

# Demand-Responsive Transport vs. Conventional Public Transport

A MATSim study about the rural town of Colditz, Germany

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Knowledge for Tomorrow




# Demand-Responsive Transport (DRT)

**Bus 326 Bahnhof - Rathaus - Friedberg**

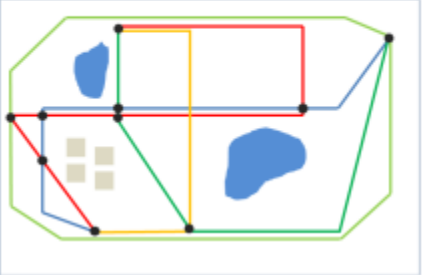
	Montag bis Freitag	Samstag	Sonn- und Feiertage
0			
1			
2			
3			
4			
5			
6			
7	4 19 34 49		
8	4 19 34 49	4 34	
9	4 34	4 34	
10	4 34	4 34	
11	4 34	4 34	
12	4 19 34 49	4 34	
13	4 19 34 49	4 34	
14	4 19 34 49	4 34	
15	4 19 34 49	4 34	
16	4 19 34 49	4 34	
17	4 19 34 49	4 34	
18	4 34	4 34	
19	4 34		
20	4 34		
21			
22			
23			

**No timetable**



**No fixed stops**

**Liniennetz**



**Fahrscheine**

	A	B	C	D
Einzelfahrt	...	...	...	...
Mehrfahrtenkarte	...	...	...	...
Kurzstrecke	...	...	...	...
Wochenkarte	...	...	...	...
Monatskarte	...	...	...	...
Jahreskarte	...	...	...	...

**No fixed routes**



DRT = Demand-Responsive Transport  
CPT = Conventional public transportation

# Background

CPT providers have the function to:



A big challenge – especially in rural areas.

Is DRT able to cope with the challenges of the rural CPT sector?

→ **Comparison of DRT vs. CPT services in rural context**



## Related work

- Flexible transportation solutions in rural context known as
  - **community car** since the 1960s in England (Ryley et al. 2014)
  - **paratransit** since the 1970s in the USA (Ronald et al. 2015)
  - **Anrufbus** since the 1980s in Germany (König/Grippenkoven 2017)
  - so-called **informal transport** in the developing world (Cervero 2000).
- **DRT** wants to provide an **universal solution** by **offering on demand mobility to everyone everywhere at any time**; can be imaged as something in between a traditional bus and a taxi (Navidi et al. 2017).
- Urban MATSim studies (Bischoff et al. 2018 / Bösch et al. 2018) on the usage of DRT instead of CPT services predict
  - **cost benefits for providers,**
  - **smaller travel times for customers,**
  - **enhanced spatial accessibility.**



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# Methodology

Analysis of three scenarios:

(1)

CPT service as **one bus line** serving eight stops in a 30min cycle

(2)

Free-floating **DRT stop-based service** serving 14 stops

(3)

Free-floating **DRT door-to-door service** serving all activity locations

- Simulations of these scenarios undertaken with activity-based, microscopic, multi-agent simulation framework **MATSim** (Horni et al. 2016).
- **MATSim version 0.0.10** and its **drvp** (Maciejewski 2016), **drt** (Bischoff et al. 2018) and **pt** (Rieser 2016) **modules** were used.
- A **synthetic MATSim model** for the greater rural region of **Colditz** was **programmed**, according to demographics, labor and mobility statistics.

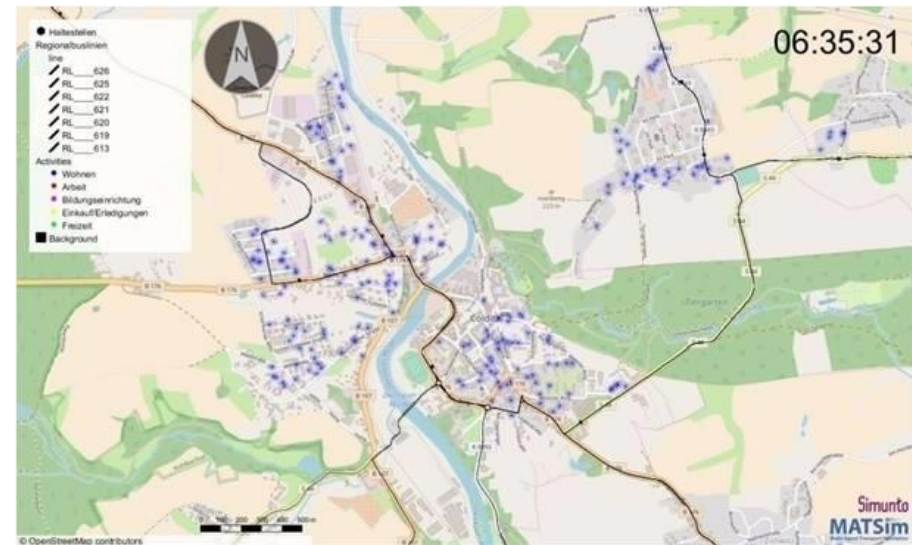


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# Colditz Case Study

## Simulated synthetic MATSim model in the core town of Colditz:

- 360 agents
- 4% public transportation modal split (target value)
- agent's activities (day schedule)
- on Tuesday, the 12th June 2018.



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# Colditz Case Study

- 100 Iterations and each iteration allowed
  - 10% of agents to adapt their times within a range of 30min,
  - 10% of agents to alter their routes and
  - the remaining 80% of agents to keep their best scored plan.
- Agents are willing to walk 600m at most to the next bus or DRT stop.
- Only DRT simulations with an overall request rejection rate <5% were evaluated, to assure quality of service.



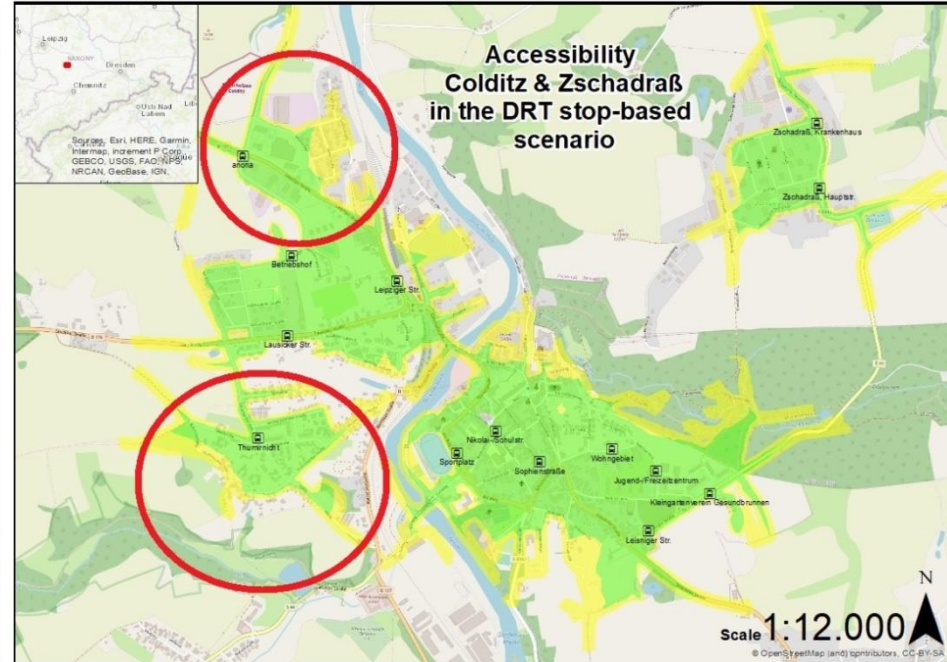
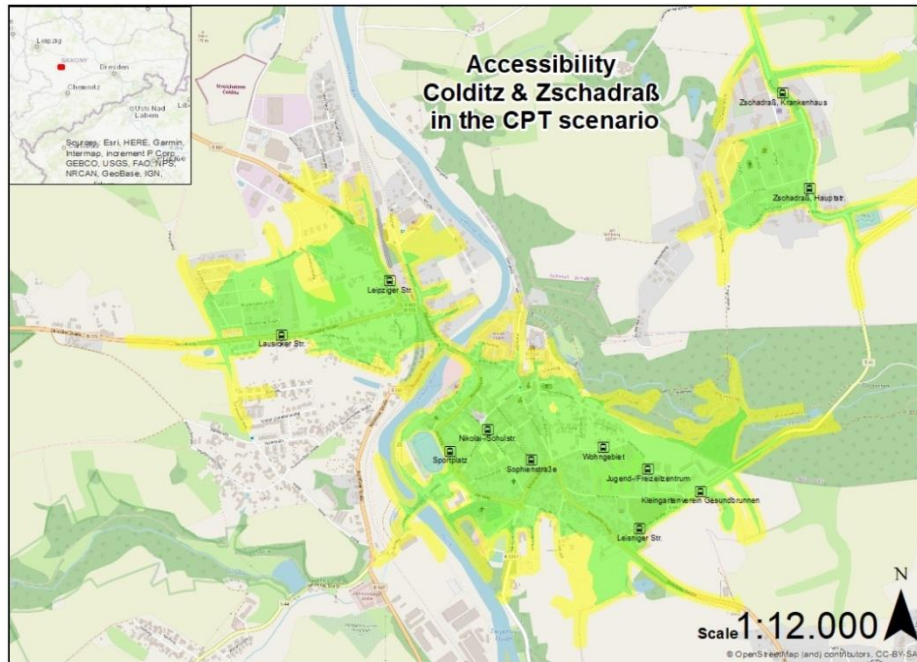
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# Case Study Results

Green accessibility polygons = 400m range

Yellow accessibility polygons = 600m range

- Societal perspective





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# Case Study Results

Service expansion →

• Operator perspective

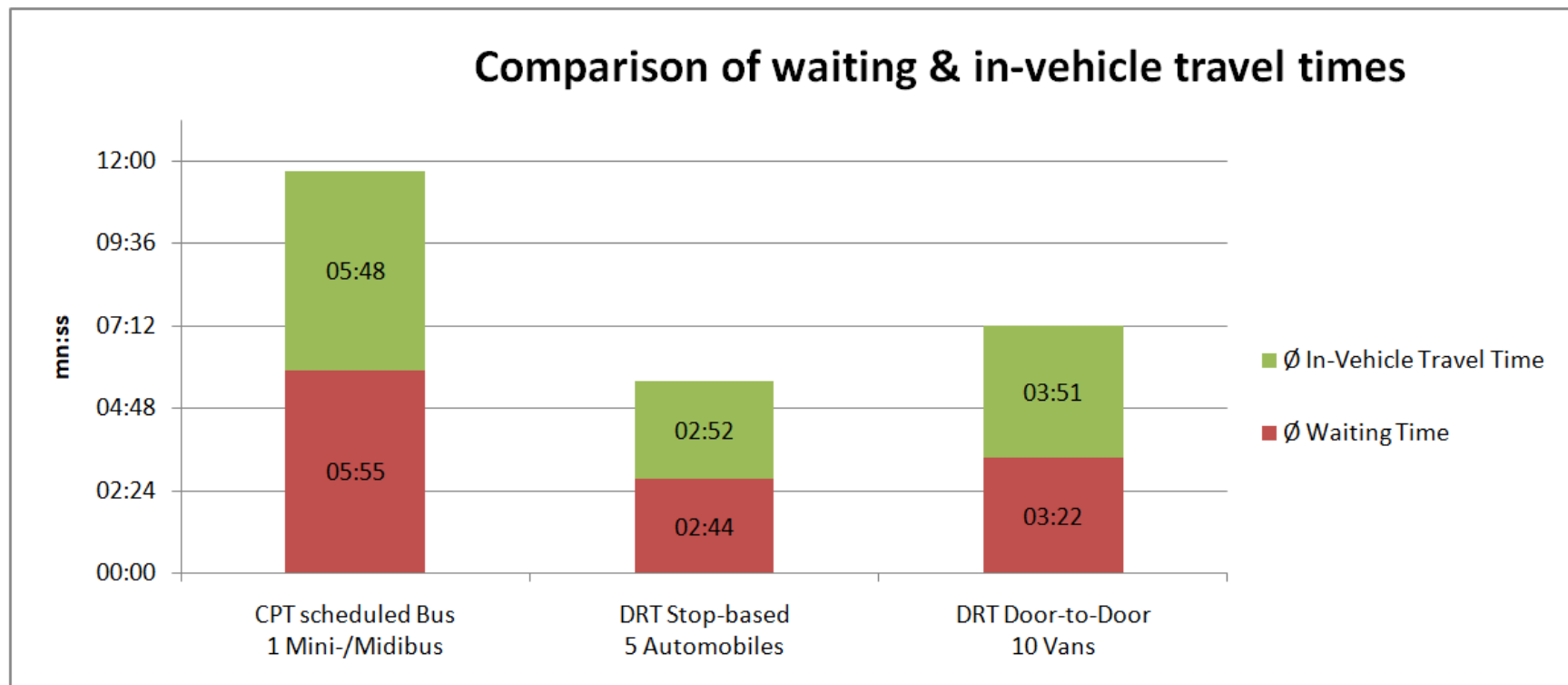
	<b>CPT scheduled Bus</b>	<b>DRT Stop-based</b>	<b>DRT Door-to-Door</b>
<b>Vehicle(s)</b>	1 Mini/Midibus	5 Automobiles	10 Vans
<b>Capacity</b>	min. 12 Places	min. 4 Places	6-14 Places
<b>VKM (km)</b>	200	644	838
<b>Rides</b>	93	458	512
<b>Agents</b>	59	206	215
<b>Empty runs</b>	51%	37%	34%



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# Case Study Results

- Customer perspective



# Conclusion

- DRT services are a useful transportation solution from **customers' and societies perspective**.
- Simulation results confirm MATSim studies on the usage of CPT vs. DRT services in urban context (Bischoff et al. 2018 / Bösch et al. 2018):
  - rural DRT services **reduce waiting & traveling times** for customers
  - rural DRT services **enhance accessibility** of a region
  - rural DRT services charge CPT providers with **additional costs & efforts**
- Recommendation: Future rural DRT (MATSim) simulation studies should model **DRT as line-based services**, which are flexible in time and their stopping along **(semi-fixed) core routes**.



# References

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# Thank you for your attention

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