U-Shift

- A novel on-the-road modular vehicle concept

Stuttgart, March 2019
DLR - Institute of Vehicle Concepts
Content

• Requirements based on tomorrow's mobility
• U-Shift vehicle concept - "Modularisation On-the-Road"
• Application examples
• U-Shift Family / Modular system
• Comparison Mover-Concepts
• Vision
Trends and Interactions
Technology trends and framework conditions reinforce each other

Diversification of mobility
- Urban measures discourage private vehicles
- New, on-demand business models; away from car ownership

Autonomous driving, connectivity
- Legislative questions are clarified
- Safe and reliable technologies are being developed

Electrification
- Battery prices continue to decline
- Energy density and driving range increase

Ecology and energy efficiency
- Legislative emission limits to be strengthened
- 2°C-target: alternative green technologies are promoted

(free translation, pictures, Internet Bosch, SWR and more)
Disruptive innovations will shape future market for mobility

Future After-Sales Markets
- Goldman Sachs: Components for automated driving (2050) → 300 bn US$
- Yole: Sensor modules (2030) → 36 bn US$
- Boston Consulting: Market for autopilot-functions (2025) → 42 bn US$

Disruptive Innovations combine several factors of success

Disruptive innovation Smart-Phone:
hardware-platforms + Touch Screen + Apps
+ rapid innovation and new markets
= Disruption in cell-phone-marketet

U-Shift project:
modular/electrical vehicle + open platform + urbane application + SAE5 automation
= Disruption in mobility market

Goal U-Shift: → New „Game Changer“

YOLE, Sensors and Data Management for Autonomous Vehicles (2015)
Requirements / Needs

Passenger traffic

Modal-Split by purpose 2014 - Traffic volume

MIV dominant for many driving purposes

Wanted:
- Mobility solution for people with multiple travel purposes
- Integration / Increase PT
- Improving transport efficiency
- Alternative for conventional MIV (Attractive)
- Business models, …

Source: VDV, Verkehr in Zahlen 2016/2017 (excerpt statistics)

MIV = Motorised private transport; PT = Public Transport
Requirements / Needs

Commercial traffic

Share of truck journeys in urban commercial transport

CEP share of tours strongly increasing

Wanted:
- The most universal transport solution for diverse commercial traffic
- Efficient, economic urban freight transport
- Integration / combination into existing logistics infrastructure
- Flexible formats, volumes and weights
- Business models, …

Source: DLR own presentation
**U-Shift** enables change in the mobility sector!

"on-the-road" modularization

**Driveboard:**
- Standardized
- Highly automated
- Electrically driven
- Large quantities (Industry)

**Capsules:**
- Individualized
- Flexible
- Application optimized
- "Simple", low weight, cost effective
- Large no. of variants (SME)

**MIT**: Private
Individual capsule
taxi, fleet, …

**PT**: Peoplemover, district bus, taxi, …

**City-logistics**: CEP, last-mile, retail, crafts, artisan, general cargo, …

* Motorized Individual Transport; # Public Transport; $ Courier Express Parcel; § Small and medium enterprises
Application example: People-Mover

Driveboard + Capsules
- Driverless, flexible, standardisable
- Electrical drive system
- High utilization rates (24/7)
- No charging break (incl. capsule battery)
  → Highly economic

Business model e.g. PT operator [1]
- Procurement driveboards + „PT“-capsule
- Flexibilisation of offer (e.g. Schorndorf [2])
- Outside peak time: Rental / XaaS
  Driveboard to parcel service provider
  → Cost reduction + additional income

[1] Public Transport

Mounting of a „PT“-capsule

On-Peak: - supplementary to PT
  - e.g. Platoon with buses
Off-Peak: - Bus stop (shelter)
  - Capsule depot (e.g. parking garage)
Capsule variants for passenger traffic

**Public transport**
- Side entry (long capsule)
- Various seat arrangements
- Can be integrated into line operation
- Flexibles call bus system / quarter bus
- New terminal stop charging concept

**MIV – (Motorised) individual transport**
- New interpretation: „standing vehicle“
- Reduced space / parking area
- Futuristic capsule design
- Seat arrangements e.g. Face-2-Face
Application example - mobile parcel locker

**Driveboard + Capsules**
- Driverless, flexible, standardisable
- Electrical drive system
- High utilization rate (24/7)
- No charging break (incl. capsule battery)
  → Highly economic

**Business model e.g. postal service**
- Procurement driveboards + „Post“-capsule
- 24h fully automate operation; silent night operation
- Future: capsule-integration in building
  → Cost reduction + extended Service

Delivery of a mobile parcel locker
- User scenario: autonomous night delivery
- Power supply: High driving range with combination of capsule and driveboard battery
- Combinable e.g. wit Hub-2-Home
Capsule variants for commercial traffic

Delivery traffic
- Parcel station, CEP*, end customer
- Supply of warehouse and commerce
- Standard-load carriers (palette, lattice wagon etc.)
- Hub2Hub, Hub2Business, Hub2Home

Service
- Craft, construction
- Mobile workshop
- Municipal services
- Events

Recycling
- Garbage truck (remote control by operator)
- Recycling
- Cleaning vehicles
- Municipal services

* Courier Express Parcel
## U-Shift Vehicle Family

<table>
<thead>
<tr>
<th>Type:</th>
<th>Large</th>
<th>Medium</th>
<th>Small</th>
<th>X-Small</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driveboard:</td>
<td>(L<em>W; mm) 5000 x 2500</em>¹</td>
<td>4000 x 2000</td>
<td>3000 x 1650</td>
<td>1200 x 1200</td>
</tr>
<tr>
<td>Total weight:</td>
<td>(tons) tbd. &lt;&lt; 7.5</td>
<td>3.5 (+ 0.75)*²</td>
<td>tbd. 1.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Range:</td>
<td>(km) 200 (∞)*³</td>
<td>200 (∞)*³</td>
<td>200 (∞)*³</td>
<td>100</td>
</tr>
<tr>
<td>Max. speed.:</td>
<td>(km/h) 80</td>
<td>80</td>
<td>100 (∞)*³</td>
<td>50</td>
</tr>
<tr>
<td>Load:</td>
<td>(„Pallets“) 6 (8)*⁴</td>
<td>3 (4)*⁴</td>
<td>2</td>
<td>1/2</td>
</tr>
<tr>
<td>Cargo:</td>
<td>(Persons) 12 (16 )*⁴</td>
<td>10 (12)*⁴</td>
<td>2 +2</td>
<td>1 +1</td>
</tr>
<tr>
<td></td>
<td>(tons) &gt; 2</td>
<td>&gt; 1</td>
<td>&gt; 0.5</td>
<td>&gt; 0.3</td>
</tr>
</tbody>
</table>

*¹ Maximum width StVZO  
*² incl. battery possible  
*³ with capsule battery  
*⁴ Long capsule (overhang)
## Comparison of modularization strategies

<table>
<thead>
<tr>
<th></th>
<th>Mover</th>
<th>Modular Mover</th>
<th>DLR otr-Modular</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modularization</strong></td>
<td>platform (ex-factory)</td>
<td>“On the road” (hat-change)</td>
<td>“On the road” (horizontal)</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>People- or Cargomover</td>
<td>People- or Cargomover</td>
<td>Overall system</td>
</tr>
<tr>
<td><strong>Standardization</strong></td>
<td>Individual solutions</td>
<td>Individual solutions</td>
<td>High potential</td>
</tr>
<tr>
<td><strong>Payload</strong></td>
<td>Persons or CEP*</td>
<td>Payload area restricted by axles</td>
<td>(similar to ISO container)</td>
</tr>
<tr>
<td><strong>Loading</strong></td>
<td>Manual</td>
<td>Sideward (limited)</td>
<td>Unrestricted person-</td>
</tr>
<tr>
<td><strong>Module changing</strong></td>
<td>Not intended</td>
<td>Complex; e.g. adjustable system in every hat</td>
<td>and commercial transport</td>
</tr>
</tbody>
</table>

*) Courier Express Parcel
Vision – Urban transport in neighbourhoods

Holistic, integrated solution
- Combination of passenger and commercial transport
- Optimal control of whole traffic
- Traffic equalisation, congestion avoidance
- Intermodal transportability (road, rail, air, cable etc. – NGT-station)
- Equalisation power supply (capsule charg.)
- Combined business models:
  - PT, commercial transport, sharing, XaaS

Plug&Drive of driveboards and transport capsules
Modular driveboard-architecture, drive and power modules
Automated vehicle family, capsule variants
Innovative digitalisation / functions (e.g. upgrades „over-the-air“)
Unique vehicle concept with high added value / USPs

U-Shift enables a variety of new vehicle concepts and business models

Radical „rethinking“ of today’s highly integrated solutions
Consistent „on-the-road“ modularisation

New products and services for automotive companies
Market opening for non-automotive companies
Thank you very much for your attention.

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