Our clients benefit from our global presence and industry experts in all major regions

Global Presence of Strategy&

- Oldest management consultancy company globally, founded 1914
- Globally leading strategy and management consultancy company
- More than 60 offices on all six continents
- World-wide staff of more than 3,000 people
- Part of the PwC network
- Client list: 400 of the Fortune Top 500 companies

Part of the PwC network
Global trends will have different impact on two principle market situations requiring tailored strategies to success.

**Framework Overview**

**Global Trends**

- Top Market – Industrialized
  - Technology leading
  - Complex logistics process
  - Industrial digitization
  - Cloud services
  - Focus on TCO

- Basic/Value Market – Emerging
  - Technology follower
  - Universal/multi-use transport solutions
  - Limited application of new technologies
  - Sensitive investment costs

Source: Strategy& analysis

PwC Strategy&
Confidential information for the sole benefit and use of PwC’s client.
Digitization will change the entire logistics value chain in four dimensions

**Digitization Impact**

1. **Connectivity, vehicle-to-x communication and autonomous driving** will dominate the technological trends in the top market.

2. Strengthening of emissions regulations and technological developments will lead to a changed logistic system and processes.

3. Many industry stakeholders will be impacted and new opportunities and business cases present themselves to the well prepared stakeholders.
   - Financial attractiveness of many of these cases will lead to increased competition (TCO approach).

4. We expect in the long term a disruptive development in the entire logistics value chain with significant impact on their stakeholders.

Source: Strategy& analysis

PwC Strategy& Confidential information for the sole benefit and use of PwC’s client.

Effects in industrialized regions

Industrialized regions
Emerging regions
Six key technological advancements will lead the way forward

Overview of main technological trends

- Integration in Logistics and Supply Chain Systems
- Remote Diagnostics
- Vehicle-to-Infrastructure Communication
- Automated Freight Matching
- Autonomous Driving
- Vehicle-to-Vehicle Communication

Source: Strategy& analysis
Integration of real time data in logistic systems will lead to automated coordination processes

Integration in Logistics and Supply Chain systems

- Customer orders goods
- Order is received, confirmation sent and load dispatched with connected truck
- Due to traffic or accident the route is automatically calibrated and the ETA adjusted
- Expected delivery time cannot be met anymore
- Automated notifications to the stakeholders about delay, reasons for delay and new ETA
- Automatic integration of new information in logistic and company IT systems
- Automated coordination process takes over, negotiates rate changes and adjusts following logistics process chain with new times and alternative options
- Simple approval of stakeholders

Source: Strategy& analysis

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Digitization can enable more efficient repairs and reduce truck down-time considerably

Remote Diagnostics

- Truck continuously monitors its own maintenance status, notifies issues immediately
- Gives real-time updates to driver and fleet mgmt:

- Issues and problem report are sent to driver and fleet management
- Automated suggestion of closest repair shop (within service agreement) with spare parts available
- Chosen repair shop is automatically contacted
- Diagnostic report instantly transmitted
- Repair shop starts analysis immediately and has contact with fleet management/driver
- With diagnostic report already analysed and problem identified, the repair can start immediately on truck’s arrival
- Larger mechanical problems will result in automatic order of replacement vehicle

Source: Strategy& analysis
A smart trailer can serve as a cornerstone of intelligent telematics systems by providing trailer-level data

Source: Strategy& analysis

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Platooning technology will reduce fuel consumptions and enable to create new business models for service provider

Platooning

- Utilizes vehicle-to-vehicle communications integrated with advanced driving technology, such as adaptive cruise control, collision avoidance systems, radar etc., to allow multiple trucks to drive in a very tight formation at highway speeds
- **Constant communicative link**
- Interlinked trucks follow driving behaviour of lead truck
- Platooning technology can save consider-able fuel costs, depending on trucks position in the platoon (for 3 truck platoon btw. 2 - 11% savings)
- Remuneration payments through internal settlement system
- Truck-&-Car platoons possible

Platooning offers easy operational costs saving through reduced fuel need

Source: Peloton website, Daimler, Lastauto Omnibus (04/16)

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Interconnectivity and advancements in automated load area tracking will pave the road for automated freight matching.

**Automated Freight Matching**

1. Sensor based automatic tracking of used up load area
2. Trailer recognizes its loading status and communicates it to truck; additional trailer information available (e.g. distance, maintenance, etc.)
3. Truck assess current loading weight and available capacity for more efficient transportation
4. Truck communicates loading capacity, scheduled route, ETA and other relevant information with digital freight matching platform
5. Driver and fleet management is notified about available freight sharing opportunities
6. Agreement is struck between truck operator and freight owner/forewarder/negotiator

Additional information can be collected to support trailer location tracking, maintenance organization, rental payments, etc.

Source: Strategy& analysis

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The overhaul of connected and digitized freight matching and transportation is likely to occur in 3 phases

Automated Freight Matching – ‘Uberization’

1. Limited automation
   - Good/product owner notifies of transportation need, information: what, where, when
   - Truck owner/logistics company reports of any spare capacities, information: capacity, where, when, price
   - Software (third party) finds matches, notifies the involved parties and suggests a deal
   - Parties accept or decline

2. Semi-automated freight matching
   - Good/product owner notifies of transportation need
   - Truck automatically uploads information regarding capacity, destination etc.
   - Software (third party/truck owner) finds matching goods to fill loading area and notifies goods owner
   - Good owner accepts/declines suggested price
   - Truck owner accepts trucks suggestion as status quo

3. Fully-automated freight matching
   - Goods and products equipped with connected chip (data: product, single/bundle, destination, latest delivery time) and searches for own transportation
   - Truck automatically uploads information regarding capacity, destination etc.
   - Goods and trucks communicate, find matches, routes and delivery terms
   - Owners accept/reject with a simple button

Degree of connectivity / digitization

Source: Strategy& analysis

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We will see a much more established Hub-and-Spoke network, similar to the aviation industry

**Trucking**

**Hub-and-Spoke**

- Large distribution centres outside of agglomeration areas
- Data-driven routing and freight sharing between the centres
- Last-mile delivery with electrified small-to-medium sized trucks
- Storage time in distribution centre minimal due to just-in-time delivery planning along the entire supply chain

**Vision**

Source: Strategy& analysis

PwC Strategy&
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The Hub-to-Hub connections will be dominated by autonomous trucks

1. Autonomous Trucks

**Vision**

- **Autonomous trucks** will dominate long-distance transportation between large distribution centres outside of agglomeration areas.
- Trucks will have the ability to **drive majority** of Hub-to-Hub route completely **without human interaction**.
- **Platooning** between the centres reduces need for **long-distance drivers**.
- Remaining **drivers** utilize freed up time for logistic **back-office tasks**.
- **First road testing** done in US (Freightliner) and Germany (Mercedes-Benz).

*Source: Photo by Daimler*
Highways will see a considerable increase in XXL trucks in different constellations

3 XXL Trucks

<table>
<thead>
<tr>
<th>XXL Trucks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Motor vehicle with dolly and semitrailer</td>
</tr>
<tr>
<td>B</td>
<td>Articulated truck with semitrailer and trailer</td>
</tr>
<tr>
<td>C</td>
<td>Motor vehicle with two twin axle trailers</td>
</tr>
<tr>
<td>D</td>
<td>Articulated truck with two semitrailer</td>
</tr>
<tr>
<td>E</td>
<td>Extended motor vehicle with semitrailer</td>
</tr>
<tr>
<td>F</td>
<td>Motor vehicle with superstructure and trailer</td>
</tr>
<tr>
<td>G</td>
<td>Motor vehicle with superstructure and three axle trailer</td>
</tr>
<tr>
<td>H</td>
<td>Articulated truck with semitrailer and short three axle trailer</td>
</tr>
</tbody>
</table>

**Vision**

- Currently EU ‘Weights and dimensions’ directive of 1996 still in place, but under review
- Noticeable trend in European countries towards allowing EuroCombis or testing of these (DE, NL, FI, DK, BE, SE)
- Typical allowed mega truck lengths of 25,25m and weight of 60t except Germany with limit to 40/44t
- EuroCombi fuel consumption ~15% less per transported ton than conventional truck
- Transport volume per truck can increase by 50%
- Alignment within European Union and tightening emission regulations will leading to **considerable more large trucks**

<table>
<thead>
<tr>
<th>Country</th>
<th>Length</th>
<th>Weight</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>25.25 m</td>
<td>40/44 t</td>
<td>some federal states</td>
</tr>
<tr>
<td>Denmark</td>
<td>25.25 m</td>
<td>60 t</td>
<td>nationwide</td>
</tr>
<tr>
<td>Netherlands</td>
<td>25.25 m</td>
<td>60 t</td>
<td>nationwide</td>
</tr>
<tr>
<td>Sweden</td>
<td>25.25 m</td>
<td>60 t (ab 06/2016: 64 t)</td>
<td>nationwide, trials with 32m/90t</td>
</tr>
<tr>
<td>Finland</td>
<td>25.25 m</td>
<td>76 t</td>
<td>nationwide</td>
</tr>
</tbody>
</table>
Autonomous truck technology will change completely the truck design

4 Autonomous Truck – Future Shape

Truck Today

- Traditional truck design
- Focus on traditional parameters like powertrain efficiency and advanced cabin design
- Integration of first features regarding autonomous trucking

Limited self driving truck

Autonomous Truck 2030

- Full focus on freight capacity maximization
- Powertrain efficiency and connected/autonomous driving capabilities
- No need for driver centricity

The fully autonomous truck in 2030 will look different from current solutions as e.g. cabin will not be necessary anymore

Source: Strategy& analysis
Hub-to-Delivery will be executed by hybrid and full-electric small to medium sized trucks

Electric, hybrid Trucks

Vision

- Last-mile delivery to end-customer will be executed by small-to-medium sized trucks
- Emission regulations in cities seen as main drivers for hybridization and electrification
- Power train changes will reduce fuel consumption, emissions and general air pollution
- Scale of city traffic and ban on certain vehicles will prevent large trucks from entering cities
- Proof of concept: DHL Group Street-Scooter, electric delivery trucks

Source: Photo by DHL Group, Street-Scooter
We have identified 7 main stakeholder that will be impacted, but can also benefit from these trends

Overview of main technological trends and stakeholders

<table>
<thead>
<tr>
<th>Technological trends</th>
<th>Main stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration in Logistics and Supply Chain Systems</td>
<td>1 Component supplier</td>
</tr>
<tr>
<td>Remote Diagnostics</td>
<td>2 OEMs</td>
</tr>
<tr>
<td>Vehicle-to-vehicle communication</td>
<td>3 Service provider</td>
</tr>
<tr>
<td>Digitized Trucking 2025</td>
<td>4 Logistic provider / trucking company</td>
</tr>
<tr>
<td>Automated Freight Matching</td>
<td>5 Regulators</td>
</tr>
<tr>
<td>Autonomous Driving</td>
<td>6 End-user/customer</td>
</tr>
<tr>
<td></td>
<td>7 Driver</td>
</tr>
</tbody>
</table>

Source: Strategy& analysis

16
Many possible connected service opportunities will be developed from these trends; we have selected 4 +1 business cases.

### Overview stakeholder Impact

<table>
<thead>
<tr>
<th>stakeholder</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Connected truck</td>
</tr>
<tr>
<td>1 Component Supplier</td>
<td>✔️</td>
</tr>
<tr>
<td>2 OEMs</td>
<td>✔️</td>
</tr>
<tr>
<td>3 Service Provider</td>
<td>✔️</td>
</tr>
<tr>
<td>4 Logistic Prv./Truck.Comp.</td>
<td>✔️</td>
</tr>
<tr>
<td>5 Regulators</td>
<td>✔️</td>
</tr>
<tr>
<td>6 End-user/Customer</td>
<td>✔️</td>
</tr>
<tr>
<td>7 Driver</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Source: Strategy& analysis

PwC Strategy&
Confidential information for the sole benefit and use of PwC’s client.
The annual operating costs for a traditional average long-haul truck will be reduced step by step with autonomous driving technologies.

Business Case 5: Operating costs development of traditional average truck

Current Cost Structure 2016 [k€]

- Total fixed costs**
- Total variable costs
- Total operational costs
- Driver
- Total

Future Cost Structure [k€]*

- Operating depreciation, fuel costs, lubricants, Adblue, repair costs
- Interest buying price (1.5%), vehicle-/transport price, break down days, other**
- Fixed depreciation (time dependent)

** Additional investment and operational costs for autonomous technology is included
** Total fixed costs includes tax, testing costs, fixed rate for cleaning and communication costs

Remark: An annual driving basis of 140,000 km was taken
Source: Lastauto Omnibus (05/2016), PwC Strategy& analysis
Based on predicted trends, the logistics value chain will change dramatically.

**Outlook: Transition of the logistic value chain**

**Logistics stakeholder chain today**

- Component supplier
- OEM
- Leasing operator
- Trucking Company
- Logistics operator
- End-customer

**Alternative logistics stakeholder chain 2030**

- Component supplier
- OEM
- Leasing operator
- Trucking Company
- Logistics operator
- End-customer

**Scenario 1:** Autonomy of trucks enables OEM’s participation as mobility service provider combining traditional services of trucking companies and logistics provider as need for drivers and manual coordination decreases.

**Scenario 2a:** Endcustomer will take over parts of the logistics value chain in order to get more control over the hub-and-spoke network as well as the last mile delivery.

**Scenario 2b:** Endcustomer will in some extent expand to the design and manufacturing of specific truck solutions in order to have tailored and cost efficient equipment available.

**Scenario 3:** Outside Tech Giants may enter the market and occupy relevant parts of the entire logistics value chain causing disruptive situations for the traditional players in the value chain.

*Source: Strategy& analysis*

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Digitized trucking will lead to significant changes in the entire logistics value chain with adjusted roles of current and new stakeholders.

### Conclusion and Outlook

#### Technological trends

| I | Integration in Logistics and Supply Chain Systems |
| II | Remote Diagnostics |
| III | Digitized Trucking 2025 |
| IV | Vehicle-to-vehicle communication |
| V | Automated Freight Matching |
| VI | Autonomous Driving |

#### Main stakeholders

1. Component supplier
2. OEMs
3. Service provider
4. Logistic provider / trucking company
5. Regulators
6. End-user / customer
7. Driver

##### Conclusion and Outlook

- **Trucking cost reduction** up to 28% by autonomous driving
- **Main saving potential** is the substitution of driver, but limited by adequate regulatory adaptations
- Development of hub-and-spoke systems is forced by increased emission regulations for urban areas and based on autonomous trucking technologies
- **Last-mile-delivery** will be done by emission free midsize trucks
- **Digitization** will disrupt the entire logistics value chain and enables the market entry of new Tech Giants

Source: Strategy& analysis

PwC Strategy& Confidential information for the sole benefit and use of PwC's client.