

## „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

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Wissen für Morgen



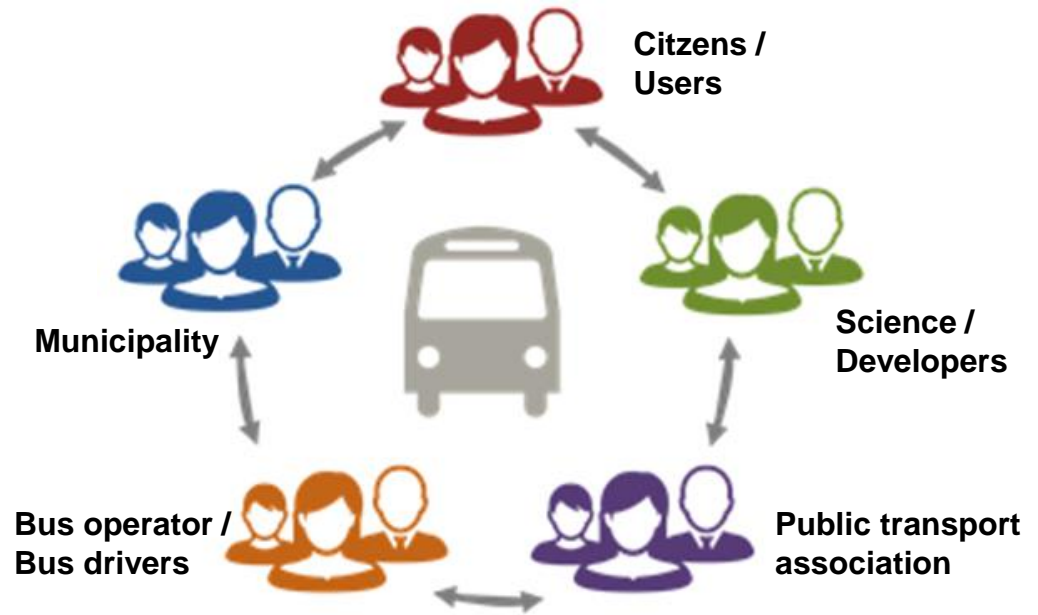
# What is a real-world-laboratory?

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?

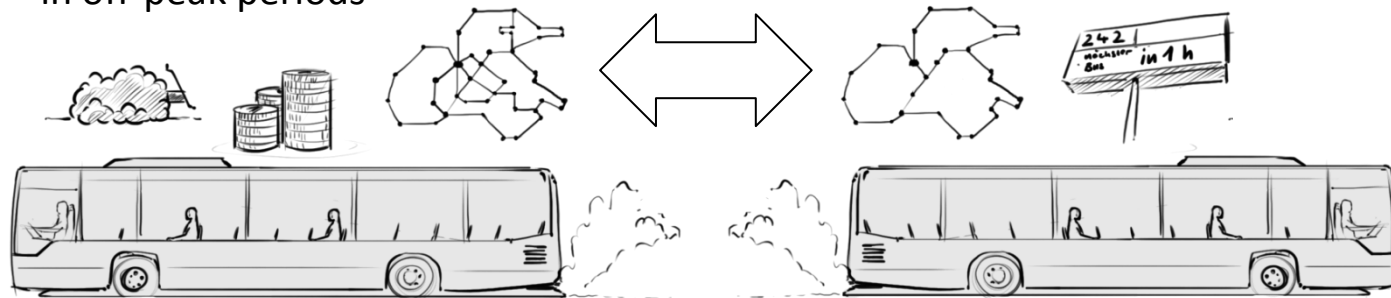


# Why develop and test a DRT system for public transport?

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

high frequency, many routes:  
low load factors or empty busses  
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.

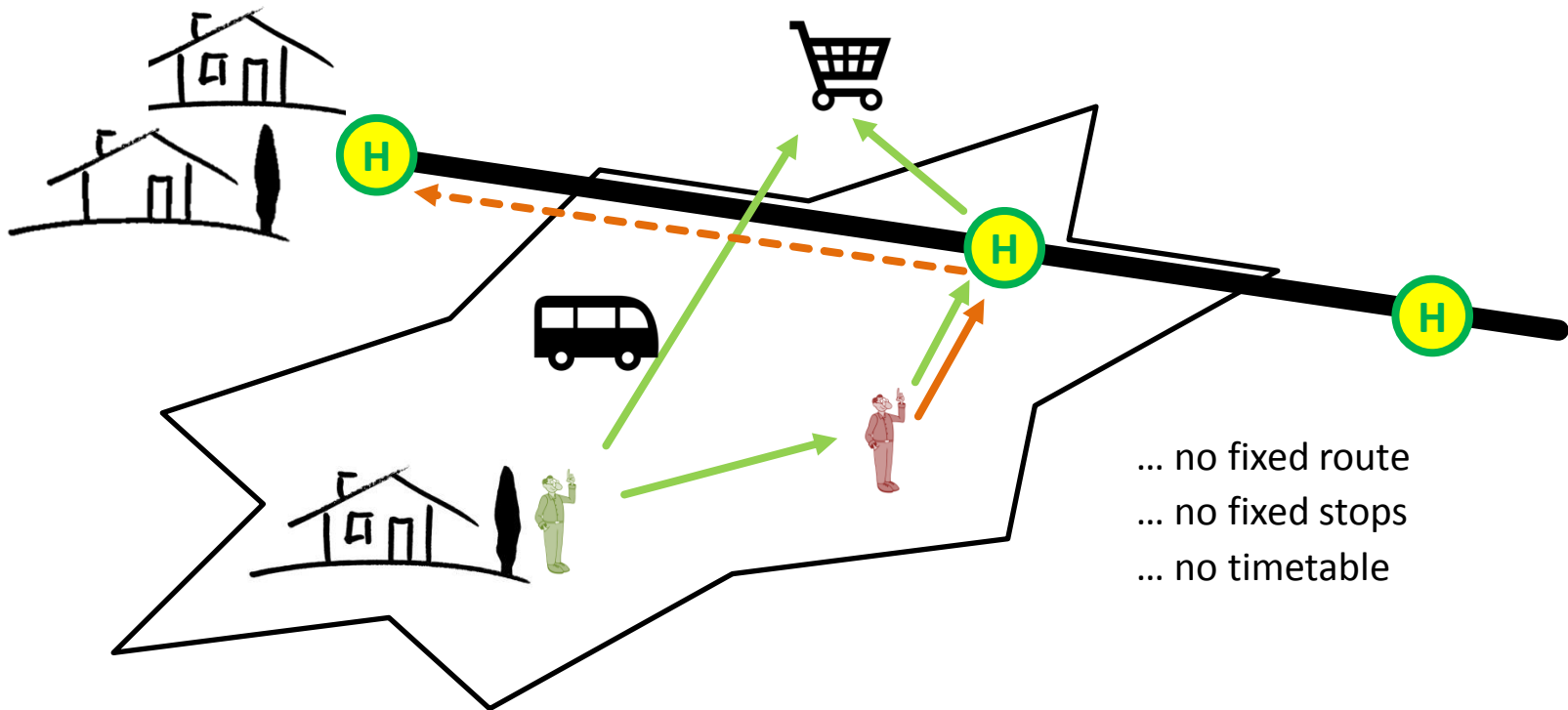
## Motivation for real-world-laboratory methodology:

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



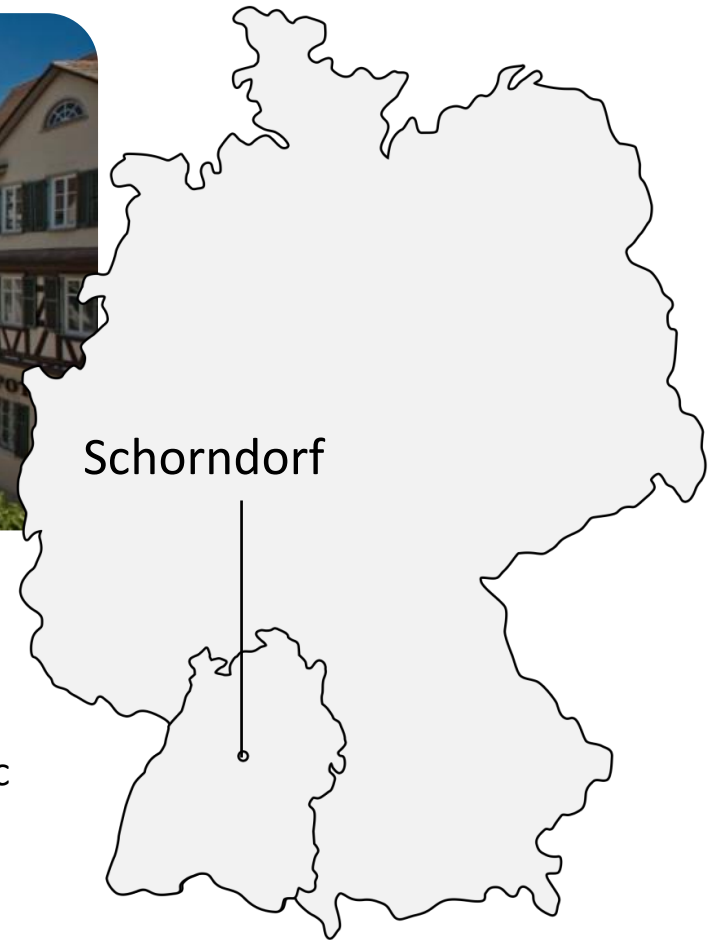
## Major challenges:

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)

Picture references: Shlain (Noun Project), Prajapati (Noun Project), Proença (Noun Project), Weis (Pixelio)



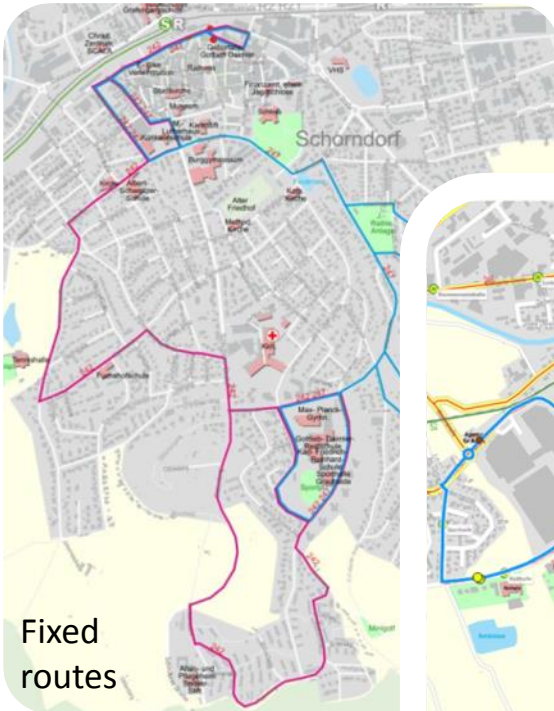
# Real-world setting for testing the DRT system: City of Schorndorf



- 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



- 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



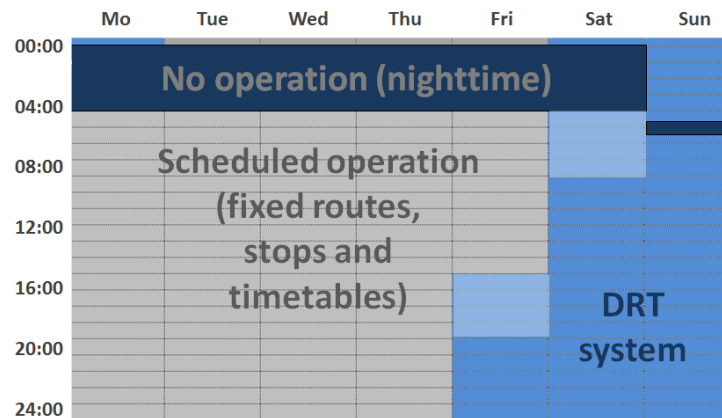


# DRT Service Span

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.

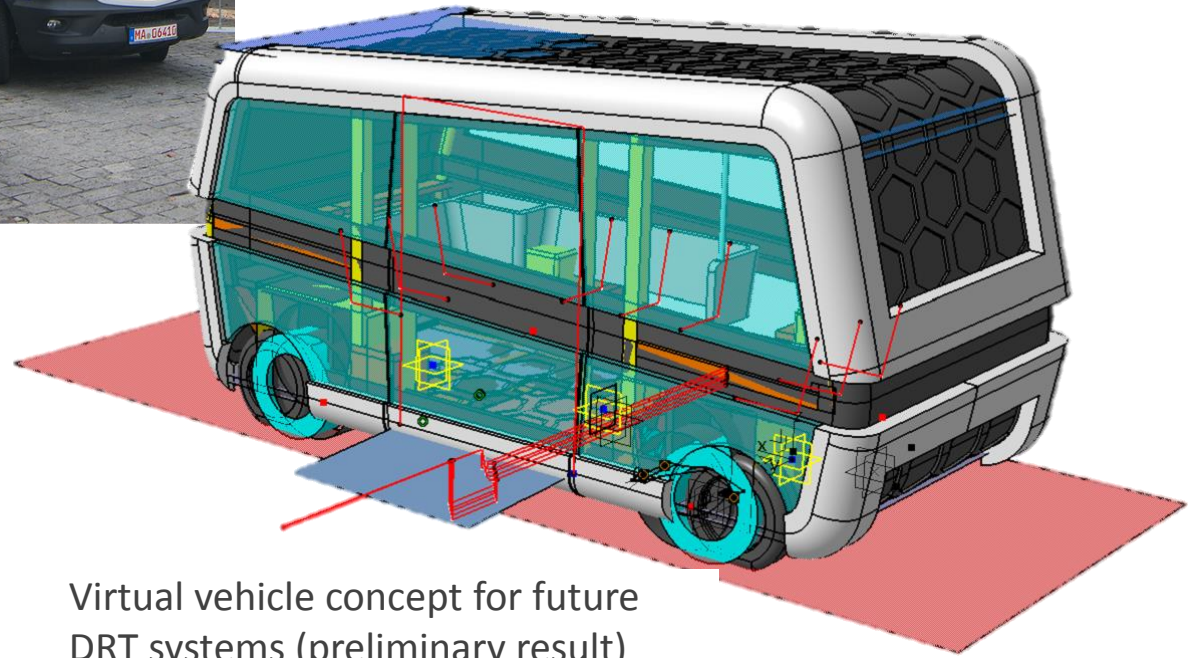




# Vehicles for DRT Systems



Vehicles used for pilot DRT operation

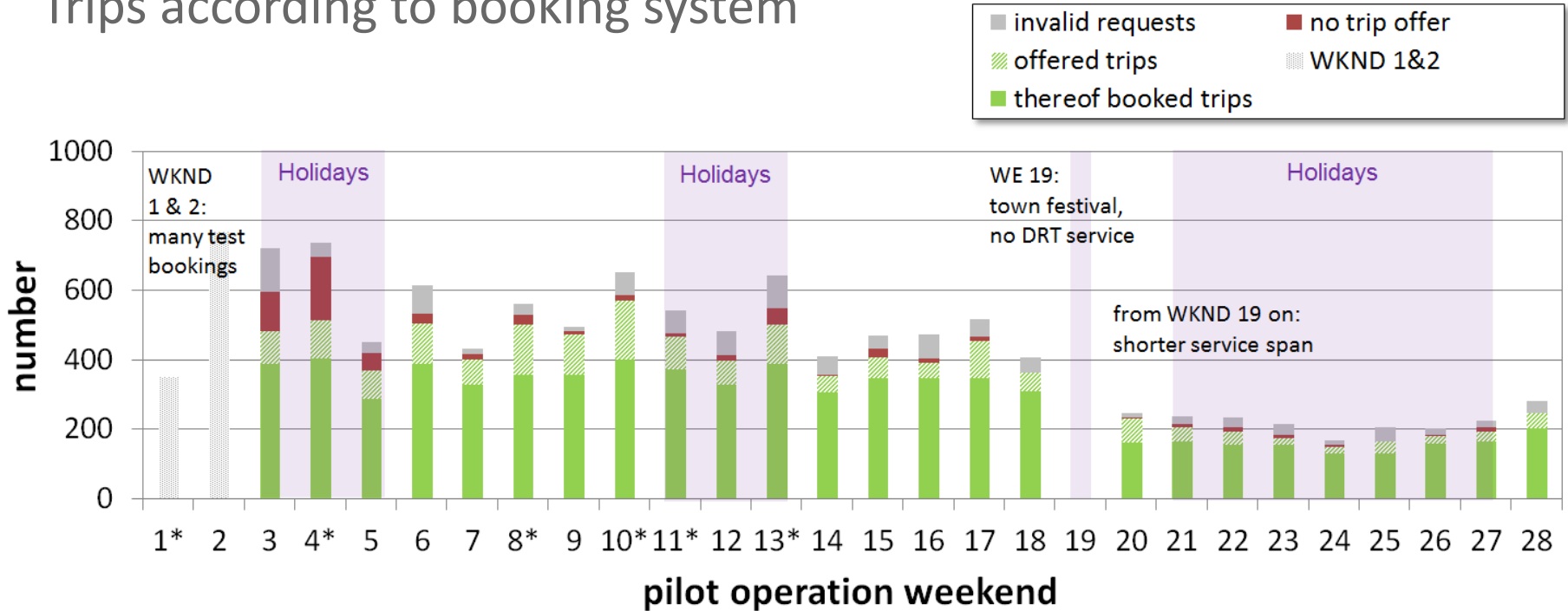


Virtual vehicle concept for future DRT systems (preliminary result)



# 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<sup>th</sup> 2018)
- Share of rejected trip requests could be significantly reduced (shown in red)

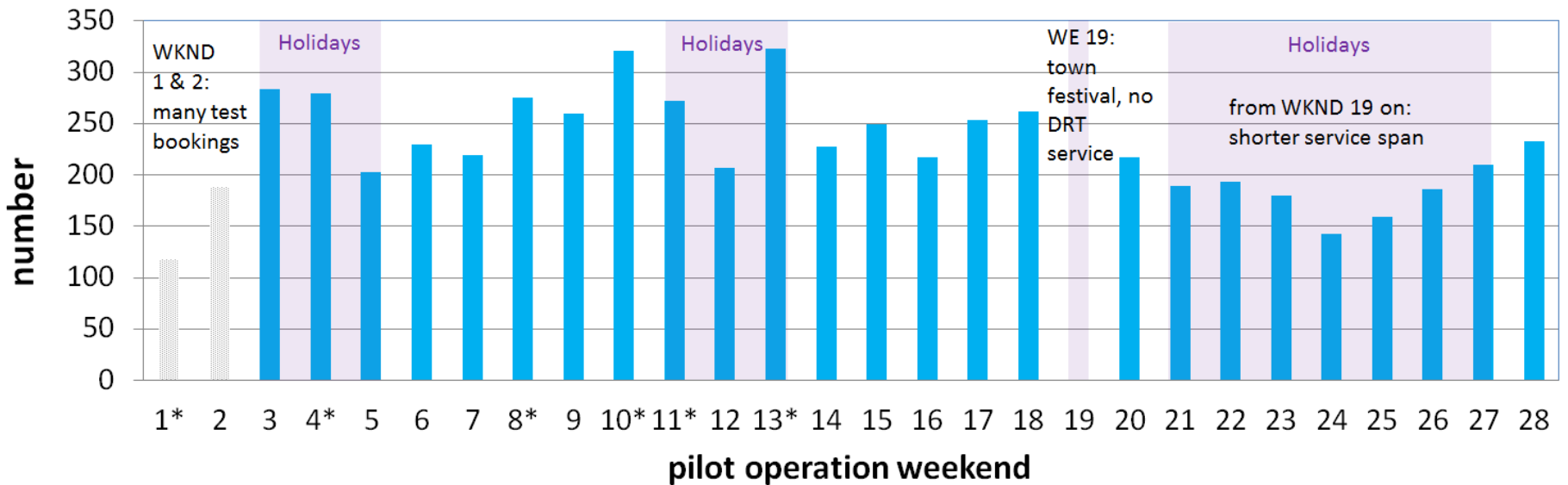
\* Weekend with different total service span due to start of test phase or public holidays

\*\* 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.

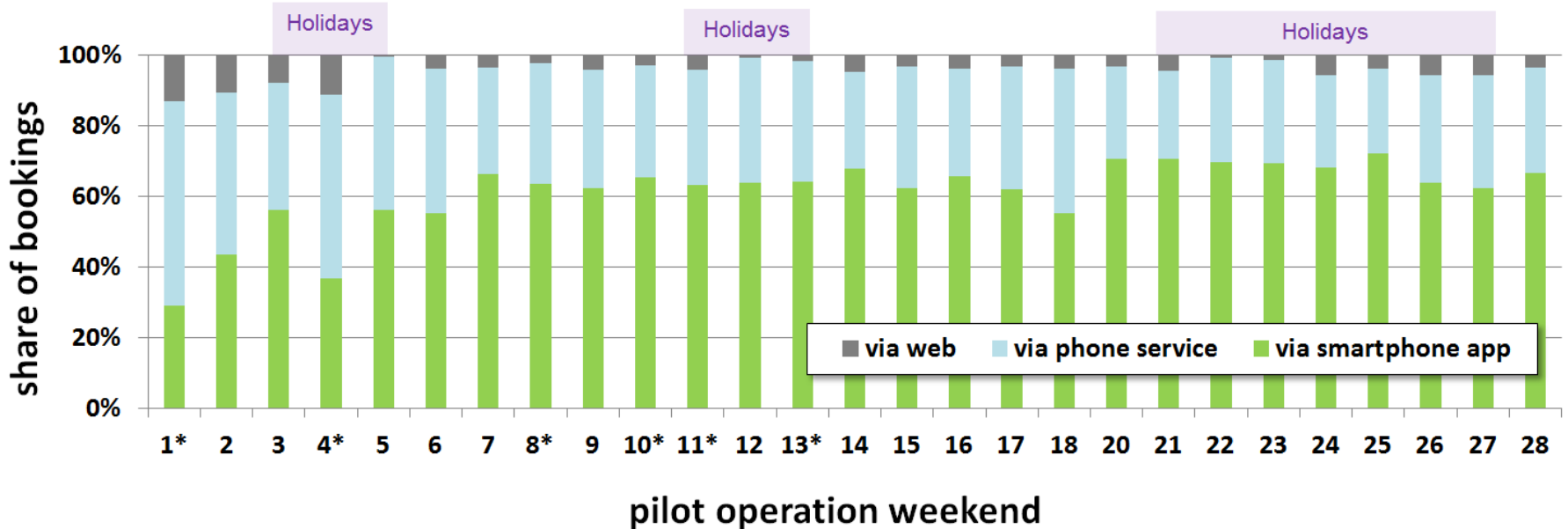
\* Weekend with different total service span due to start of test phase or public holidays





# 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 %

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

Seat load factor  
 (weighted average, all round trips, all buses) **22 %**  
 ! Only passengers with booking !

All numbers: as at Sept. 18<sup>th</sup> 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

$$= \frac{\textit{Empty bus kilometers}}{\textit{Total bus kilometers}}$$

**29 %**

as at Sept. 18<sup>th</sup> 2018, preliminary result, 23 weekends, 15,734 total bus kilometers

Picture references: The Black Sheep





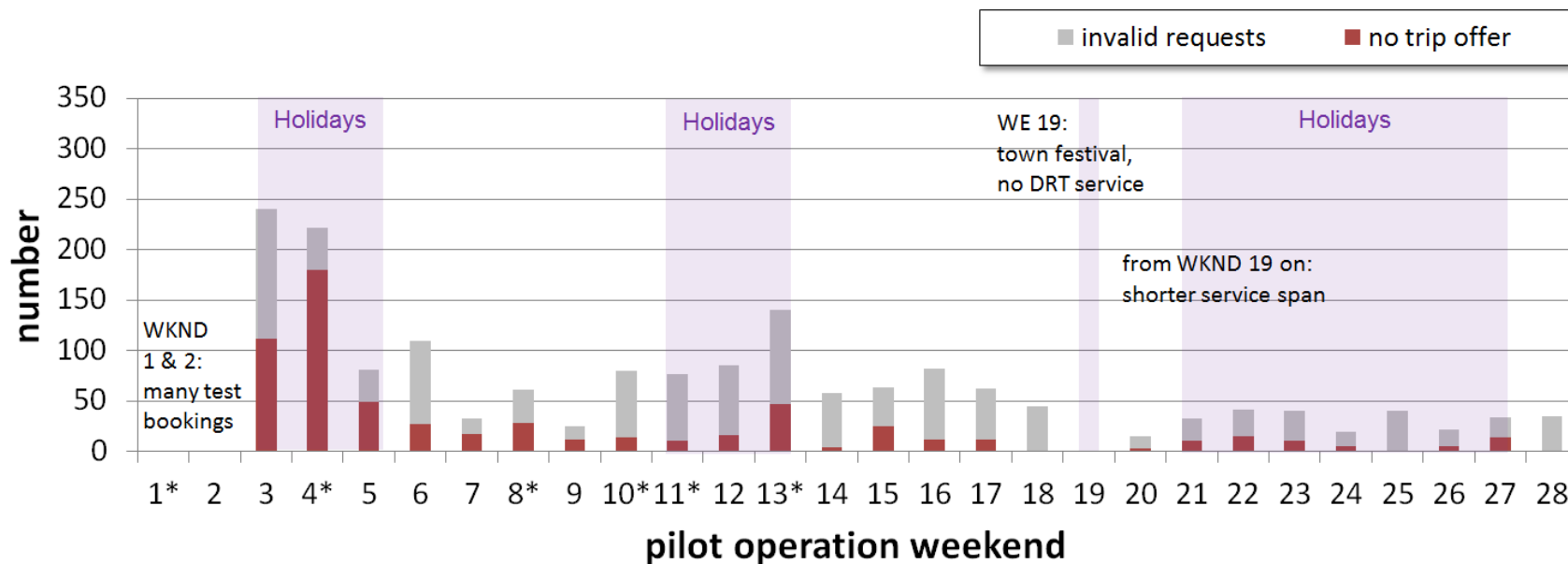
# Share of successful valid trip requests

$$= \frac{\text{Number of successful valid trip requests}}{\text{Number of valid trip requests}}$$

## 96 % (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. 18<sup>th</sup> 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



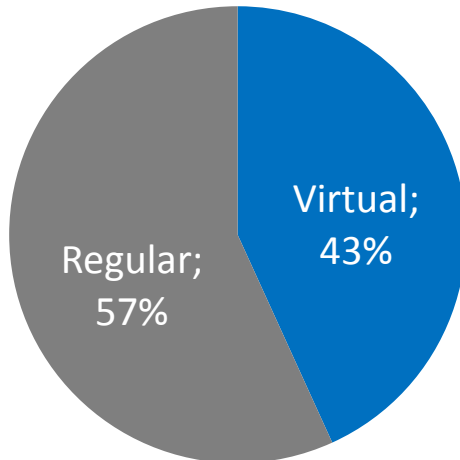
# Share of virtual stop usage compared to regular stop usage

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

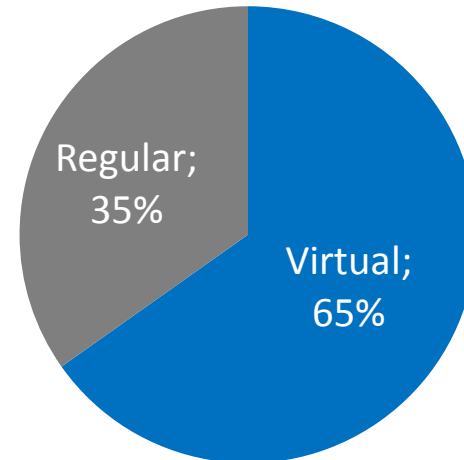
$$= \frac{\text{Number of times a trip started or ended at a virtual stop}}{\text{Number of trips} \times 2 \text{ (origins and destinations of all trips)}}$$

**54 %**

**Origin of a trip**



**Destination of a trip**

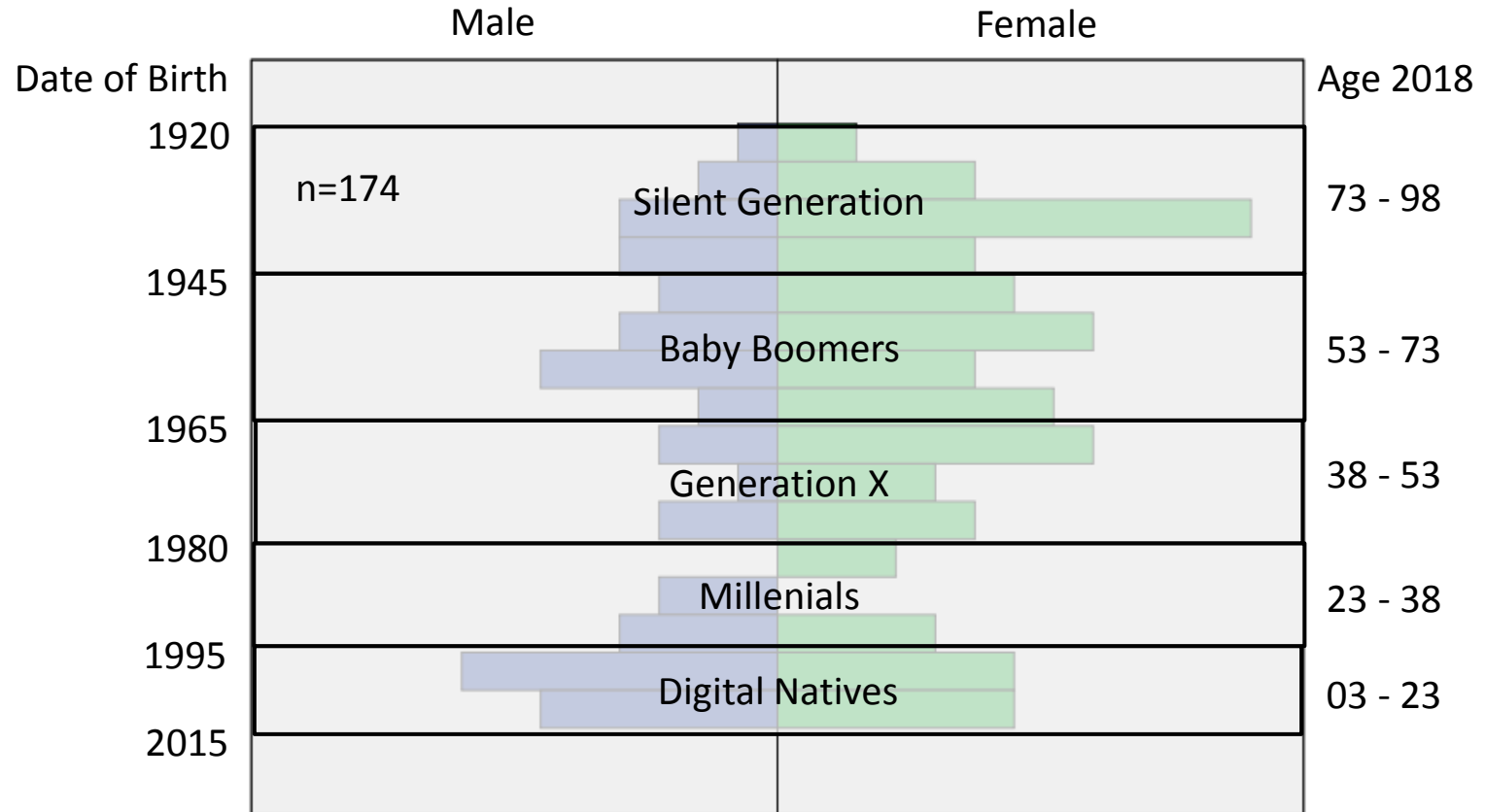


as at Sept. 18<sup>th</sup> 2018, preliminary result, 23 weekends, 10,926 used stops evaluated



# Generational participation

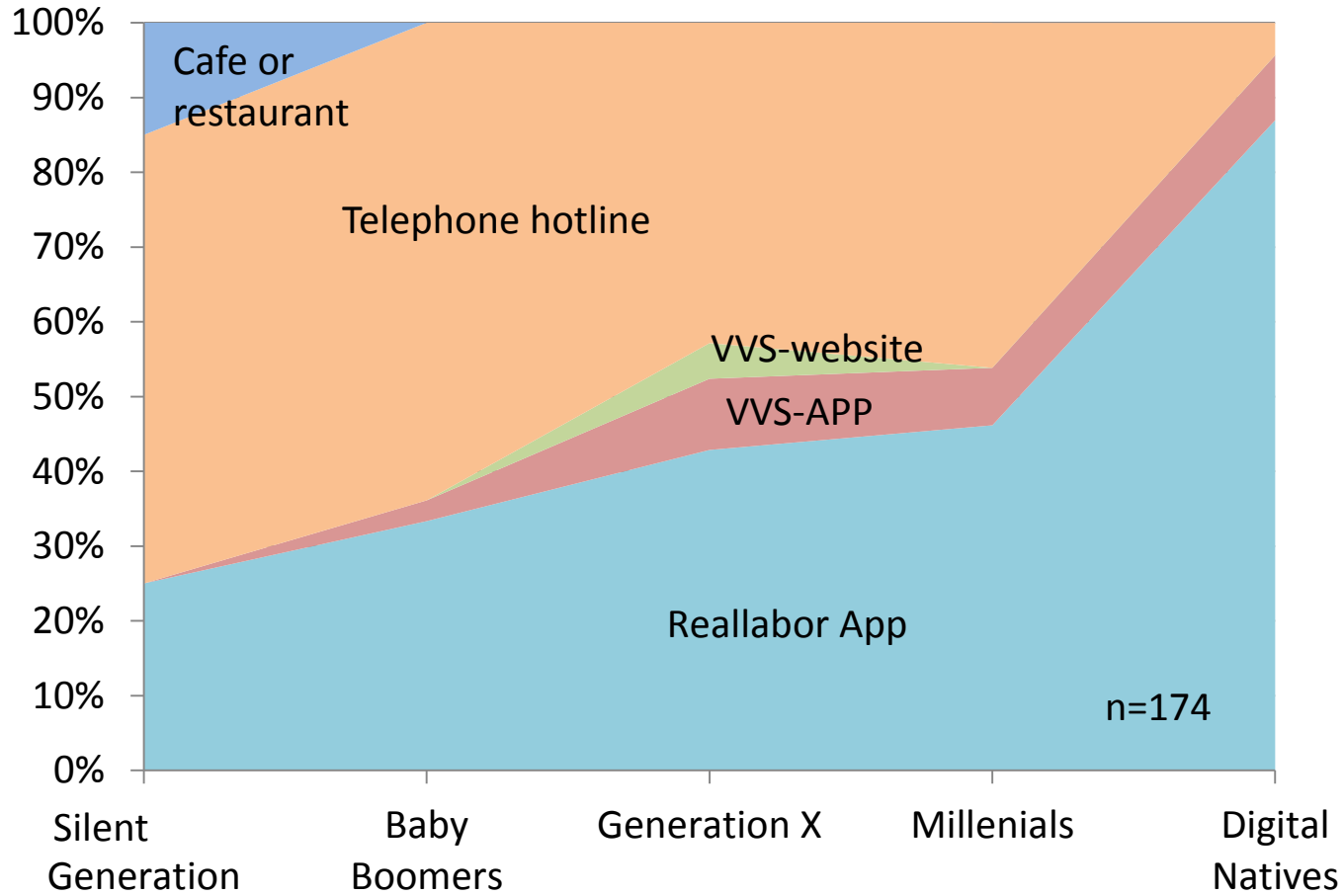
## Baby Boomers are biggest user group





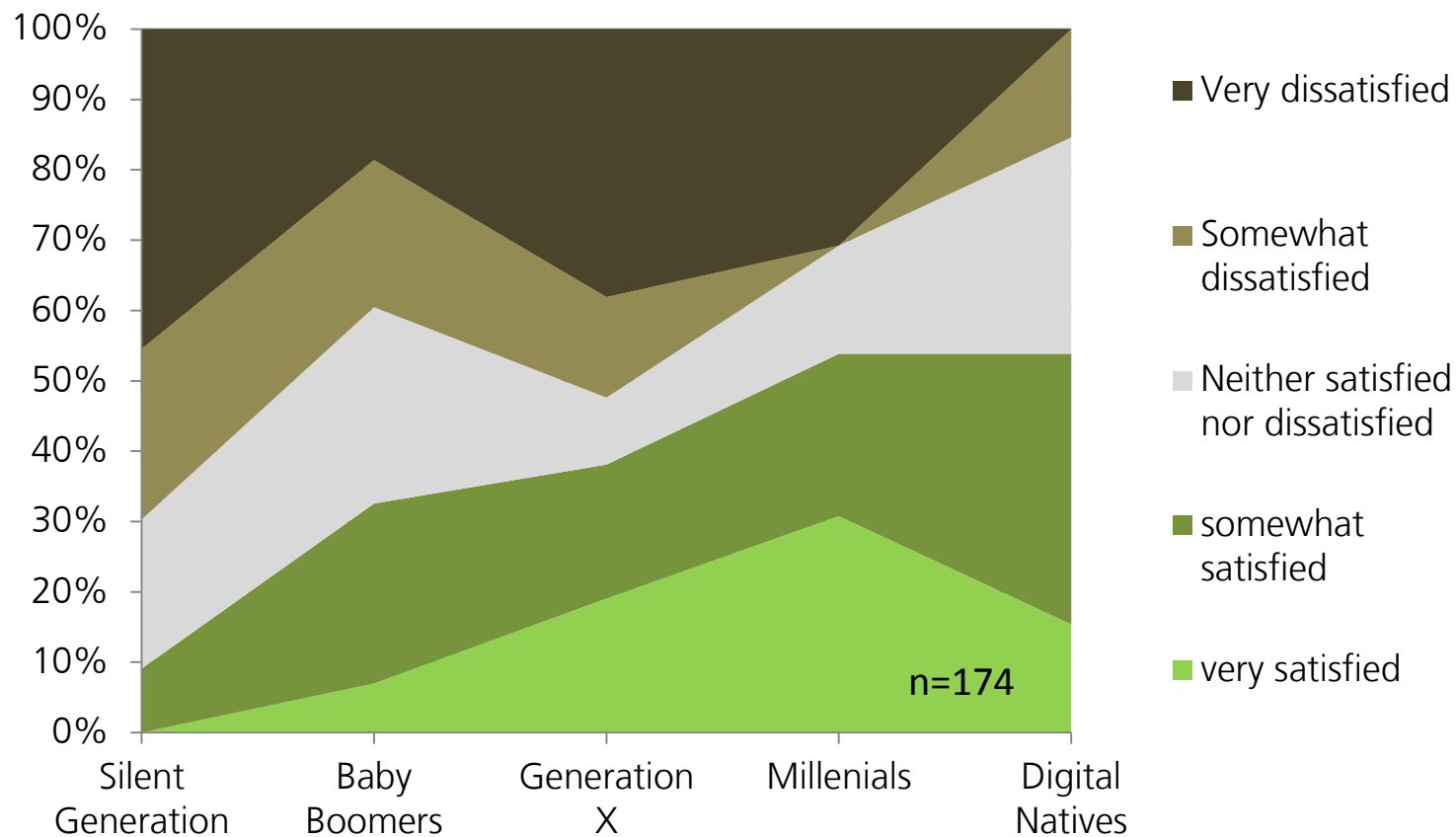
# Booking process: generational split

## Digital Natives as the revolutionaries



# Approval rating of the new bus system

## Generational divide



## 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





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# [www.reallabor-schorndorf.de](http://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



**Knauss**  
LINIENBUSSE

**SCHORNDORF** »  
DIE DAINLERSTADT



**Hochschule Esslingen**  
University of Applied Sciences

**zirius**

**ulmer**  
Kommunikations





# Participatory processes and formats

Requirements-  
analysis

Development & Prototyping  
DRT system + vehicle concept

DRT operation

Evaluation

Participating observation

Workshops

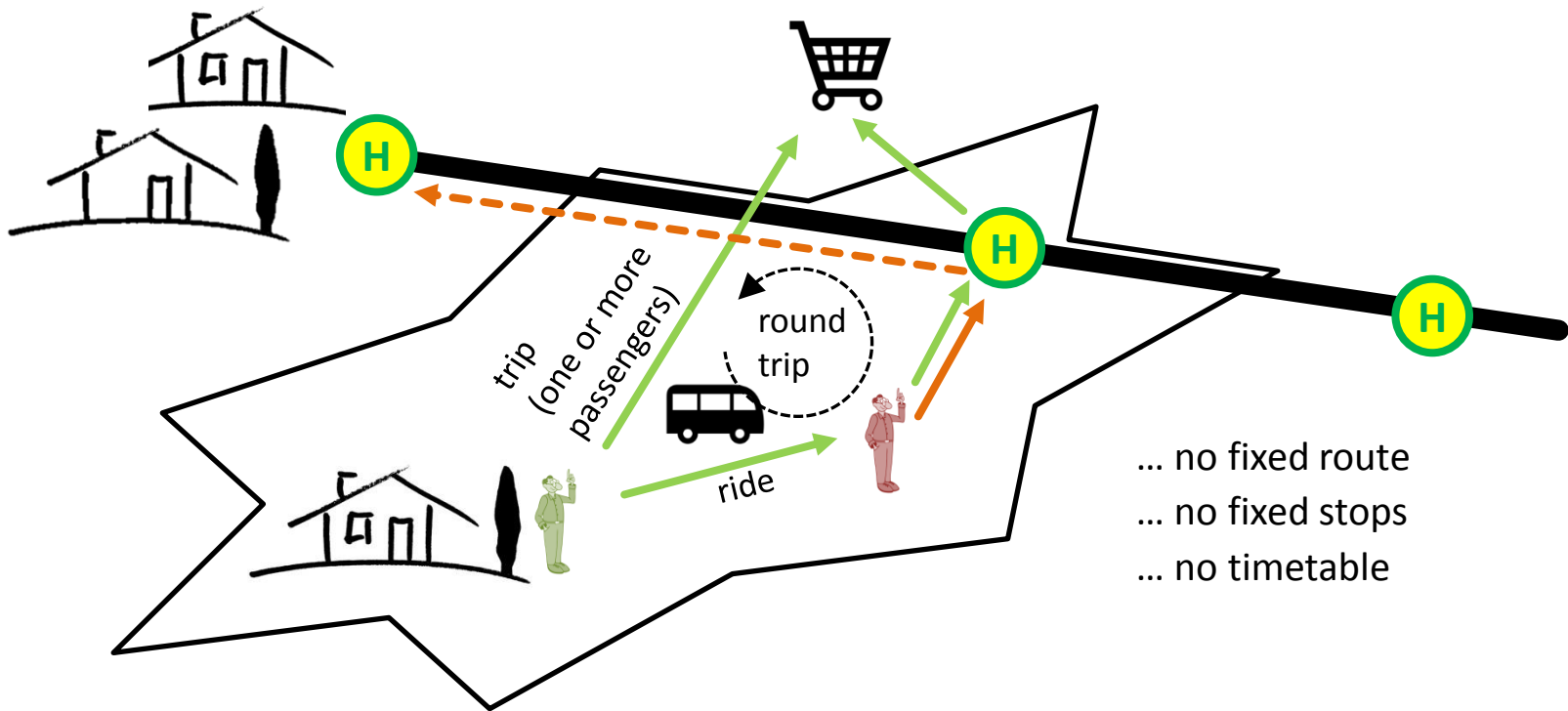
Surveys, Interviews

Manifold dialogue formats

Test users



# Operation mode and challenges of a DRT system



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