„Reallabor Schorndorf“

Results from the real-world-laboratory based pilot operation of a demand responsive bus system

European Transport Conference (ETC) 2018, 10 – 12 October Dublin Castle

M. Brost, L. Gebhardt, T. Steiner, E. Neidhardt, A. Brandies, K. Karnahl, A.-M. Ademeit
What is a real-world-laboratory?

The real-world-laboratory approach of the „Reallabor Schorndorf“ is characterized by:

• researching in an inter- and transdisciplinary team with experts from social, technical and computer sciences and various local stakeholders (operators, municipality, politics and citizens)
• experimenting in a real-world setting (operation of a flexible bus system)

Objectives:

• initiate and understand societal transformation
• contribute to implement sustainable mobility solutions
• enhance attractiveness of public transport
• develop virtual vehicle concepts according to specific needs of new systems
Research Questions

- How can public transport be made more convenient and hence attract more users?
- How will a demand responsive transport (DRT) system look like when the system is developed from a user perspective?
- How can users be integrated into the development process?
- What kind of technical and societal challenges are connected to the implementation of a DRT system?
Why develop and test a DRT system for public transport?

Fluctuating demand can create problems for transport services with fixed routes and timetables:

- **High frequency, many routes:**
  - Low load factors or empty buses
  - In off-peak periods

- **Low frequency, few routes:**
  - Unattractive for passengers

Solution approach: A DRT system.
The bus runs where and when it is needed.

Motivation for real-world-laboratory methodology:
Implementing a DRT system challenges developers and passengers. The methodological approach of a real-world-laboratory shall ensure the development of a user-oriented system. Users are included from the beginning of the project, during test operation and evaluation of the system. User feedback is collected and the system is accordingly optimized.
Operation mode and challenges of a DRT system

Major challenges:
System must be flexible, but not too flexible for passengers, minimize changes of departure times, keep detours minimal, but maximize number of passengers (emissions, costs)
Real-world setting for testing the DRT system: City of Schorndorf

- medium-sized major district town (40 000 inhabitants)
- 26 km east of city of Stuttgart (600 000 inhabitants)
- within the catchment area of Stuttgart, part of the public transport system (regional and suburban trains, buses)
- Typical structure for the federal state of Baden-Württemberg
DRT operation area and booking options

- Fixed routes
- DRT route network
- Smartphone app
- Web interface
- Telephone service
- Cooperating partners

Replacement of 2 existing bus lines - DRT system offers:
- high availability
- short walking distances (>200 virtual stopping points)
- direct links (no need to change buses)
- no empty runs
DRT Service Span

System replaces parts of the existing public transport at certain operating times. This implies:

• system must be accessible for any kind of passenger, regardless of disabilities or smartphone possession
• definition of service span must consider passenger numbers and needs of e.g. commuters

Therefore, service span for the 9 month DRT test operation is from Friday afternoon to Sunday night.
Vehicles for DRT Systems

Vehicles used for pilot DRT operation

Virtual vehicle concept for future DRT systems (preliminary result)
Pilot operation data
Trips according to booking system

- 300 to 400 (130 to 200) booked trips** per weekend (shorter service span)
- Over 7500 trips with approx. 8200 passengers since pilot start (as at Sept. 18\textsuperscript{th} 2018)
- Share of rejected trip requests could be significantly reduced (shown in red)

* Weekend with different total service span due to start of test phase or public holidays
** Trips can be booked for one or more passengers
Pilot operation data
Passenger numbers according to bookings

- To allow a better comparison of passenger numbers before and after service span adaption, displayed figures for weekend 1-18 show only passengers that booked trips within the shorter service span applied after weekend 19.
- Statistics show fluctuating passenger numbers due to holidays, special events, weather etc. There is no recognizable general trend at this stage.

* Weekend with different total service span due to start of test phase or public holidays
Pilot operation data
Share of booking options

- Share of bookings via smartphone app is quite high, approximately 60 to 65%.
- Very few bookings via web (higher amount in the beginning due to test bookings).
- Bookings via local cooperation partners (stores etc.) are included in phone service bookings.

* Weekend with different total service span due to start of test phase or public holidays.
Seat load factors according to disposition system

City bus
37 seats, 135 round trips
Ø number of passengers: 3,3
Ø seat load factor 9%

Sprinter City 35
14 seats, 1824 round trips
Ø number of passengers: 2,9
Ø seat load factor 21%

Elena
8 seats, 422 round trips
Ø number of passengers: 2,5
Ø seat load factor 31%

Seat load factor
\[ \text{Seat load factor} = \frac{\text{number of passengers during one round trip}}{\text{seat capacity of the bus used in this round trip}} \]

Seat load factor (weighted average, all round trips, all buses) 22%

All numbers: as at Sept. 18th 2018, preliminary results, 23 weekends, 2,381 trips evaluated, passenger load factor to be calculated

Picture references: st@dtbus.de, Stuttgarter Zeitung
Empty mileage

Share of kilometers driven without passengers

$$\frac{Empty\ bus\ kilometers}{Total\ bus\ kilometers} = 29\%$$

as at Sept. 18th 2018, preliminary result, 23 weekends, 15,734 total bus kilometers
Share of successful valid trip requests

\[
\frac{\text{Number of successful valid trip requests}}{\text{Number of valid trip requests}} = 96\% \text{ (Average)}
\]

**Successful request**: desired trip can be combined with all requests received before

**Invalid request**: sent too far ahead of / too short before bus departure, or requested departure time is not within DRT service span

as at Sept. 18th 2018, preliminary result, 24 weekends, 8,437 valid trip requests evaluated

* Weekend with different total service span due to start of test phase or public holidays
Share of virtual stop usage compared to regular stop usage

Share of using virtual stops as origin or destination of a trip:

\[
\frac{\text{Number of times a trip started or ended at a virtual stop}}{\text{Number of trips} \times 2 \text{ (origins and destinations of all trips)}}
\]

54 %

as at Sept. 18th 2018, preliminary result, 23 weekends, 10,926 used stops evaluated
Generational participation
Baby Boomers are biggest user group

<table>
<thead>
<tr>
<th>Date of Birth</th>
<th>Male</th>
<th>Female</th>
<th>Age 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td></td>
<td>Silent Generation</td>
<td>73 - 98</td>
</tr>
<tr>
<td>n=174</td>
<td></td>
<td>Baby Boomers</td>
<td>53 - 73</td>
</tr>
<tr>
<td>1945</td>
<td></td>
<td>Generation X</td>
<td>38 - 53</td>
</tr>
<tr>
<td>1965</td>
<td></td>
<td>Millennials</td>
<td>23 - 38</td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td>Digital Natives</td>
<td>03 - 23</td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Booking process: generational split
Digital Natives as the revolutionaries

Digital Natives

- VVS-website
- VVS-APP
- Reallabor App
- Telephone hotline
- Cafe or restaurant

Silent Generation
Baby Boomers
Generation X
Millenials
Digital Natives

n=174
Approval rating of the new bus system
Generational divide

- Very dissatisfied
- Somewhat dissatisfied
- Neither satisfied nor dissatisfied
- Somewhat satisfied
- Very satisfied

n=174
Summary, Conclusion and outlook

- DRT pilot operation with temporal replacement of two regular bus routes since March 2018, ongoing until Dec.
- High share of elderly users, hence challenging requirements regarding accessibility and communication
- Satisfaction with DRT system highly dependent on age of users
- With regard to progressing demographic change, DRT systems within public transport must offer adequate accessibility also for elderly people
- Compromise of flexibility, spontaneity and planning reliability for users must be found
- Preliminary results of analysis of booking system data and quantitative/qualitative surveys are available
- Analysis is planned to be completed end of January 2019
www.reallabor-schorndorf.de

Partners: German Aerospace Center (DLR e.V.), University of Esslingen, University of Stuttgart - ZIRIUS, Verkehrs- und Tarifverbund Stuttgart (VVS), Knauss Linienbusse, City of Schorndorf
Participatory processes and formats

- Requirements-analysis
- Development & Prototyping
  - DRT system + vehicle concept
- DRT operation
- Evaluation

- Workshops
- Participating observation
- Surveys, Interviews
  - Test users
- Manifold dialogue formats
Operation mode and challenges of a DRT system

Major challenges:
System must be flexible, but not too flexible for passengers, minimize changes of departure times, keep detours minimal, but maximize number of passengers (emissions, costs)