electrification/alternative drives**
  - CV electrification is driven by regulation and local emission optimization
  - In Europe: need for low/zero emission buses and inner-city delivery vehicles
  - Low TCO benefits limit pull effect from fleets
  - OEMs are facing heavy investment demands – New vehicle architectures required
  - Suppliers may benefit from increase in value add, e.g. electric axles

- **Autonomous trucks**
  - Automated trucks address several challenges: hours-of-service, safety, driver shortages and fuel costs
  - Fast payback of investment can only be achieved in a few applications with a high share of truck platooning in the early stages
  - Significant cost savings are expected only in the long term with driverless trucks
  - Safety regulation will become a major driver

- **Digitalization**
  - The evolution of digital technologies and culture will create new use cases, e.g. in the context of advanced truck & trailer telematics
  - Moreover, AI-based optimization methods drive down congestion, low utilization and costs

Source: Roland Berger
The logistics landscape changes are expected to affect the current customer structure of truck & trailer OEMs

Customer structure – Status quo and trends (example Western Europe)

<table>
<thead>
<tr>
<th>Customer segments</th>
<th>Definition</th>
<th>Fleet size</th>
<th>Market share&lt;sup&gt;1)&lt;/sup&gt;</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner-driver</td>
<td>&gt; Truck driver owns truck&lt;br&gt;&amp; Works as subcontractor and/or covers market niche</td>
<td>1</td>
<td>~15-25%</td>
<td>Affected by market consolidation but covering market niches</td>
</tr>
<tr>
<td>Small/mid-sized fleet operator</td>
<td>&gt; Works as subcontractor and/or covers market niche&lt;br&gt;&amp; Lower professionalization due to lack of economies of scale</td>
<td>2-20</td>
<td>~35-40%</td>
<td>Affected by market consolidation due to competitive disadvantages</td>
</tr>
<tr>
<td>Municipalities</td>
<td>&gt; Fleets operated by public authorities&lt;br&gt;&amp; Transport not a core function</td>
<td>up to 100</td>
<td>~5-10%</td>
<td>Ongoing privatization partly resulting in decreasing relevance</td>
</tr>
<tr>
<td>Special vehicle fleet operator</td>
<td>&gt; Focus on specific transport needs&lt;br&gt;&amp; High professionalization in their segment</td>
<td>1-5</td>
<td>&lt;5%</td>
<td>Stable demand in the coming years expected (depending on industry segment)</td>
</tr>
<tr>
<td>Large fleet operator</td>
<td>&gt; Large logistics providers or large corporate fleets&lt;br&gt;&amp; Highly professionalized, e.g. some with own repair shops</td>
<td>&gt;100</td>
<td>~25-35%</td>
<td>Growth due to cost advantages (e.g. due to own repair shops, improved utilization)</td>
</tr>
</tbody>
</table>

<sup>1</sup) Estimate for Western Europe

Source: Expert interviews; desk research; Roland Berger
The transport industry will continue to change towards a digital platform ecosystem

Surviving players in the logistics industry ("endgame 2030+")

<table>
<thead>
<tr>
<th>Booking &amp; optimization platforms (BOP)</th>
<th>Carrier, terminal operators, trucking companies (CTO)</th>
<th>Supply chain specialists (SCS)</th>
<th>Service providers (SP)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Independent platform for the management of logistics transactions</td>
<td>&gt; Asset holders and operators performing logistics tasks</td>
<td>&gt; Solution provider for complex or industry-specific tasks</td>
<td>&gt; New players, hardware providers and existing online players</td>
</tr>
<tr>
<td>&gt; Route and cost optimization capabilities</td>
<td>&gt; High asset and cost efficiency</td>
<td>&gt; In-depth understanding of industry-specific supply chains</td>
<td>&gt; Provision of support services for logistics companies</td>
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<tr>
<td></td>
<td>&gt; Either specialized or standardized</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Active in multiple industries

Source: Roland Berger

New players in services (especially in BOP)

Profit pool shift away from the business of traditional freight forwarders

Increasing number of large freight carriers & trucking companies vs. supply chain specialists

Stronger specialization of players (asset heavy vs. asset light)
Further new logistics business models will emerge – Today, still mostly related to city transport

New logistics business models – Examples

<table>
<thead>
<tr>
<th>Same-day delivery – shutl.com: Realization of shortest delivery times with attractive pricing on basis of a broad network of carriers and partnerships.</th>
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</thead>
<tbody>
<tr>
<td>Own car as delivery box – Volvo Drop-off/Pick-up System: Testing of a system that allows consumers to have their shopping delivered straight to their car.</td>
</tr>
<tr>
<td>Route optimization – Routific: Smart trucks are navigated by GPS and telematics data to ensure optimized route and capacity utilization.</td>
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<tr>
<td>Smart Trucks – DHL: DHL combines advanced technology with dynamic route planning in its vehicles to increase efficiency in both pickup and delivery.</td>
</tr>
<tr>
<td>City freight consolidation platform – CARGONEXX: Brokerage service for bundling of shipments from different wholesalers/manufacturers to serve customers within one specific area.</td>
</tr>
<tr>
<td>Smartlane is an easy-to-use web-based delivery management software focusing on automated tour planning and optimizing as well as simplified process controlling.</td>
</tr>
<tr>
<td>City freight consolidation platform – Cargo hopper: Provision of efficiently bundled shipments through electric transportation vehicles.</td>
</tr>
<tr>
<td>Digital logistics agents – Sennder: Digital logistics agent and full forwarding service for entire transportation route. Avoiding different subcontractors reduces transportation costs. InstaFreight follows the same business model.</td>
</tr>
<tr>
<td>FTL freight brokerage for shippers and carriers – Transfix: Manufacturers &amp; distributors can connect with a truck driver network shipping long-haul freight across the U.S. Parties are connected by a mobile app.</td>
</tr>
<tr>
<td>Shared logistics concept – Gogovan: Offering of logistics-on-demand, e.g. in Hong Kong – Currently &gt;26,000 registered drivers.</td>
</tr>
<tr>
<td>Potential city logistics concepts – FreightExchange: Without a specific time schedule, hitchhiking is the most efficient mean of transportation as operators can sell unused capacity to businesses that need to ship goods.</td>
</tr>
<tr>
<td>RYTLE provides the first holistic and interconnected concept of city logistics. Consists of a unique cargo bike called MOVR, a standardized BOX and a mobile HUB.</td>
</tr>
<tr>
<td>Quiqup is a London-based on-demand delivery company formed in 2014. Founded originally to let consumers order anything for local same-hour delivery, Quiqup has since expanded its proposition to provide last mile delivery to businesses of any size and sector.</td>
</tr>
</tbody>
</table>

1) Full truck load

Source: Company information; Roland Berger
Regulation, for example access restrictions in cities, is expected to drive electrification of trucks and buses

Overview of selected city access restrictions – Examples

<table>
<thead>
<tr>
<th>City</th>
<th>Future restrictions</th>
<th>Expected impact on buses and trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>- In 2019 an Ultra Low Emission Zone (ULEZ) will be established&lt;br&gt;- Until October 2021 it will cover the same area as the congestion charge zone – Thereafter expansion to an area bounded by North &amp; South Circular&lt;br&gt;- Trucks, buses and coaches need to meet Euro VI emission standards&lt;br&gt;- Daily charges if restrictions are not met</td>
<td>A possible diesel ban or ICE ban could significantly influence the transportation sector as well as the public transport sector as there are a multitude of applications for inner-city driving:&lt;br&gt;MDT: Delivery trucks for shops; HDT: Construction sector; Bus: Local transportation</td>
</tr>
<tr>
<td>Paris</td>
<td>- Since July 2016, all vehicles must reach at least Euro 1 emission standards&lt;br&gt;- Between 2017 and 2020, Euro 2, 3 and 4 will be phased out&lt;br&gt;- The anti-pollution plan further envisages a ban on old diesel vehicles and a complete ban on diesel cars by 2020&lt;br&gt;- Free parking for electric vehicles</td>
<td></td>
</tr>
<tr>
<td>Hamburg</td>
<td>- Partial access restrictions have been put in place (April 2018) on specific routes into the city for trucks not meeting Euro VI standards&lt;br&gt;- Further and more restrictive access restrictions expected in other German cities until 2019 (e.g. Stuttgart)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Press; Roland Berger
Aside from regulation, applicability of BEV and HEV strongly depends on respective use cases

Use cases for BEV/HEV – Examples

<table>
<thead>
<tr>
<th>Use case</th>
<th>Intracity / urban</th>
<th>Construction</th>
<th>Long haul</th>
<th>Short haul</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment</td>
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<tr>
<td>Medium</td>
<td></td>
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<td>Heavy</td>
<td>Heavy</td>
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<tr>
<td>Duty</td>
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<tr>
<td>Travel dist. p.a.</td>
<td>~40,000 km</td>
<td>~20,000 km</td>
<td>~100,000 km</td>
<td>~75,000 km</td>
</tr>
<tr>
<td>Tank volume</td>
<td>100-300 l</td>
<td>100-300 l</td>
<td>500-700 l</td>
<td>300-500 l</td>
</tr>
<tr>
<td>Fuel type</td>
<td>Diesel</td>
<td>Diesel</td>
<td>Diesel</td>
<td>Diesel</td>
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<tr>
<td>Ø mileage per day</td>
<td>≤ 50 km</td>
<td>50-100 km</td>
<td>&gt;100 km</td>
<td>&lt;100 km</td>
</tr>
<tr>
<td>Highway use</td>
<td>low</td>
<td>low/medium</td>
<td>high</td>
<td>medium</td>
</tr>
</tbody>
</table>

Indication of priority based on TCO

- BEV vs. HEV

= Expected focus of new vehicle registrations (Europe 28) ≥ 1% of total registrations

Source: Company information; expert interviews; Roland Berger
Launch of several new xEV-MDT/HDT models is planned for the coming years – Multiple third-party outfitters already active

Planned SOPs of selected xEV-MDT/HDT models

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<tr>
<td>MDT</td>
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<td>DAIMLER</td>
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<td>100-370</td>
<td>BEV</td>
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<tr>
<td>eMoss</td>
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<td>50-200</td>
<td>BEV</td>
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<td>BYD</td>
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<td>50-300</td>
<td>BEV</td>
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<td>DAIMLER</td>
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<td></td>
<td></td>
<td>200</td>
<td>BEV</td>
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<tr>
<td>E-FORCE E18</td>
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<td></td>
<td>160-500</td>
<td>BEV</td>
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<tr>
<td>Emoss EMS 16/18 Series / EVER Semi/Rigid</td>
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<td>200-400</td>
<td>BEV</td>
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<tr>
<td>E-Moss</td>
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<td>350</td>
<td>BEV</td>
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<tr>
<td>E-Moss</td>
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<td></td>
<td>125-250(1)BEV + RE(2)</td>
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<td>800-1600</td>
<td>FCEV</td>
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<td>n.a.</td>
<td>BEV</td>
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<td></td>
<td>200-300</td>
<td>BEV</td>
</tr>
</tbody>
</table>

1) EVER Semi/Rigid range >250 km  2) CNG/LPG Range extender; EVER Semi/Rigid only  3) According to company announcements

Source: Official company information; press research; IHS; Roland Berger
The emergence of autonomous driving is one of the key disruptive trends and will trigger changes in products and services.

Technology roadmap autonomous driving

Stage 0: No Automation
- Driver is fully engaged all the time, warning signals might be displayed

Stage 1: Driver Assistance
- Automation of individual function, driver fully engaged – Driver may be "feet off" (when using ACC) or "hands off" (when using Lane Keep Assist)

Stage 2: Partial Automation
- Automation of multiple functions, driver fully engaged – Driver may be both "feet-off" and "hands off", but eyes must stay on the road

Stage 3: Conditional Automation
- Automation of multiple functions, driver responds to a request to intervene – Driver may be "feet-off", "hands off" and "eyes off", but must be able to resume control quickly

Stage 4: High Automation
- Automated in certain conditions, driver not expected to monitor road – Driver has no responsibility during automated mode

Stage 5: Full Automation
- Situation independent automated driving – Driver has no responsibility during driving

Increasing influence on future truck product and service concepts

Source: SAE, Roland Berger
The evolution of digital technologies and culture will create new use cases, for example, in the context of advanced truck & trailer

Truck telematics data and potential use cases (examples)

**Truck management**
- Mileage
- Distance traveled
- Engine performance
- Tire pressure

**Use cases:**
- Predictive maintenance
- Remote diagnostics
- Engine and fuel consumption improvements real time
- Platooning
- ... 

**Driver management**
- Travel profile
- Driver behavior
- Entertainment

**Use cases:**
- "Pay how you drive"
- Location-based services
- Warnings for inappropriate driving
- ...

**Logistics management**
- Navigation
- Parking
- Location
- Route planning
- Freight optimization

**Use cases:**
- Parking assistance (search, payment, etc.)
- Fleet management
- Last mile information to customer
- ...

**Other**
- Toll
- Driver assistance
- Theft protection
- Marketing

**Use cases:**
- eCall
- Road assistance including augmented reality
- Vehicle tracking and theft protection
- Remote truck steering
- "Take a lunch break – 20% off"
- ... 

Source: Roland Berger
Digitalization will drive the creation of a completely new truck service scenario in the future

Future service scenario
The speed with which the four megatrends develop depends on related regulation – Overall, regulatory pressure is increasing

Overview: Regulation and regulatory pressure – Example Europe

<table>
<thead>
<tr>
<th>Vehicle/technology-related regulation</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td><strong>Reg. pressure</strong></td>
<td><strong>Rationale</strong></td>
</tr>
<tr>
<td>Emission standards</td>
<td></td>
<td>Further tightening of emission standards announced and expected (incl. CO$_2$)</td>
</tr>
<tr>
<td>Zero emission zones</td>
<td></td>
<td>Zero/low emission zones planned especially for urban areas in key EU markets (e.g. GER, IT, NL, UK)</td>
</tr>
<tr>
<td>Special regulations for electric vehicles</td>
<td></td>
<td>Beneficial regulatory impact expected for xEV trucks</td>
</tr>
<tr>
<td>Size &amp; load</td>
<td></td>
<td>Easing of restrictions (e.g. Germany 2017) – Further liberalization expected</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
<td>Tightening of standards discussed by EU commission including mandatory installation of certain ADAS</td>
</tr>
<tr>
<td>Platooning</td>
<td></td>
<td>As a form of autonomous driving is expected to be fostered by regulatory framework</td>
</tr>
<tr>
<td>Autonomous driving</td>
<td></td>
<td>Favorable regulatory framework expected to be introduced fostering autonomous driving</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transportation-related regulation</th>
<th></th>
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<tbody>
<tr>
<td><strong>Type</strong></td>
<td><strong>Reg. pressure</strong></td>
<td><strong>Rationale</strong></td>
</tr>
<tr>
<td>Cabotage restrictions</td>
<td></td>
<td>European Commission enforcing liberal cabotage rights – Expected to push for further liberalization</td>
</tr>
<tr>
<td>Tolls &amp; road charges</td>
<td></td>
<td>Increasing pressure due to rising tolls (e.g. AT, CH) and introduction in new countries (e.g. EST)</td>
</tr>
<tr>
<td>Driving times and rest periods</td>
<td></td>
<td>Strict regulation by the European Commission in place – Enforcement to be intensified in future (e.g. FR, BE)</td>
</tr>
<tr>
<td>Minimum wages</td>
<td></td>
<td>Increasing pressure on logistics providers due to introduction of minimum wages e.g. in Germany</td>
</tr>
<tr>
<td>Self-employment of drivers</td>
<td></td>
<td>Stricter enforcement of existing regulation against quasi-self-employment to combat pressure on wages</td>
</tr>
<tr>
<td>Cross-border order placement</td>
<td></td>
<td>Strict enforcement of existing regulation to combat pressure on wages by drivers from Eastern European countries</td>
</tr>
</tbody>
</table>

Expected regulatory pressure:  | Very low | Very high |

1) Trucking companies can disposition orders to foreign countries only via employing subsidiary and not local subsidiary

Source: Market expert interviews, Roland Berger
The regulatory push is considered the major driving force for technology upgrades within commercial vehicle systems globally.

### Key regulations by region

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<td><strong>EMEA</strong></td>
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<tr>
<td>Europe</td>
<td>ABS/EBS EURO VI</td>
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<td>AEB &amp; LDWS</td>
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<td>Russia</td>
<td>ABS EURO V</td>
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<td><strong>North America</strong></td>
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<td>United States</td>
<td>ABS EPA 10</td>
<td>EPA 16</td>
<td>EPA 17</td>
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<td>EPA 21</td>
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<td>Brazil</td>
<td>ABS based on EURO V</td>
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<td>Rota 2030®</td>
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<td><strong>APAC</strong></td>
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<tr>
<td>India</td>
<td>ABS EURO IV</td>
<td>BS IV</td>
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<td>BS VI (Euro VI)</td>
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<tr>
<td>Japan</td>
<td>ABS EURO VI</td>
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<td>AEBS, ESC</td>
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<td>LDWS</td>
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<tr>
<td>China</td>
<td>ABS CHINA V</td>
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<td>nationwide</td>
<td>CHINA V</td>
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<td>CHINA VI</td>
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<td>EBS dangerous goods veh. &gt; 12t</td>
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<td></td>
<td>ESC, FCW, LDWS, LKAS, AEBSS</td>
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</tr>
</tbody>
</table>

- Emission standard (toxic emissions and fuel efficiency)
- Electronic systems (brake control and ADAS)
- Expected/in discussion

1) Approved on 15.05.2018, government intends to stimulate energy efficiency and vehicle safety, details to be confirmed.

Source: Market research; Market expert interviews; Roland Berger
"LEAD" dimensions are expected to shape the truck and trailer market until 2030

Key trends and implications for the truck and trailer market – Example Europe

| Megatrends | Sub-trends | Relevance over time (indicative) | | |
|------------|------------|---------------------------------|---|
| New Logistics | Shift towards large fleet customers | ![Relevance over time](image) | 2017 | 2020 | 2025 | 2030 |
| | Emergence of new players & business models | ![Relevance over time](image) | | | | |
| | Specialization of logistics players | ![Relevance over time](image) | | | | |
| Electrification/alternative drives | New vehicle architectures | ![Relevance over time](image) | | | | |
| | Higher component technology content | ![Relevance over time](image) | | | | |
| | Need for electronics competence | ![Relevance over time](image) | | | | |
| Autonomous trucks | Emergence of truck platooning¹ | ![Relevance over time](image) | | | | |
| | Role of driver losing importance | ![Relevance over time](image) | | | | |
| | Increasing annual mileage | ![Relevance over time](image) | | | | |
| Digitalization | Emergence of fleet mgmt. solutions | ![Relevance over time](image) | | | | |
| | New service providers enter value chain | ![Relevance over time](image) | | | | |
| | Shorter innovation cycles | ![Relevance over time](image) | | | | |

Impact on volume | Impact on profitability
--- | ---
OEM | Supplier
--- | ---

1) Depending on region, e.g. early adoption in US likely

Source: Roland Berger
B. Truck & trailer market development (spotlight on Europe)
This study covers medium and heavy trucks, buses >8t and trailers – Global focus, with a regional spotlight on Europe

Regional and country scope of this study

**Truck and bus production**

- Europe
- North America
- South America
- APAC
- China

**Trailer production**

- Western Europe
  - Austria
  - Belgium
  - Croatia
  - Denmark
  - Finland
  - France
  - Germany
  - Ireland
  - Italy
  - Luxembourg
  - Netherlands
  - Norway
  - Portugal
  - Serbia
  - Spain
  - Sweden
  - Switzerland
  - United Kingdom

- Eastern Europe
  - Belarus
  - Bulgaria
  - Czech Republic
  - Estonia
  - Hungary
  - Latvia
  - Lithuania
  - Poland
  - Romania
  - Russia
  - Slovakia
  - Slovenia
  - Ukraine
  - Turkey

1) Including Russia/CIS and Turkey
2) Japan, Korea and India only
3) Considered for truck/bus production; excluded in trailer analysis

Source: Roland Berger
Roland Berger has conducted approximately 80 interviews with market experts to evaluate the truck & bus and trailer market.

Overview of market expert interviews conducted [#]

<table>
<thead>
<tr>
<th>Interviewees</th>
<th>truck &amp; bus</th>
<th>trailer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By geography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe¹,²</td>
<td>16</td>
<td>Europe¹,²</td>
</tr>
<tr>
<td>North/South America¹</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>APAC¹,³</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>China¹</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td><strong>By expertise</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>11</td>
<td>OES Sales/ OEM Purchasing</td>
</tr>
<tr>
<td>OES Sales/ OEM Purchasing Strategy/Marketing/ General Mgmt.</td>
<td>31</td>
<td>Strategy/Marketing/ General Mgmt.</td>
</tr>
<tr>
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<td></td>
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<tr>
<td><strong>∑</strong></td>
<td>51</td>
<td><strong>∑</strong></td>
</tr>
</tbody>
</table>

1) Other markets were also covered in interviews  2) Including Russia/CIS and Turkey  3) China excluded

Source: Roland Berger
In Europe, besides the impact of megatrends, a set of region-specific drivers will determine the development of the market.

Key drivers for the truck and trailer market – Example Europe

<table>
<thead>
<tr>
<th>Market drivers</th>
<th>Relevance</th>
<th>Direction of influence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macroeconomic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP development$^1$</td>
<td></td>
<td></td>
<td>Short/mid-term GDP in Europe will drive global truck and trailer demand. Stronger growth for Eastern European countries is forecast.</td>
</tr>
<tr>
<td>Business climate change</td>
<td></td>
<td></td>
<td>Short-term indicator with high impact on volatility of truck/trailer business, currently stable in Europe.</td>
</tr>
<tr>
<td>Construction sector</td>
<td></td>
<td></td>
<td>Growth of construction sector to have positive impact on truck and trailer demand.</td>
</tr>
<tr>
<td>Transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of transport tonnage km</td>
<td></td>
<td></td>
<td>Long-term factor of overall transport volume creates the increasing transportation demand driving the truck/trailer industry, especially in the smaller European countries.</td>
</tr>
<tr>
<td>Development of modal split: Road vs. other transport</td>
<td></td>
<td></td>
<td>Road transport vs. other modes of transport (e.g. rail, waterways) is expected to be stable overall.</td>
</tr>
<tr>
<td>Fuel prices</td>
<td></td>
<td></td>
<td>Fuel prices are expected to remain low in the medium term, helping freight forwarders significantly, which also positively impacts truck/trailer demand.</td>
</tr>
<tr>
<td>Emission regulations</td>
<td></td>
<td></td>
<td>Emission regulations are expected to put more pressure on the truck industry – High predictability for OEMs from long-term emission standard cycles.</td>
</tr>
<tr>
<td>Regulatory environment changes</td>
<td></td>
<td></td>
<td>Positive impact expected on truck and trailer demand from implemented/proposed regulatory changes regarding driver assistance and less cabotage restrictions.</td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td>Population is expected to increase slightly in most regions – Marginal positive impact on truck and trailer demand.</td>
</tr>
</tbody>
</table>

Overall | Favorable trends overall

$^1$ Including development of raw material prices, in particular in Brazil

Source: Market research; interviews with market participants; Roland Berger
Forecasts of major truck & trailer market drivers in Europe indicate a further positive development over the upcoming years.

Development of the key truck & trailer market drivers

- Real GPD development [% indexed]
- Construction sector [EUR trillion]
- Population [m people]
- Road transport tonnage km [trillion tkm]

Source: Oxford Economics; IHS; Progtrans; Roland Berger

1) Gross output (real) general construction and specialized construction as well as repair activities for buildings, civil engineering and infrastructure works
In the short and mid term, the truck and bus market is expected to be mostly impacted in three dimensions:

**Clean Mobility**
- Emission reduction by:
  - Tightening of CO₂ emissions standards for heavy-duty vehicles
  - Enhanced aerodynamic efficiency
  - Electrification (primarily metro areas)

**Safe Mobility**
- Reduction of road accidents by:
  - New road safety policies
  - Implementation of additional safety features (e.g. blind spot detection etc.)

**Connected and Automated Mobility**
- Enhanced safety and traffic flow through:
  - V2V/V2X communication (CACC platooning)
  - Increased assisted driving up to Level 3 (enhanced ADAS systems)

> Clean and safe mobility lead to **higher demand** for vehicles with **advanced safety features** and better fuel economy/less emissions, achieved through
- **ADAS (Level 0-2)**, such as advanced emergency braking, lane-keeping assist and cyclist detection systems for trucks
- **Technology upgrades of CV systems**, such as automatic manual transmission and engine emissions systems
> Those trends are expected to take effect within **short and mid-term implementation** (until 2022)
> **Autonomous driving**, fully automated platooning, etc. are expected to materialize **long term** (after 2023)

Source: Market research; Roland Berger
Production of medium/heavy duty trucks and buses is on the rise globally – For Europe, approx. 1% annual increase expected

Annual truck and bus production\(^1\) [k units] by region and CAGR, 18E-22E

1) For medium/heavy duty trucks and buses >8 t   2) Including Russia/CIS and Turkey

Source: IHS, Roland Berger

\(\text{\(x\%\)} = \text{Compound annual growth rate 2018-2022}\)
Global medium / heavy truck and bus production with strong CAGR '16-'18E (7.5%) and almost no growth '18E-'22E (CAGR 0.3%)

Truck and bus production\(^1\) 2016-18E-22E ['000] and delta analysis ['000]

Source: Market expert interviews; Roland Berger

1) for medium/heavy duty trucks and buses >8 t
2) Including Russia/CIS and Turkey
3) China excluded. APAC defined as Japan, Korea and India
Trucks account for 84% of global truck and bus production on average (2016-22E)

Truck and bus production\(^1\) by region, 2016-22E

\[
\begin{align*}
\text{China} & : 2,761, 3,284, 3,188, 3,104, 3,126, 3,178, 3,227 \\
\text{Europe} \^2 & : \\
\text{APAC} \^3 & : \\
\text{NA} & : \\
\text{SA} & : \\
\end{align*}
\]

Share of global truck and bus production
- Truck and bus production in China accounts for 42% of global production on average (2016-22E)
- Europe accounts for 21%, APAC for 20% and North America for 13% of global production on average (2016-22E)

Share of bus production in region
- Production rate for buses is not reported separately in USA due to similar platform
- Share of bus production is highest in South America with 25% on average (2016-22E)
- Share of bus production is lowest in Europe with 9% on average (2016-22E)

Source: Market expert interviews; Roland Berger

1) for medium/heavy duty trucks and buses >8 t  
2) Including Russia/CIS and Turkey  
3) China excluded. APAC defined as Japan, Korea and India
Spotlight: Tightening emission standards (for diesel engines as of January 2018) led to a massive "pre-buy" effect in China in 2017

Truck and bus production\(^1\) by region, 2011\(^2\)-23E

Volatile T&B production rate in China
> Weak macroeconomics in 2015
> China accounted for the largest share of global truck and bus production increase from 2016 to 2018
> Tightening emission standards (nationwide):
  – CHINA V (similar to EURO V) required for new diesel vehicle registration from January 2018
  – CHINA VI type approval in 2020

South American economy recovers after recession in 2015/16
> T&B production increases only gradually from a low basis
> Hence governments adopt a cautious approach to new regulations so as not to jeopardize recovery

---

1) for medium/heavy duty trucks and buses >8 t  
2) actual figures are shown for 2011  
3) Including Russia/CIS and Turkey  
4) China excluded. APAC defined as Japan, Korea and India

Source: Market expert interviews; Roland Berger
Key regional truck markets in Europe are dominated by local OEMs – Top 5 players typically account for >70% of production

Medium/heavy duty truck production by region and by OEM, 2017 [%]

1) Excluding buses 2) Incl. Russia and Turkey

Source: IHS Automotive; Roland Berger
Trailer production in Eastern Europe shows slightly stronger growth than in Western Europe

European trailer production by region, 2012-30 [m units]

Source: Clear International; local market research; interviews with market experts; Roland Berger

1) Medium/heavy duty commercial vehicle trailers; 2) Incl. Russia, excl. Turkey; 3) Prognosis, Q1 2017 analyzed and data forecast till end of 2017 based on market interviews/data analyses
Semitrailers constitute the majority of trailer production – Production share of drawbar trailers declining long term

European\(^1\) trailer\(^2\) production by vehicle segment, 2012-30 [m units]

1) Incl. Russia, excl. Turkey; 2) Medium/heavy duty commercial vehicle trailers; 3) Prognosis, Q1 2017 analyzed and data forecast till end of 2017 based on market interviews/data analyses

Source: Clear International; local market research; interviews with market experts; Roland Berger
The trailer production market is still fragmented with a multitude of smaller specialized companies

Trailer\(^1\) production by region and by trailer manufacturer, 2017 [\%, k units]

<table>
<thead>
<tr>
<th>Western Europe</th>
<th>Eastern Europe(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
</tbody>
</table>

1) Medium/heavy duty commercial vehicle trailers; 2) Incl. Russia, excl. Turkey

Source: Clear International; local market research; interviews with market experts; Roland Berger
C. Impact on truck & trailer component suppliers (examples)
Today, the largest share of value in a standard truck tractor lies in powertrain and cabin; increasing value of connectivity systems in future

Truck tractor – Content per vehicle [% of EUR]¹)

**Powertrain**
- Engine
- Transmission/steering
- Exhaust system

**Cabin**
- Exterior
- Interior
- Electrics/electronics
- Comfort/safety

**Chassis**
- Axles
- Brakes
- Suspension
- Wheels/tires

**Systems/connectivity**
- ADAS
- Infotainment
- Telematics

1) Average content per vehicle as OEM cost after assembly, considering penetration rates

Source: Roland Berger

Indication based on standard European HDT (>15t GVW)

Value add by OEM vs. suppliers: "+" = high value add by OEM, "-" = high value add by supplier

Development of value share until 2030

Overall component value from low to high

Sample component for deep dive
Braking systems and intelligent steering systems are key enablers for increased ADAS penetration by 2022

Automated commercial vehicle development paths with focus by 2022

<table>
<thead>
<tr>
<th>Level 0</th>
<th>No Automation</th>
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<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Driver Assistance</th>
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</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Level 2</th>
<th>Partial Automation</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 3</th>
<th>Conditional Automation</th>
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</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

2018

- Blind spot detection
- Collision warning system
- Lane departure warning
- Driver monitoring system
- Traffic sign recognition

2022

- Emergency braking
- ACC
- Lane keep assist
- Driver-assisted truck platoon (CACC)

Market feedback

"...strongly believe that automation Level 3 will be skipped since it offers no TCO benefit. Expect operators to go into Level 4 directly once available."

Rolland Berger

2018-2022 Timeline shows when market penetration of viable applications is expected

1) Advanced steering and braking systems as enabler for ADAS
2) Equipment rates of ADAS (Level 1-2) are expected to increase globally due to increasing road safety standards
3) CACC Platooning (Level 1) realized by decreasing minimum distance between multiple trucks and synchronization of braking via V2V
   - Improved fuel economy (up to -10%) only achieved with experienced drivers of platoon lead vehicle
   - CACC Platooning expected to remain a niche application within next 5 years (primarily tested by large fleets) since TCO effect is not consistent or easy to reap
4) Automated truck platooning expected once Level 4/5 permits driverless trucks (significant TCO reduction), expected for >2025

Source: ERTRAC; market expert interviews; Roland Berger
Technology upgrade due to regulatory push/operational pull is expected to be a main driver of future market value growth

<table>
<thead>
<tr>
<th>Emission standards</th>
<th>Further tightening of emission standards announced and expected (incl. CO₂)</th>
<th>Engine air</th>
<th>Technology upgrade of CV systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>Tightening of standards, including mandatory installation of certain ADAS</td>
<td>Braking and steering systems</td>
<td></td>
</tr>
<tr>
<td>Zero/low emission zones</td>
<td>Zero/low emission zones planned, esp. for urban areas in key markets</td>
<td>Electrification</td>
<td></td>
</tr>
</tbody>
</table>

**Operational pull**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Major impact on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction of total cost of ownership (TCO)</td>
<td>Better fuel economy</td>
<td>Powertrain</td>
</tr>
<tr>
<td></td>
<td>Reduced driver strain</td>
<td>Transmission, ADAS</td>
</tr>
<tr>
<td></td>
<td>Optimized damage and operational costs</td>
<td>Braking and steering syst., ADAS</td>
</tr>
<tr>
<td>Driver shortage</td>
<td>US trucking industry facing growing driver shortage</td>
<td>ADAS, Transmission</td>
</tr>
</tbody>
</table>

**Techno-logy adoption within each region**

- Further tightening of emission standards
- Increasing road safety standards
- In general sufficient driver availability
- High awareness for safety and sustainability topics
- Driver shortage drives demand for comfort/safety systems
- Optimization of total cost of ownership (TCO)

Source: Market research; Roland Berger
Major technology upgrades for CV systems related to braking, steering, ADAS and powertrain are expected within the next 5 years

<table>
<thead>
<tr>
<th>Braking systems</th>
<th>Steering systems</th>
<th>ADAS</th>
<th>Powertrain</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Shift from drum to disc brakes</td>
<td>&gt; Shift from mechanical to actuated (torque overlay) steering</td>
<td>&gt; Increased penetration of ADAS tags along enhanced braking and steering systems (e.g. AEBS, LDWS)</td>
<td>&gt; Shift from manual to automated manual (AMT) and fully automated transmissions</td>
</tr>
<tr>
<td>&gt; Implementation of brake controls, such as EBS(^1) and ESC(^2)</td>
<td>&gt; Increased capability for automated change of vehicle direction (e.g. highway lane change)</td>
<td></td>
<td>&gt; Implementation and advancement of engine emission regulation, such as EGR(^5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Key enablers for further levels of automation (Levels 3-5)</td>
<td>&gt; E-mobility starting to evolve, primarily in (Chinese) metro areas</td>
</tr>
</tbody>
</table>

1) Electronic braking system  2) Electronic stability control  3) Autonomous emergency braking system  4) Lane departure warning system  5) Exhaust gas recirculation

Source: ERTRAC, market expert interviews; Roland Berger
Varying technology standards and equipment rates indicate further potential for market growth of selected CV systems.

<table>
<thead>
<tr>
<th>Established technology</th>
<th>Technology upgrade</th>
<th>West. Europe</th>
<th>East. Europe</th>
<th>NA</th>
<th>SA</th>
<th>APAC</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum brake systems</td>
<td>Disc brake systems(^1)</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td></td>
<td>EBS, ESC</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td>ABS</td>
<td>Semi/fully automate transmission</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td>Manual transmission</td>
<td>Engine air</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td>Mechanical steering</td>
<td>Torque overlay steering</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td></td>
<td>ADAS(^2)</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
</tbody>
</table>

- 100% EQR\(^3\) of technology upgrade
- 0% EQR of technology upgrade
- Significant increase of EQR
- Increase of EQR
- No significant change of EQR

---

1) Disc brake is already established in Western Europe
2) Systems defined as FCW, LDWS/LKAS, AEBS, ACC, Blind spot assist
3) Equipment rate
4) China excluded

Source: Market expert interviews; Roland Berger
Spotlight on China: Chinese OEMs are expected to increasingly upgrade into advanced CV systems supplied by Western OES

China as the single largest global market for CVs has started to embrace increasing safety and emission standards – albeit starting from a very low penetration level.

Primary market focus is on the upgrade from drum to disc brakes and correspondingly an increased deployment of braking systems (particularly highway transportation).

Prospectively the market is expected to also adopt ADAS, that are currently barely implemented in China – regulation will be a significant accelerator: Starting from 2019 ESC, FCW, LDWS and AEBS will sequentially become mandatory.

China is forecast to provide a significant growth opportunity for CV systems given low penetration levels for advanced braking systems and ADAS. Market experts forecast that Chinese CV OEMs will increasingly upgrade from currently local sourcing of mechanical components to advanced CV systems supplied through Western OES.

Source: Market expert interviews; market research; Roland Berger

Market feedback

"There is indeed a trend from drum brakes to disc brakes due to safety considerations and government regulations. In order to gain more market share, many local companies are trying to transform or extend their business to involve themselves in the disc brake business. However, the foreign manufacturers have already captured some competitive advantages in this business. Foreign brands have occupied 60% to 70% of the disc brake market."

Chinese market expert
Market development is derived bottom up using three main drivers: Equipment rates, unit prices and truck / bus production

Main drivers of the market model

1) Equipment rates defined as portion of newly built vehicles equipped with corresponding component
2) Based on market expert interviews, unit prices are expected to remain stable except for disc brakes in Europe and North America – industrial cost/product optimization offsetting inflationary price increases; Further price sensitivity analyses were not conducted for this market report
3) Including Russia/CIS and Turkey
4) China excluded
5) Market growth defined as increase of value of units equipped into newly built Commercial Vehicles

Split by systems
- Braking systems
- Powertrain
- Steering systems
- ADAS

Split by systems
- Braking systems
- Powertrain
- Steering systems
- ADAS

Split by region
- Europe
- North America
- South America
- APAC
- China

Output
- Value-based CAGR and volume per system and region from 2016 to 2022E with intermediate timesteps 2016-18-22
- Content (component value) per vehicle
Results of market analysis indicate consistent outperformance of CV systems growth vs. truck/bus production

Truck and bus production\(^1\) growth and CAGR\(^2\) of selected CV systems

<table>
<thead>
<tr>
<th></th>
<th>2016-22E</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\text{Europe}^4)</td>
<td></td>
</tr>
<tr>
<td>Truck and bus production(^1)</td>
<td>3.1%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Braking systems</td>
<td>3.5-4%</td>
<td>3.5-4%</td>
</tr>
<tr>
<td>Powertrain</td>
<td>7-8%</td>
<td>8-9%</td>
</tr>
<tr>
<td>Steering systems</td>
<td>9-10%</td>
<td>8-9%</td>
</tr>
<tr>
<td>ADAS</td>
<td>10-12%</td>
<td>17-19%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>All analyzed systems(^3)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.5-7.5%</td>
<td>6.5-7.5%</td>
</tr>
</tbody>
</table>

\(^1\) For medium/heavy duty trucks and buses >8 t 
\(^2\) Based on market value 
\(^3\) CAGR (2016-22E) of absolute value of market growth of the four analyzed component systems 
\(^4\) Including Russia/CIS and Turkey 

Source: Market expert interviews; Roland Berger

> Braking systems remain the backbone of the CV systems market, are expected to grow stronger (~50%) than global truck and bus production

> ADAS are forecast to generate the highest relative as well as absolute increase of value in global CV systems market

> High growth expected of powertrain and steering systems due to technological upgrade as enabler for safety features and subsequent autonomous driving capabilities
Results of market analysis indicate consistent outperformance of CV systems growth vs. truck/bus production

<table>
<thead>
<tr>
<th>Truck and bus production(^1) growth and CAGR(^2) of selected CV systems</th>
<th>2016-18E</th>
<th>Global</th>
<th>2018E-22E</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck and bus production(^1)</td>
<td><strong>Europe(^4)</strong></td>
<td>6.9%</td>
<td>7.5%</td>
<td><strong>Europe(^4)</strong></td>
</tr>
<tr>
<td>Braking systems</td>
<td>6-7%</td>
<td>8-9%</td>
<td>1.5-2.5%</td>
<td>1.5-2%</td>
</tr>
<tr>
<td>Powertrain</td>
<td>8-10%</td>
<td>10-11%</td>
<td>6-7%</td>
<td>7-8%</td>
</tr>
<tr>
<td>Steering systems</td>
<td>9-10%</td>
<td>10-11%</td>
<td>9-11%</td>
<td>7-8%</td>
</tr>
<tr>
<td>ADAS</td>
<td>11-13%</td>
<td>20-22%</td>
<td>9-11%</td>
<td>16-18%</td>
</tr>
<tr>
<td>All analyzed systems(^3)</td>
<td>8-9%</td>
<td>9.5-10.5%</td>
<td>5-7%</td>
<td>5-6%</td>
</tr>
</tbody>
</table>

\(^1\) For medium/heavy duty trucks and buses >8 t
\(^2\) Based on market value
\(^3\) CAGR (2016-18E and 2018E-22E) of absolute value of market growth of the four analyzed component systems
\(^4\) Including Russia/CIS and Turkey

Source: Market expert interviews; Roland Berger
Braking systems will remain a backbone of the CV systems market – Even stronger increase expected from higher ADAS penetration

Volume of selected CV systems (2016-22E)

<table>
<thead>
<tr>
<th></th>
<th>Volume¹) [EUR m]</th>
<th>Volume difference¹) [EUR m]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Europe²)</td>
<td>Global</td>
</tr>
<tr>
<td>Braking systems</td>
<td>700</td>
<td>2,575</td>
</tr>
<tr>
<td></td>
<td>850</td>
<td>3,150</td>
</tr>
<tr>
<td>Powertrain</td>
<td>250</td>
<td>775</td>
</tr>
<tr>
<td></td>
<td>375</td>
<td>1,300</td>
</tr>
<tr>
<td>Steering</td>
<td>175</td>
<td>575</td>
</tr>
<tr>
<td></td>
<td>325</td>
<td>950</td>
</tr>
<tr>
<td>ADAS</td>
<td>300</td>
<td>425</td>
</tr>
<tr>
<td></td>
<td>550</td>
<td>1,150</td>
</tr>
<tr>
<td>Total</td>
<td>1,425</td>
<td>4,350</td>
</tr>
</tbody>
</table>

² Including Russia/CIS and Turkey

¹ Rounded to nearest EUR 25 m

Source: Market expert interviews; Roland Berger
Geographically, Europe is expected to provide the second largest absolute increase, after North America.

### Volume and content per vehicle of selected CV systems by region (2016-22E)

<table>
<thead>
<tr>
<th>Region</th>
<th>Volume¹ (volume difference) [EUR m]</th>
<th>Content per vehicle² (CAGR) [EUR/vehicle]</th>
<th>Volume difference¹ [EUR m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe³</td>
<td>1,425 - 2,100 +675</td>
<td>2,425 - 3,000 +4%</td>
<td>100</td>
</tr>
<tr>
<td>NA</td>
<td>650 - 1,350 +700</td>
<td>2,000 - 3,225 +8%</td>
<td>175</td>
</tr>
<tr>
<td>SA</td>
<td>125 - 225 +100</td>
<td>1,375 - 1,475 +1%</td>
<td>550</td>
</tr>
<tr>
<td>APAC⁴</td>
<td>750 - 925 +175</td>
<td>1,250 - 1,400 +2%</td>
<td>675</td>
</tr>
<tr>
<td>China</td>
<td>1,400 - 1,950 +550</td>
<td>1,225 - 1,500 +4%</td>
<td>700</td>
</tr>
<tr>
<td>Total</td>
<td>4,350 - 6,550 +2,200</td>
<td>1,575 - 2,025 +4%</td>
<td>2,200</td>
</tr>
</tbody>
</table>

1) Rounded to nearest EUR 25 m  
2) Rounded to nearest EUR 25  
3) Including Russia/CIS and Turkey  
4) China excluded

Source: Market expert interviews; Roland Berger
Braking systems will continue to play a major role in all regions, ADAS increase mainly in Europe and North America

Volume\(^1\) [EUR m] for selected CV system and CAGR\(^2\) (2016-22E) per region

> Market growth of braking systems mainly due to shift from drum to disc brake, unit prices are expected to remain constant
> Shift to disc brakes mainly due to tighter safety regulations and TCO benefits
  – Increased safety (shorter braking distance) and reduced damage costs
  – Slower shift in APAC given low truck speeds
> Overall, strong growth of disc brakes\(^5\) greater than growth of truck and bus production
> Regulations for reduced stopping distance push demand for advanced brake control systems, such as EBS and ESC
  – Disc brakes combined with advanced brake control systems yield best stopping performance

Source: Market expert interviews; Roland Berger
Today, the largest share of value in a standard trailer lies in chassis and structural elements; shift towards connectivity systems expected

Trailer – content per vehicle [% of EUR]

Chassis
- Axles
- Brakes
- Suspension

Structural elements
- Exterior
  - Body parts
  - Landing gear
    - Side wings
    - Tail
    - Lighting
- Interior
- Electrics/electronics

Systems/connectivity
- ADAS
- Telematics

Indication based on standard European trailer

<2%  45-50%  50-55%

1) Average content per vehicle as trailer OEM cost after assembly, considering penetration rates

Source: Roland Berger
Example: The European trailer first-fit market for axles, brakes and landing gear is estimated at ~EUR 1.5 bn in 2017

European\(^1\) trailer\(^2\) first-fit component market by product, 2012-30 [EUR bn]

Notes: All CKD fitted components are considered in country of assembly. First-fit market (excl. aftermarket); \(^1\) Incl. Russia, excl. Turkey; \(^2\) Medium/heavy duty commercial vehicle trailers; \(^3\) Prognosis, Q1 2017 analyzed and data forecast till end of 2017 based on market interviews/data analyses \(^4\) Comprising the brake caliper, brake disc and pads

Source: Clear International; local market research; interviews with market experts; Roland Berger
Example: The competitive landscape for landing gears is dominated by large suppliers, while more fragmented for trailer axles.

Indicative European\(^1\) trailer first-fit component production shares, 2016 [\%]

1) Western and Eastern Europe, incl. Russia, excl. Turkey

Source: Annual reports; company information BPW, Knorr-Bremse, SAF Holland, Schmitz Cargobull; expert interviews; Roland Berger
To succeed in the European truck & trailer components market, power to innovate and technical capabilities will become even more important.

Key success factors from OEM customer point of view

<table>
<thead>
<tr>
<th>Success factors</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong brand and reputation</td>
<td>&gt; Strong brand and reputation as one of the most important of the key success factors in Europe</td>
</tr>
<tr>
<td>Strong customer relationship</td>
<td>&gt; Strong customer relationships (fleets) and broad customer portfolio serving both truck and trailer OEMs</td>
</tr>
<tr>
<td>Competitive prices/TCO</td>
<td>&gt; Effective customer approach based on a combined push and pull strategy for OE and aftermarket customers</td>
</tr>
<tr>
<td>High technical capabilities</td>
<td>&gt; Prices remain one of the key criteria – Customers are highly price sensitive</td>
</tr>
<tr>
<td>High delivery performance</td>
<td>&gt; Western European customers are more likely to consider the full TCO</td>
</tr>
<tr>
<td>Power to innovate</td>
<td>&gt; Advanced product features help secure volume in the market</td>
</tr>
<tr>
<td>High quality</td>
<td>&gt; Technical capabilities as one potential USP for many market players</td>
</tr>
<tr>
<td>Geographic proximity and local content</td>
<td>&gt; Power to innovate and capabilities for new variants and products are necessary for differentiation</td>
</tr>
<tr>
<td></td>
<td>&gt; Innovation through cooperation and disruptive thinking are of increasing importance</td>
</tr>
<tr>
<td></td>
<td>&gt; Basic delivery performance is considered an order qualifier, however Just in Time (JIT)/Just in Sequence (JIS) performance and short-term delivery can also be used as a differentiator vs. competitors</td>
</tr>
<tr>
<td></td>
<td>&gt; Basic requirement as order qualifier incl. meeting technical product specifications as well as OEM defined ppm ratios</td>
</tr>
<tr>
<td></td>
<td>&gt; Due to fixed industry standards, individual differentiation via quality is not possible</td>
</tr>
<tr>
<td></td>
<td>&gt; Local content depends on regulation and market specifics and is very important for many markets with specific requirements</td>
</tr>
<tr>
<td></td>
<td>&gt; Homologation and local production adjustments required for certain markets</td>
</tr>
</tbody>
</table>

Source: Interviews with market participants; Roland Berger
D. Roland Berger
Roland Berger is the only leading global consultancy of German heritage and European origin

Roland Berger at a glance

- Founded in 1967 in Germany by Roland Berger
- 50 offices in 34 countries, with around 2,400 employees
- Nearly 220 Partners currently serving over 1,000 international clients
- Broad spectrum of services based on 3 solid pillars: Knowledge, Technology, Capital
- Terra Numerata™ digital ecosystem joining forces with more than 30 leading digital firms
- Global Expert Network of 500 industry specialists

Source: Roland Berger
Our Automotive Competence Center comprises five clusters and has a truly global footprint with more than 300 consultants worldwide.

Automotive Competence Center – Functional clusters and global presence

### Our clusters

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Suppliers</th>
<th>Product creation &amp; technology</th>
<th>Financial &amp; mobility services</th>
<th>Commercial vehicles, agri. &amp; construction</th>
<th>Marketing, sales &amp; aftersales</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Image]</td>
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<td>[Image]</td>
<td>[Image]</td>
</tr>
</tbody>
</table>

### Our global presence

- **USA**
  - 4 Partners
  - 30 Consultants

- **Western Europe**
  - 18 Partners
  - 150 Consultants

- **Eastern Europe**
  - 2 Partners
  - 20 Consultants

- **Russia/CIS**
  - 2 Partners
  - 20 Consultants

- **China/Hong Kong**
  - 3 Partners
  - 40 Consultants

- **Korea**
  - 3 Partners
  - 20 Consultants

- **Japan**
  - 3 Partners
  - 30 Consultants

- **South America**
  - 2 Partners
  - 10 Consultants

- **MENA**
  - 1 Partner
  - 10 Consultants

- **India**
  - 2 Partners
  - 20 Consultants

- **Singapore**
  - 1 Partner
  - 5 Consultants

Source: Roland Berger
Roland Berger is the leading consultancy for the global commercial vehicle industry

Our value proposition

- We are a trusted advisor in the commercial vehicle industry with a longstanding track record at OEMs and suppliers around the globe
- We have a global team of specialized consultants for the commercial vehicle industry as well as our own network of top-class experts with longstanding experience in the commercial vehicle industry
- We are considered thought leaders and in our studies and projects we develop responses to the topics of tomorrow within the commercial vehicle industry
- We cover all functional areas within the commercial vehicle industry, developing implementable solutions for our clients
- We distinguish ourselves by a pragmatic approach, excellent and fast results as well as a cooperative work environment with our clients – For this reason independent studies rank us as #1 in implementation
- We employ new and agile work methods to develop solutions, supported by our analytics team and our digital hub 'Spielfeld' in Berlin

Source: Roland Berger
Within our Automotive Competence Center we have a strong team of experts dedicated to the commercial vehicle industry.

Members of the global Roland Berger Commercial Vehicle team:

- **Dr. Wilfried Aulbur**
  Senior Partner, Chicago

- **Stephan Keese**
  Senior Partner, Chicago

- **Dr. Walter Rentzsch**
  Principal, Chicago

- **Giovanni Schelfi**
  Principal, Chicago

- **Rodrigo Custodio**
  Principal, Sao Paolo

- **Norbert Dressler**
  Senior Partner, Stuttgart

- **Dr. Wolfgang Bernhart**
  Senior Partner, Stuttgart

- **Dr. Matthias Ermer**
  Partner, Munich

- **Frank Pietras**
  Principal, Munich

- **Eric Kirstetter**
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- **Matthieu Simon**
  Principal, Paris

- **Dr. Thomas Schlick**
  Senior Partner, Frankfurt

- **Alexander Brenner**
  Partner, Hamburg

- **Benny Gutman**
  Principal, Gothenburg

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  Senior Partner, Milan

- **Eduard Cherkin**
  Principal, Moscow

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  Senior Partner, Amsterdam

- **Francois Castelein**
  Partner, Brussels

- **Rudolf Kemler**
  Senior Partner, Vienna

- **Rene Seyger**
  Senior Partner, Amsterdam

- **Rudolf Kemler**
  Senior Partner, Vienna

- **Satoshi Nagashima**
  Senior Partner, Tokyo

- **Jeffry Jacob**
  Partner, Mumbai

- **Martin Tonko**
  Partner, APAC

Focus on European market

Source: Roland Berger
Trends in the truck and trailer market –
Your Commercial Vehicle contacts at Roland Berger

Contacts at Roland Berger Automotive Competence Center

<table>
<thead>
<tr>
<th>Name</th>
<th>City</th>
<th>Phone Number</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frank Pietras</td>
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<td><a href="mailto:Benny.Gutman@rolandberger.com">Benny.Gutman@rolandberger.com</a></td>
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