Light rail
Ridership and service reliability

dr. ir. N. van Oort

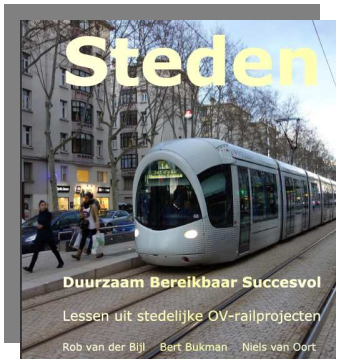
Assistant professor public transport

Den Danske Bane Konference 2014

Resume

- Research agenda
  - Optimizing public transport
  - Network, timetables and operations
  - Three key aspects:
    - Vehicle -> Passengers
    - Trip -> journey
    - Costs -> benefits
  - Data driven research

- Light rail
  - Planning and decision making
  - Optimization of planning and operations
  - Success and failure aspects in NL
    - Project of projects in NL
    - Book in 2015, in cooperation with Dr. Rob vd Bijl, www.LightRail.nl



Outline

Increasing quality and ridership of public transport services

Light rail combines strengths of several systems (train, tram, metro)

Service reliability is key quality aspect

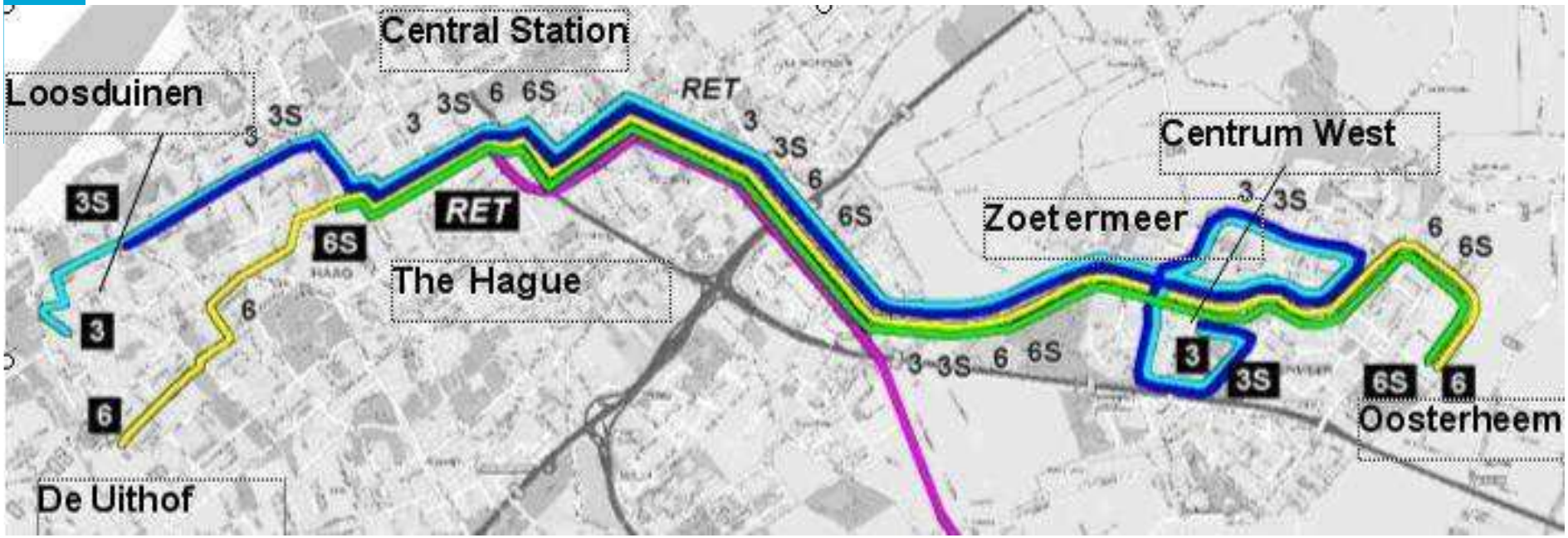
Potential impacts?

Decision making?

Two cases:

- Light rail operations: RandstadRail The Hague
- Light rail planning: New tram line Utrecht

RandstadRail: The Hague



About 95.000 passengers per day

Two lines; 33 and 27 km | 41 and 31 stops

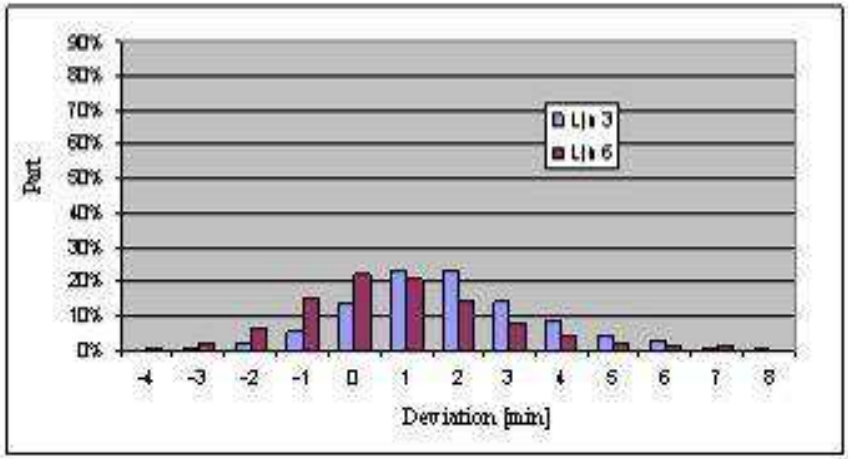
5 min headway per line per direction

RandstadRail (2)

The Hague, NL

Focus on service reliability

- High level of quality and reliability
- In urban area
  - Poor punctuality
  - Poor regularity
- High number of vehicles per hour per direction (>24)
- Signalling applied: limited capacity
- Shared tracks with tram and metro
- Operational targets of transit authority



Without controlling?

- Bunching -> Increase in average waiting time
- Overcrowding -> Probability of having a seat decreases
- Uncertainty -> Less satisfied travellers

Main elements

- Preventing unplanned stopping
- Punctuality
- Dwelling (vehicles and stops)
- Timetable
- Dispatching room

Actual effects

• Average dwell time	28 s → 24 s	
• Standard deviation	- 70%	
• Average delay	90 s → 20 s	
• Departure punctuality:	70%→ 93%	<-1,+1>
• Driving ahead of schedule:	50%→7%	<←,0>
• Customer satisfaction:	6.7->7.4	
• Ridership growth:	~30%	

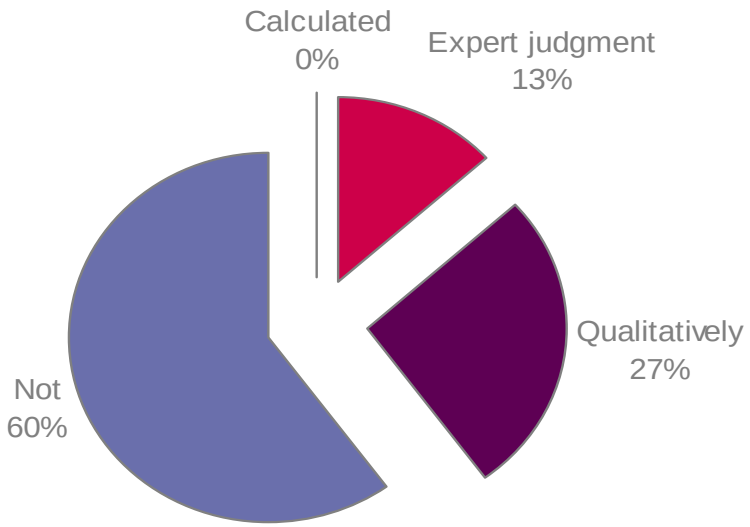
Conclusions

- RandstadRail: High frequent light rail in an urban area
- High reliability because of controlling operations
- Ridership growth due to substantial quality leap

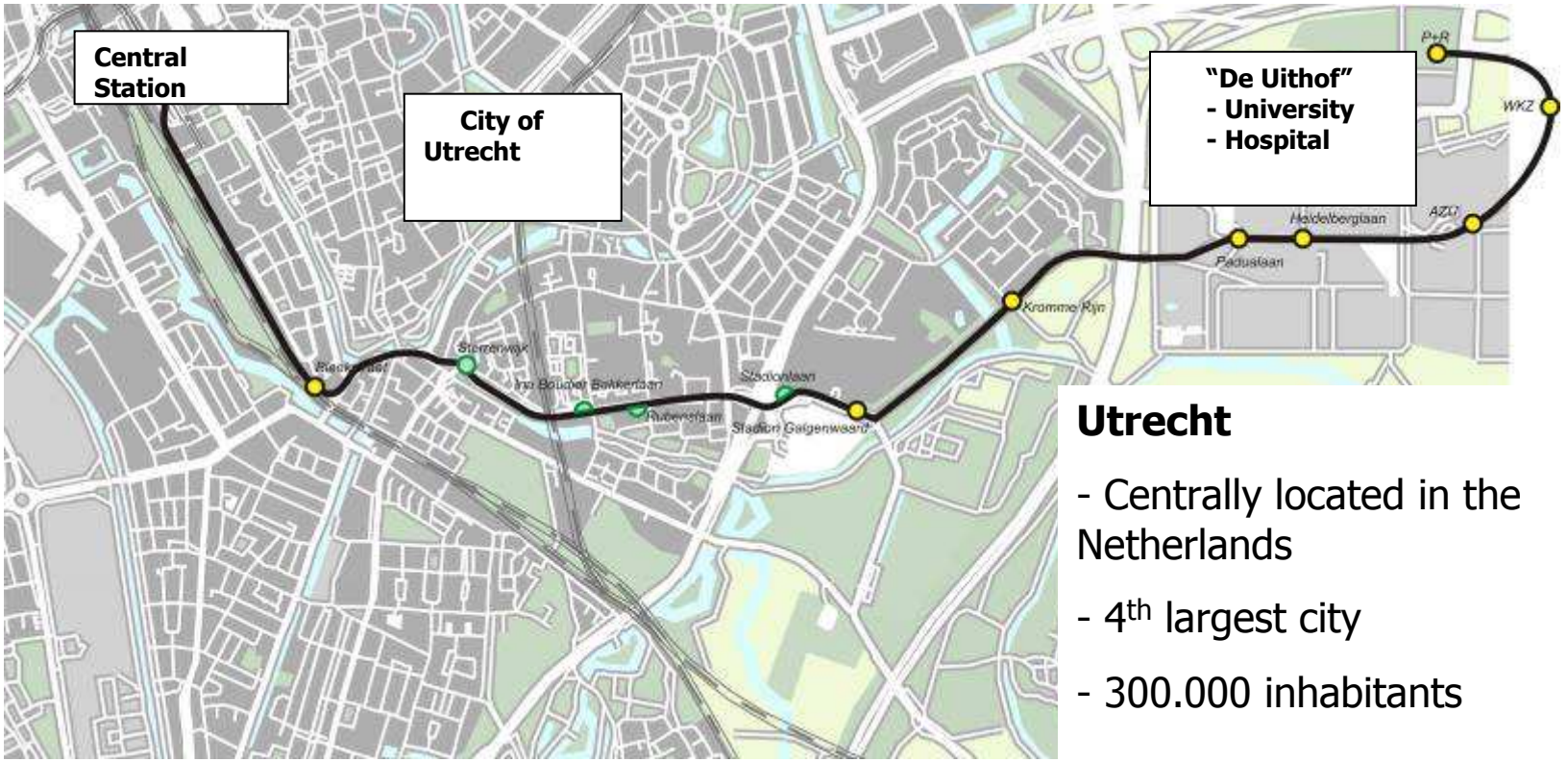
- How to incorporate quality improvements in decision making and planning?

Decision making in public transport

- Most projects aim at enhanced reliability
- Service reliability is often missing in CBA and transport models
- We developed:
  - Methodology to incorporate passenger impacts of service reliability:
    - Transport models (reliable forecasts)
    - Cost benefit analyses
- Applied in Utrecht



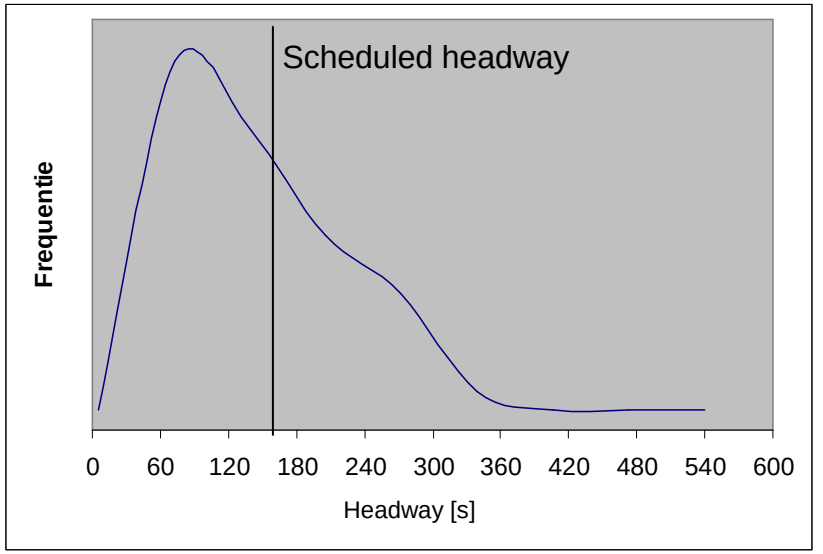
Case: Uithoflijn (line 12)



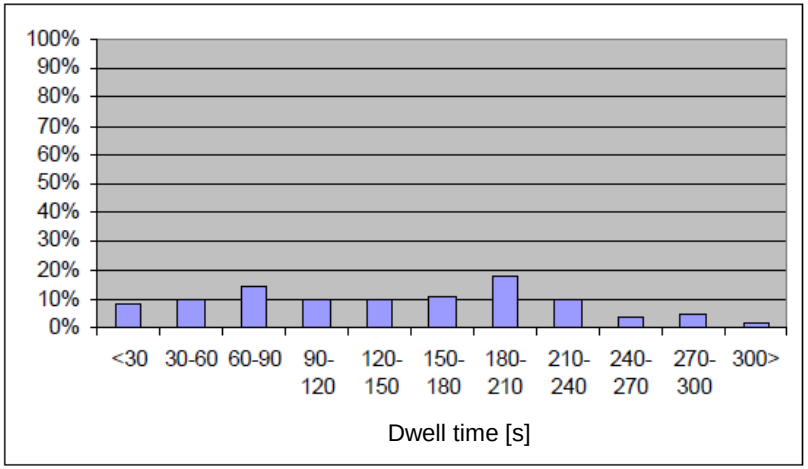
Utrecht

- Centrally located in the Netherlands
- 4th largest city
- 300.000 inhabitants

Problem analysis



Dwell time Utrecht central station



Avg. =2,5 min; σ = 1,3 min

Problem analysis

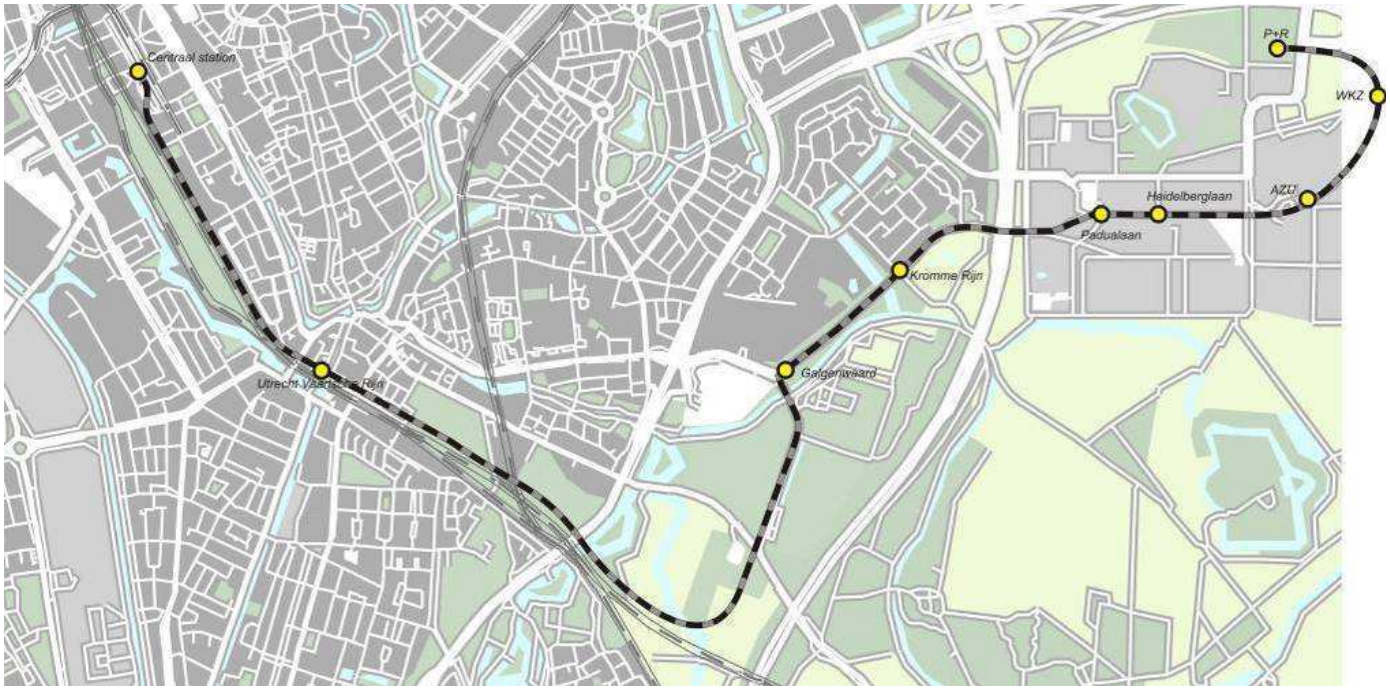
- Busiest bus line in the Netherlands: 27.000 passengers per day
- Frequency of 23x/hour/direction using double-articulated buses: 30x/hour/direction necessary
- 140-160 passengers per bus => no comfort
- Long peak period: 7– 11 AM and 2-6 PM

- Mobility is still growing
  - +25% planned property in the Uithof: +8000 students, +10.000 employees
  - Total: 53.000 students, 30.000 employees and 3.500 visitors (hospital)
  - No additional parking space
  - Demand forecast: 46.000 passenger per day

Case Utrecht Uithoflijn

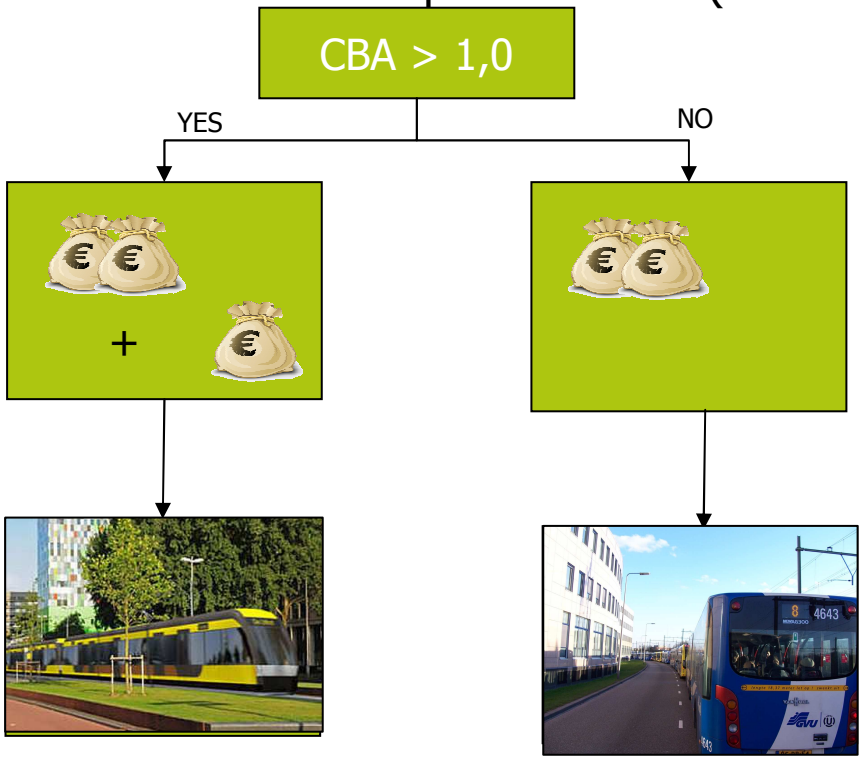
Solution

- Introduction of a light rail line: 16-20x/hour



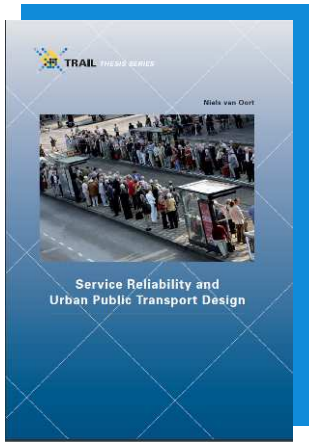
Ministry requires CBA

- Regional parties agreed with plans and finances
- €110 million of Minister of Transport available (about 1/3 of total costs)



Our approach

- **5 project alternatives were designed**
  - Bus and tram (high or medium frequency)
  - Low level of services
  - High level of services
- **Calculations of:**
  - Future demand, including tram bonus impacts
  - Costs (infrastructure and operations)
  - Benefits
    - Travel time gains
    - **Reliability gains**
    - Other



Results CBA

	Value compared to reference case (millions in 2011)
Investment costs	-€222
Operating costs	€66
Total costs	*€288*
Additional ticket revenues	€40
Increased travel time	€67
Service reliability effects	
- Less waiting time	€123
- Reduction in distribution	€78
- Increased probability of finding a seat in the vehicle	€4
External effects (emissions, safety, etc.)	€8
Total benefits	*€336*
Benefits-costs	**€48**
Benefit cost ratio	**1.2**

Additional waiting time due to unreliability

Distribution of travel time due to unreliability

Service reliability effects are over >60% of all benefits!

Conclusions

- Service reliability is important quality aspect of public transport
- Little attention to service reliability in cost-benefit analyses
- Research and case proves:
  - It is possible to quantify service reliability and calculate the monetary value
  - Service reliability benefits made the difference
- This method was approved by the Dutch Ministry and the Minister provided the €110 million

Questions / Contact

Niels van Oort

N.vanOort@TUDelft.nl

Papers:
https://nielsvanoort.weblog.tudelft.nl/

UITP Magazine

International Railway Journal