U-Shift – meeting the requirements of future urban road traffic

Hannover Messe - Germany

Prof. Dr.-Ing. Tjark Siefkes

April, 13th 2021
PROTECTING CLIMATE
PROTECTING CLIMATE

ENSURING MOBILITY
MANAGING TRANSFORMATION

PROTECTING CLIMATE

ENSURING MOBILITY
The German Aerospace Center (DLR)

- Space
- Aeronautics
- Ground Traffic
- Energy
- Digitalization
- Security

Employees: appr. 10,000

Locations: 30

Institutes & Institutions: 54
Thinking in Systems

**Transport System**
- Who will be driving in the future?
- May I ask the train to wait for me?
- Does a bus need a fixed stop?
- What is important when it comes to mobility?

**Psychology**
- What do I fear? Why?
- Who owns the vehicle?

**Technology**
- To whom does a vehicle talk to?
- How much automation do I like?
- What does a vehicle know?
- Who is responsible? CarSharing, Car2Go, Public-Shuttles – who defines the route?

**Sociology**
- What else is the journey for?
- Is an autonomous vehicle more sustainable?

**Business Model**
- Can I execute my mobility through my smartphone only?
- Can I tailor the vehicle? Can cars fly?
- Are street signs and traffic lights required in the future?
- Can I define the route for my mobility?
Decarbonization and New Vehicles
Joint Field of Action for Politics and Industry

CO₂ footprint (European Transport)

Goal achievement with many variables.

If the decarbonization rate* in 2050 is below 90%, the target corridor will easily become very small.

* Primary energy, industry (production) and direct emissions
Urban Cargo Mobility
Friend of Foe?

CEP in Germany, 2017
3,4 bn. Deliveries; Turnover 21 bn. Euro
➢ Annual increase 5-7% within the last five years
➢ 140,000 vehicles
➢ 230,000 employees

Expected CEP in Germany, 2022:
4,5 bn. Deliveries
+ 33%

Sources: Manner-Romberg & Müller-Steinfahrt
EHI Retail Institute

CEP: Courier, Express, Parcel

Chart 8   Prof. Dr.-Ing. Tjark Siefkes • Hannover Fair – Baden-Württemberg Conference • April 2021
China
Total Volume of Express Delivery

![Bar chart showing the total volume of express delivery in China from 2012 to 2017. The volume increased from 5.7 billion in 2012 to 40.1 billion in 2017.]

Factor of 13 in Comparison to Germany

Parcels [Billion]

- 2012: 5.7
- 2013: 9.2
- 2014: 13.9
- 2015: 20.7
- 2016: 31.3
- 2017: 40.1

Source: National Bureau of Statistics of China

August 20, 2018
Problem and Solution
Mobility in urban Areas – Quo Vadis?

Problem situation is multi-layered and highly complex

- Mobility infarction in metropolitan areas
- Health endeavors (e.g. NOX discussion)
- Ecological turnaround (energy transition)
- Increasing competitive pressure from Asia

- High innovation pressure in the economy
- Transformation pressure in the automotive industry
- Fears in society and in politics
- High activism at all levels with low coordination

➢ Leapfrog Innovation Required ➢

"Mayor of Stuttgart goes for Car-free Inner City in 2030"
"The amount of traffic flowing into Stuttgart, is not in line with better urbaniy."

Multiple approaches

- Entangling freight and passenger transport
- Emission-free mobility
- 24/7 operation of capital intensive systems

- Use of digitization
- Flexibility and modularization
- New business models
- Citizen participation
- Integrated approach
U-Shift Vision

Marketability of an on-the-road modular, autonomous vehicle family with electric drive in urban areas

- Opening the mindset of partners and players to completely new applications, vehicles, boundary conditions and methods, detached from evolutionary vehicle development

- Layout of perspectives for industrialization and application in the tension of application potentials, technical challenges, and political constraints

- Standardization of open application technologies, based on a white paper with international participation

➔ Invented in Baden-Württemberg ➙
U-Shift
Urban Mobility for Tomorrow

Drive Board
- Costly components
- 24/7 operation (minus maintenance)
- Quiet night operation
- Autonomous

Cargo Capsules
- Intermodal (size and interfaces standardized)
- Individual functionalities

Passenger Capsules
- On demand
- Edge zone operation (time and place)

Leapfrog Innovation
- Entangling freight and passenger transport
- Emission-free mobility
- 24/7 operation of capital intensive systems
- Use of digitization
- Flexibility and modularization
- New business models
- Citizen participation
- Integrated approach

U-Shift integrates
Vehicle- and Plant Engineering Concepts

[Image of urban mobility vehicle and cargo capsules]
## U-Shift
### Technical Layout

<table>
<thead>
<tr>
<th>Type</th>
<th>Large</th>
<th>Medium</th>
<th>Small</th>
<th>X-Small</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Board: (L*W; mm)</td>
<td>„Lkw / Bus“ 5100 x 2570</td>
<td>„Kleinbus“ 3970 x 2250</td>
<td>„Kleinwagen“ 2340 x 1480</td>
<td>„Micro-Mover“ 1200 x 1200</td>
</tr>
<tr>
<td>Total Weight: (to)</td>
<td>7,5 (+ 0,75)</td>
<td>3,5 (+ 0,75)</td>
<td>200 (+ 0,75)</td>
<td>0,6</td>
</tr>
<tr>
<td>Range: (km)</td>
<td>200 (∞)</td>
<td>200 (∞)</td>
<td>200 (∞)</td>
<td>100</td>
</tr>
<tr>
<td>Max. Speed: (kph)</td>
<td>80</td>
<td>80</td>
<td>tbd. 100</td>
<td>50</td>
</tr>
<tr>
<td>Load: (#pallets)</td>
<td>6 (8)*4</td>
<td>3 (4)*4</td>
<td>1 2+2</td>
<td>1 +1</td>
</tr>
<tr>
<td>(#passengers)</td>
<td>12 (16)*4</td>
<td>10 (12)*4</td>
<td>&gt; 1</td>
<td>&gt; 0,5</td>
</tr>
<tr>
<td>Payload: (to)</td>
<td>&gt; 2</td>
<td>&gt; 1</td>
<td>&gt; 0,5</td>
<td>&gt; 0,3</td>
</tr>
</tbody>
</table>

*1) German StVZO  *2) incl. battery  
*3) with extra battery for capsule  *4) stretched capsule (excess length)

=> U-Shift is scalable <=
U-Shift
The Challenge: Safe and Secure Operation

**Backend**
- Traffic control center, fleet management, strategic route and deployment planning
- per quarter/city tbd.

**Edge Computing**
- On-site control computer (see traffic light switchgear), operational route planning (trajectory, e.g. who, how - speed, where - lane)
- per road section / intersection / roundabout / etc.

**Road Capturing Unit**
- Sensor unit, object recognition (GDPR* compliant)
- Communication e.g. 5G (city: Smart Cells)
- Distance 50-150m (e.g. integration in lantern)
U-Shift - Urban „on-the-road-modular“ Vehicle
SAE-Level 5; electric drive; demonstrated on Stuttgart Fair Grounds

Please visit and enjoy video: https://www.youtube-nocookie.com/embed/ZJtopEtaGeU
U-Shift - Urban „on-the-road-modular“ Vehicle
SAE-Level 5; electric drive; demonstrated on Stuttgart Fair Grounds

Please visit and enjoy video: https://www.youtube-nocookie.com/embed/ZJtopEtaGeU
U-Shift – meeting the requirements of future urban road traffic

Hannover Messe - Germany

Prof. Dr.-Ing. Tjark Siefkes

April, 13th 2021

THANK YOU VERY MUCH!