Short term predictions in public transport

Applying Dutch smartcard data

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1st Smart card data workshop
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Introduction

- Assistant professor at TU Delft
- Consultant Public Transport at Goudappel Coffeng

- Practice < - > Science

- Research agenda
  - Optimizing public transport level of service
  - Network, timetables and operations
  - Data driven research
  - Special interest in reliability and robustness

- Today: pragmatic approach to PT forecasts, usable for operators and authorities
- Modeling as a tool, not as an objective

Challenges in PT industry

Main challenges:

- **Increasing cost efficiency**
- **Increasing customer experience**
- **Motivating new strategic investments**

- Data and models enable achieving objectives

Applied examples

- Monitoring and predicting passenger numbers: Whatif

- Quantifying benefits of enhanced service reliability in public transport
Van Oort, N. (2012)., Proceedings of the 12th International Conference on Advanced Systems for Public Transport (CASPT12), Santiago, Chile.

- Optimizing planning and real time control
Van Oort, N. and R. van Nes (2009), Control of public transport operations to improve reliability: theory and practice, Transportation research record, No. 2112, pp. 70-76.

- Optimizing synchronization multimodal transfers
Lee, A. N. van Oort, R. van Nes (2014), Service reliability in a network context: impacts of synchronizing schedules in long headway services, TRB

- Improved scheduling
Van Oort, N. et al. (2012). The impact of scheduling on service reliability: trip time determination and holding points in long-headway services. Public Transport, 4(1), 39-56.

Smartcard data (1/2)

The Netherlands
- OV Chipkaart
- Nationwide
- All modes: train, metro, tram, bus
- Tap in and tap out
- Bus and tram: devices are in the vehicle

Issues
- Privacy
- Data accessibility via operators

Data
- 19 million smartcards
- 42 million transactions every week

Smartcard data (2/2)

- Several applications of smartcard data (Pelletier et. al (2011). Transportation Research Part C)

Our research focus:

Connecting to transport model
- Evaluating history
- Predicting the future
- Elasticity approach (quick and low cost)

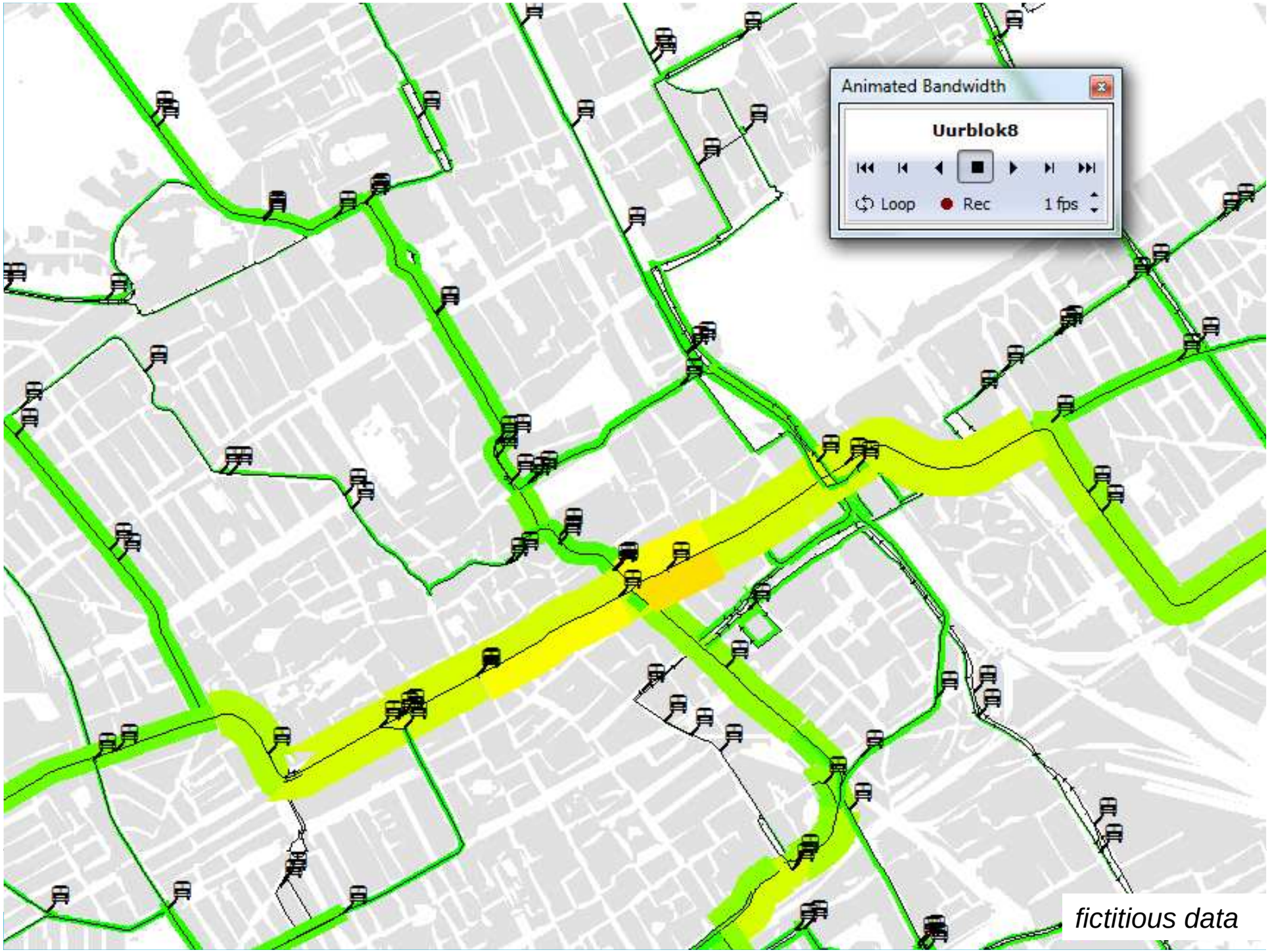
- Whatif scenario's
  - Stops: removing or adding
  - Faster and higher frequencies
  - Route changes

- Quick insights into
  - Expected cost coverage
  - Expected ridership

OmniTRANS
Transport Planning Software

Connecting data to transport model

- Importing PT networks (GTFS) (Open data)
- Importing smartcard data (Closed data)
- Matching
- Visualization options of transport model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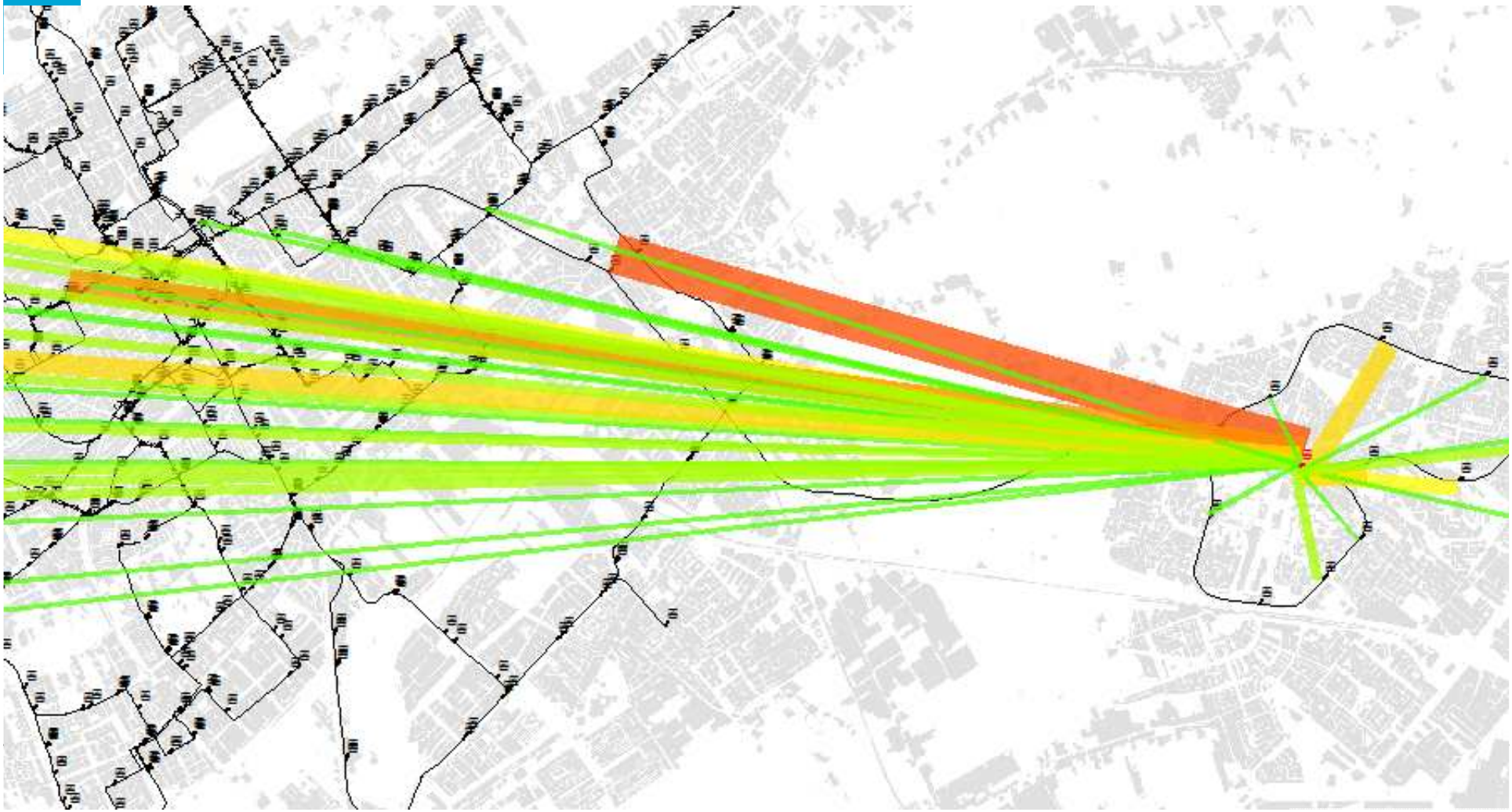
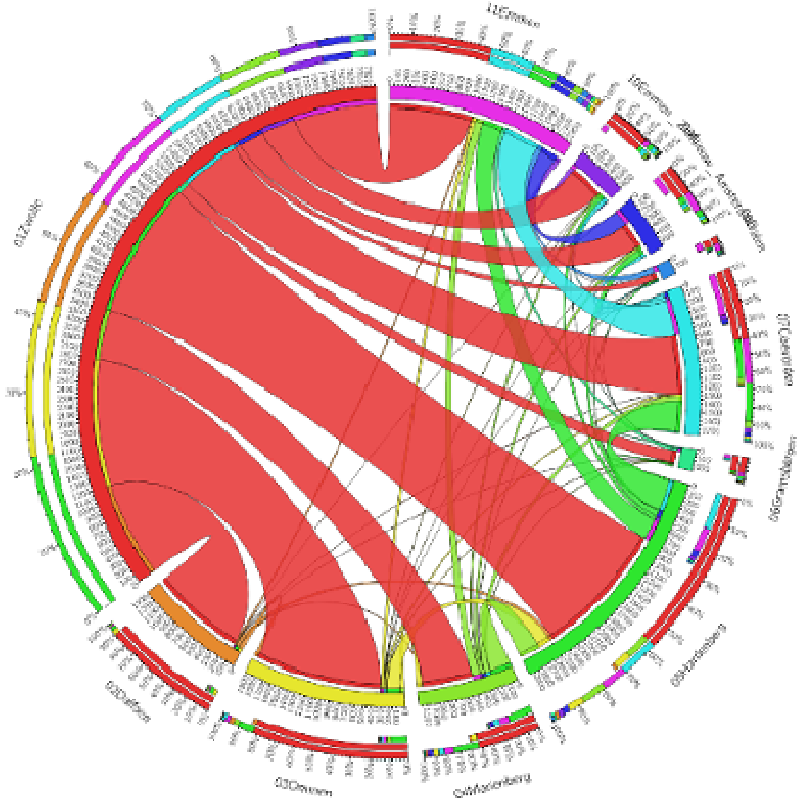
Fictieve data

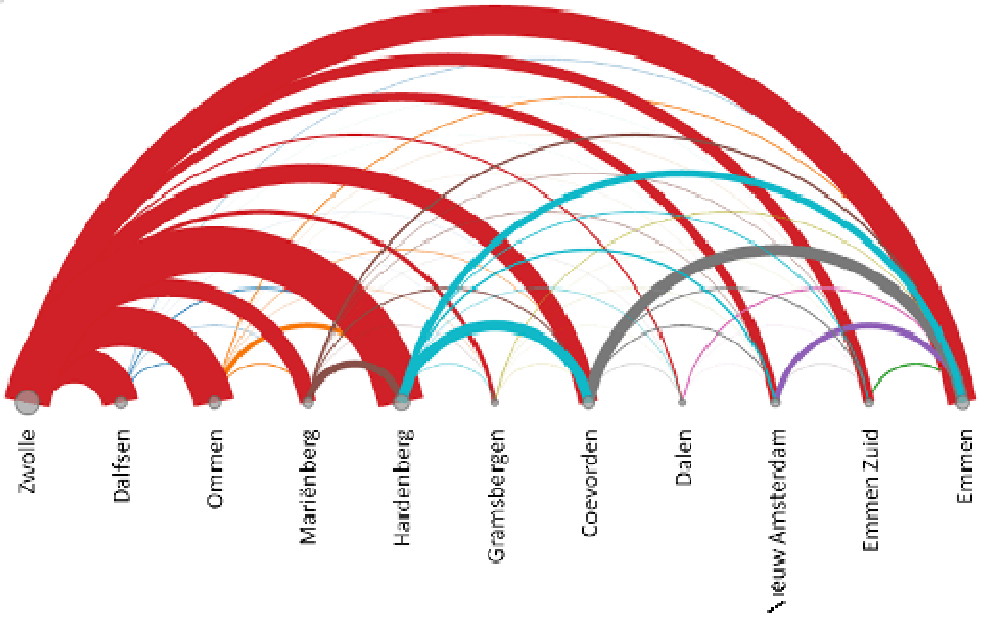
OD-patterns



Fictieve data

OD-patterns




Zwolle
Dalfsen
Ommen
Mariënberg
Hardenberg
Gramsbergen
Coevorden
Dalen
Nieuw Amsterdam
Emmen Zuid
Emmen

What if?

PT modelling

Traditional (4-step) model

Multimodal (~PT)
Network
Complex
Long calculation time
Visualisation
Much data
Detailed results

Simple calculation

PT only
Line
Transparent
Short calculation time
Only numbers
Little data
Assessments

Short term predictions

- Impact of construction works (rerouting, ridership decrease)
- Simple efficiency improvements (schedule, fares)
- Dealing with budget savings (least damage)

Elasticity method based on smartcard data

What if: elasticity approach

$$C_{ij} = \alpha_1 T_{ij} + \alpha_2 WT_{ij} + \alpha_3 NT_{ij} + \alpha_4 F_{ij} \quad (1)$$

With:

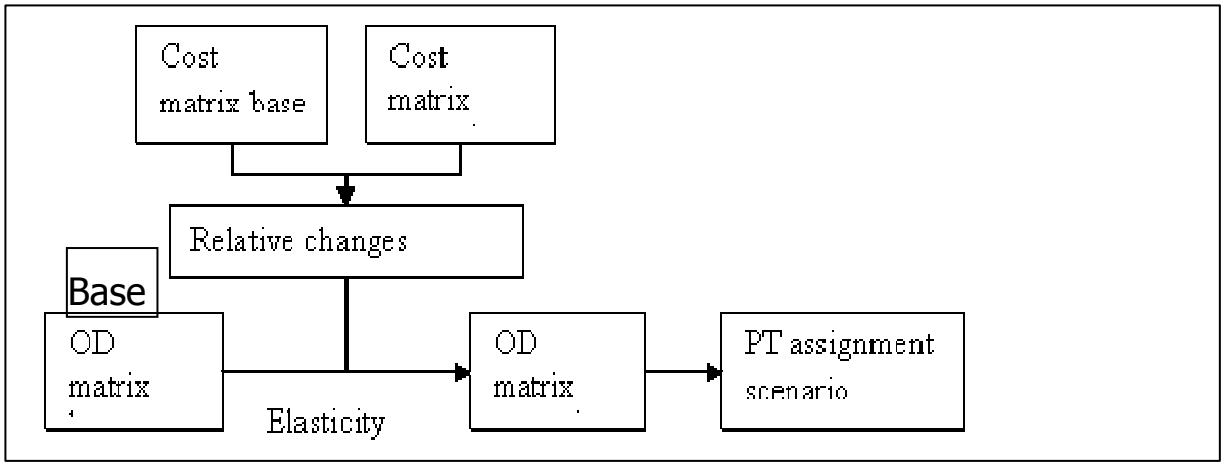
C_{ij}	Generalized costs on OD pair *i,j*
$\alpha_1, \alpha_2, \alpha_3, \alpha_4$	Weight coefficients in generalized costs calculation
T_{ij}	In-vehicle travel time on OD pair *i,j*
WT_{ij}	Waiting time on OD pair *i,j*
NT_{ij}	Number of transfers on OD pair *i,j*
F_{ij}	Fare to be paid by the traveler on OD pair *i,j*

NOTE:

- Simple changes
- Short term
- Only LOS changes
- Accuracy

Elasticities

- Literature (e.g. Balcombe)
- "Proven " rules of thumb



Whatif scenarios

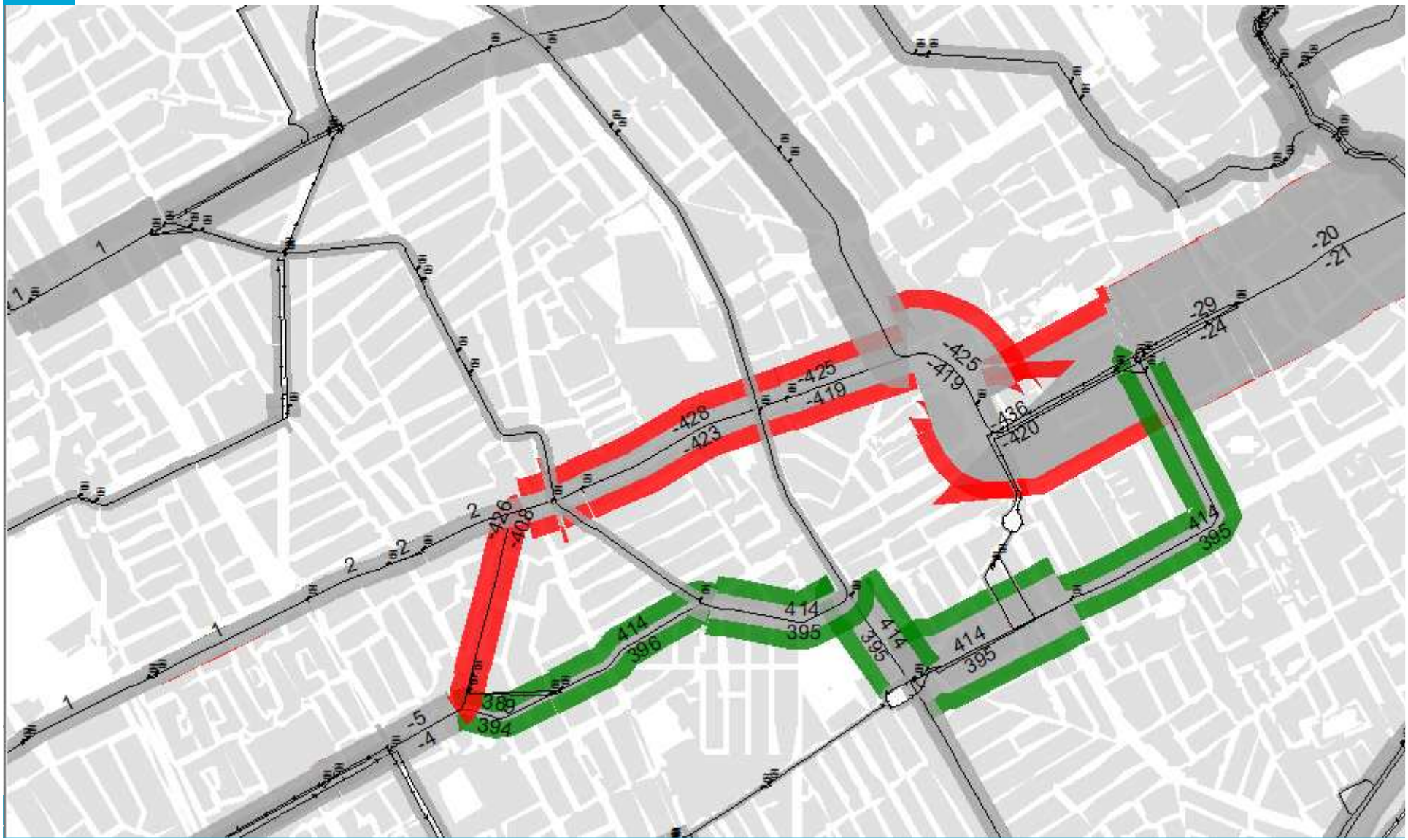
Adjusting

- Speed
- Fares
- Routes
- Frequency

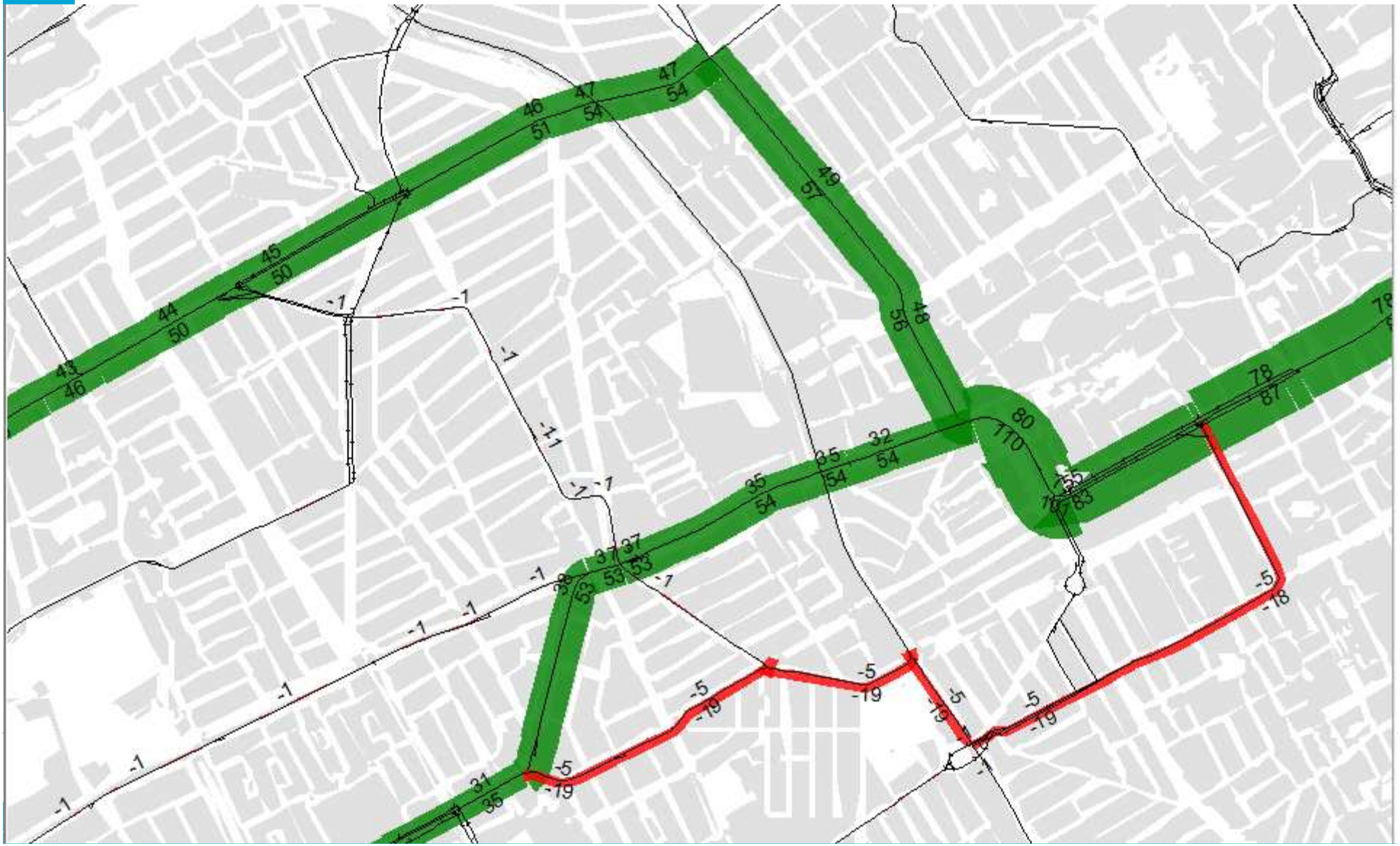
Illustrating impacts on (indicators):

- Cost coverage
- Occupancy
- Ridership
- Revenues

Whatif results: Flows rerouting



Whatif results: Flows increased frequencies



Summary

- Major challenges in public transport
- Data supports optimization
- Evaluating and controlling -> predicting and optimizing

- Connecting data to transport models enables short term predictions
- Combining strenths of two approaches (complex <-> simple)

- First cases show promising results
- Valuable for quick scan or first selection of project alternatives

Next steps
- Updating elasticities (using smartcard data)
- Additional factors in cost function (reliability, crowding, etc)

Pitfall
Combining weaknesses of two approaches

Questions / Contact

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Publications

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