Light rail transit systems

61 lessons in sustainable urban development

dr. ir. N. van Oort

Co-director Smart Public Transport Lab

Delft University of Technology

www.SmartPTLab.TUDelft.nl

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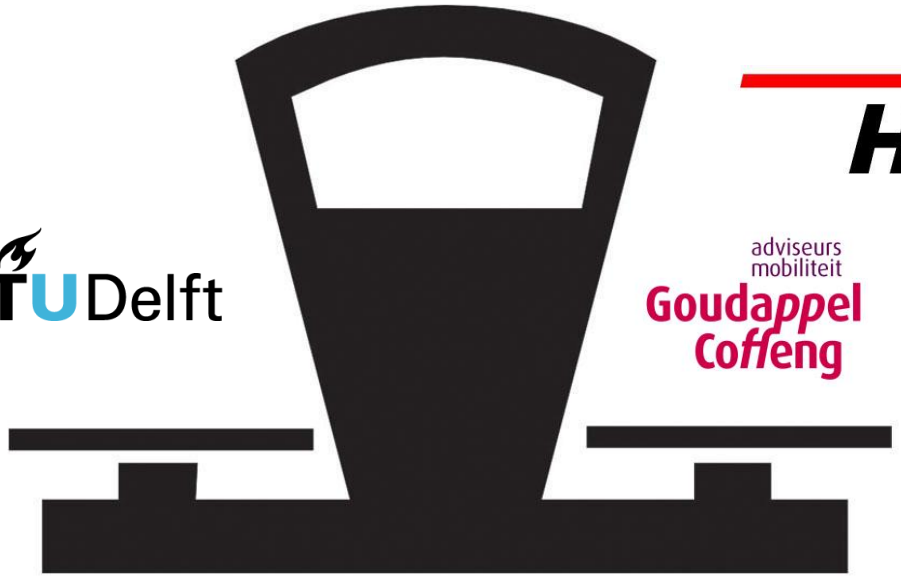
Smart Public Transport

@Niels_van_Oort

Introduction



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E
ELEKTRISCHE BUS
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UNDERGROUND


GVB
2131

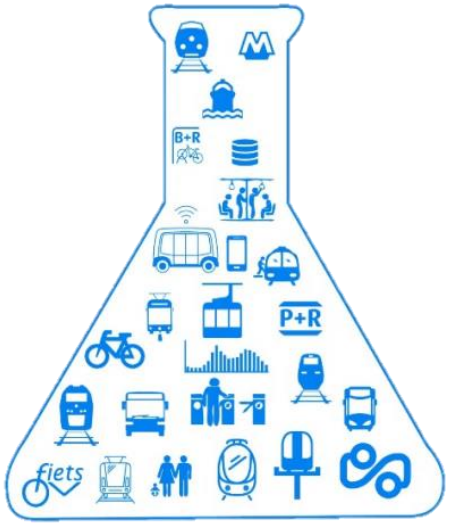
Technology trends


HYPERLOOP


BRIDJ


LUXOR
felyx

Optimal mix of modes?



Debate

- BRT vs LRT?
- BRT+LRT!

Investeer nu in lightrail om verkeersinfarct te voorkomen

De urgentie van de mobiliteitsproblematiek vraagt om concrete actie van het kabinet, stellen vervoersbedrijven en wethouders van Verkeer aan de vooravond van het Kamerdebat over OV.

Smart Mobility

Transportation Resilience Lab

Traffic and Transportation Safety

Smart Public Transport Lab

Traffic Flow Theory and Management

Automated Transport

Active Mode Lab

Rail Traffic Lab

Freight and Logistics Lab

DiTTLab (data analytics and simulation)

UMO Urban Mobility Lab

AMS Living Lab

Partners

provincie :: Utrecht

arriva

SNCF

HTM

Keolis

Gemeente Amsterdam

Vervoerregio Amsterdam

Ministerie van Infrastructuur en Waterstaat

GVB

UITP

INTERNATIONAL ASSOCIATION OF PUBLIC TRANSPORT

EMTA

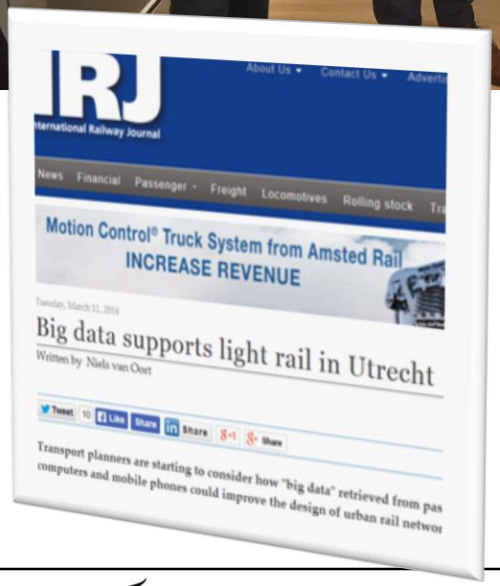
European Metropolitan Transport Authorities

metro

MONASH University

AMS

AMSTERDAM INSTITUTE FOR ADVANCED METROPOLITAN SOLUTIONS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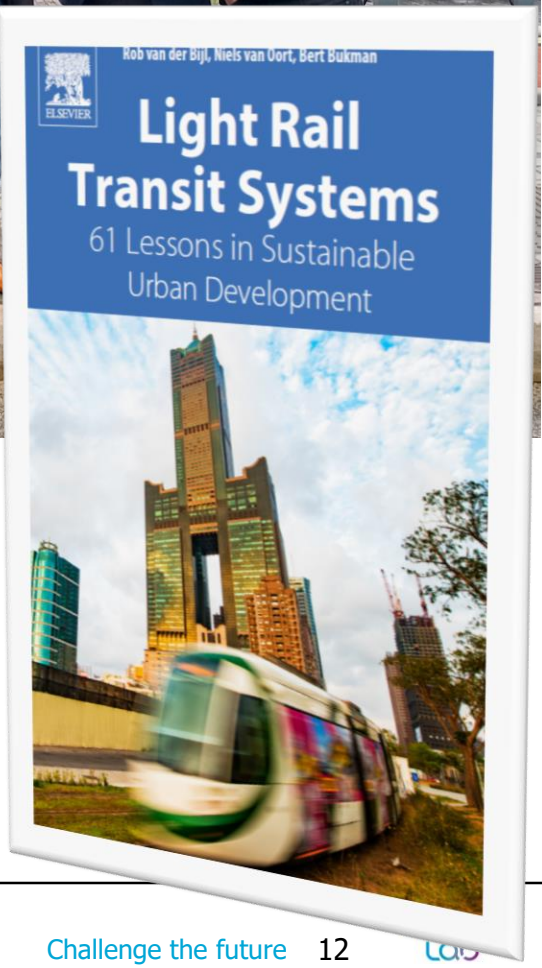
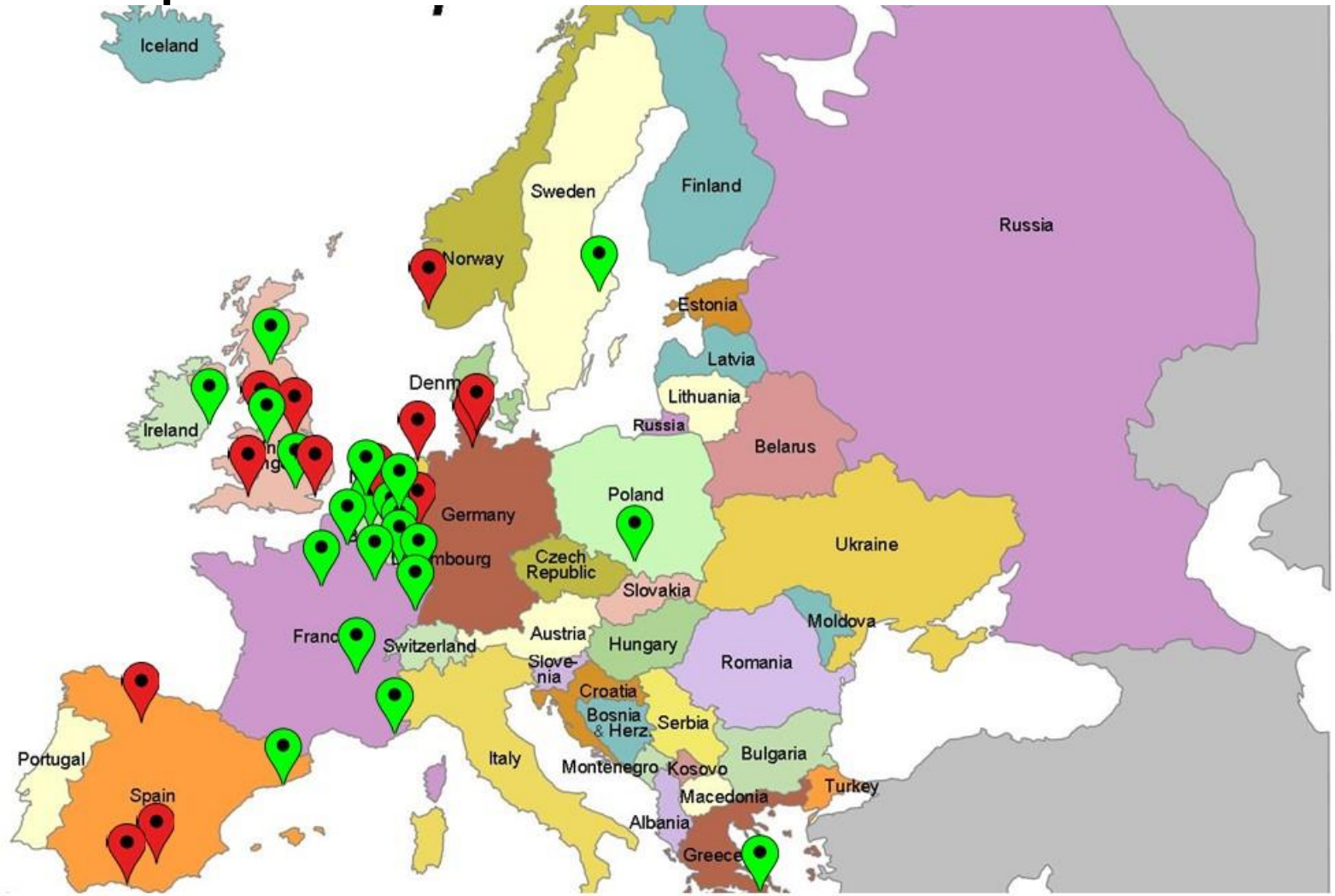
INCREASE REVENUE
Big data supports light rail in Utrecht
Written by Niels van Oort
Transport planners are starting to consider how "big data" retrieved from pas
computers and mobile phones could improve the design of urban rail networ


Light Rail Explained
Better public transport
& More than public transport
EMTA


Rob van der Bijl, Niels van Oort, Bert Bukman
ELSEVIER
Light Rail
Transit Systems
61 Lessons in Sustainable
Urban Development

Cases worldwide

Europe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Russia
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Estonia
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Ireland
Belarus
Poland
Germany
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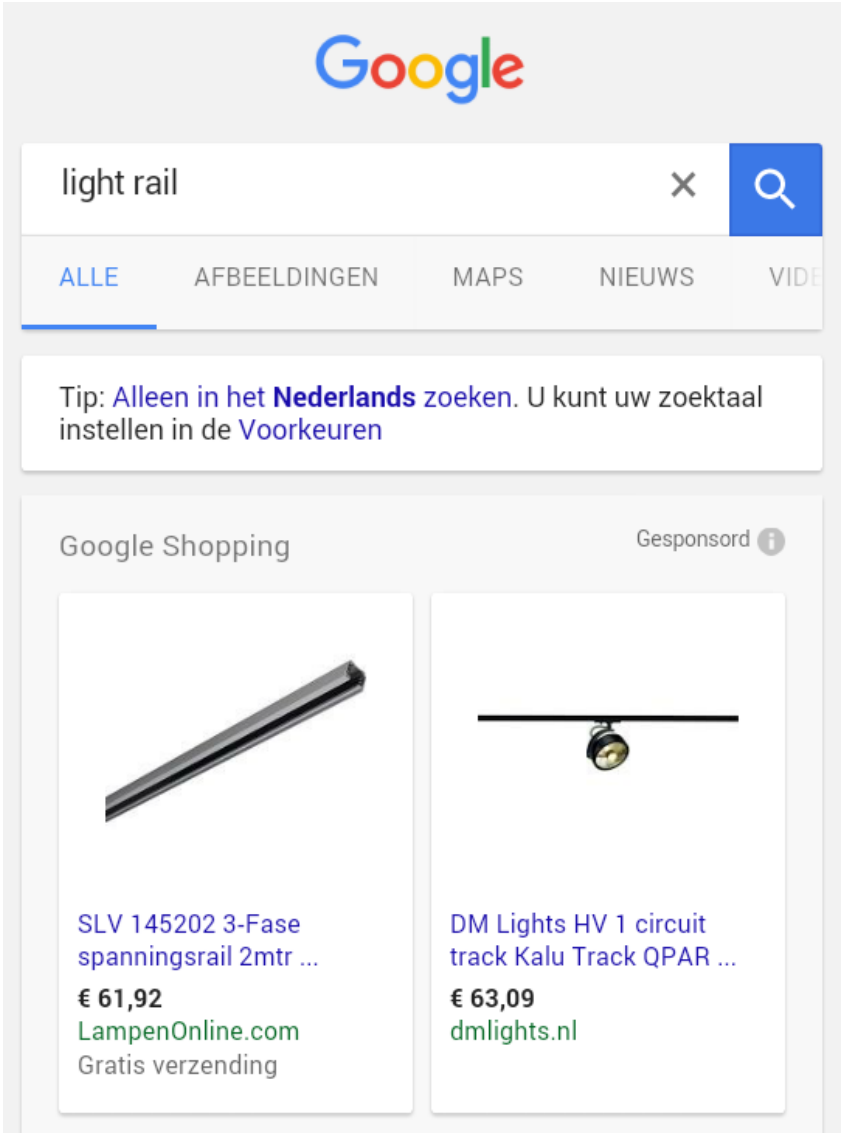
Slovakia
Moldova
Austria
Hungary
Switzerland
Romania
Slove-nia
Croatia
Bosnia & Herz.
Serbia
Portugal
Italy
Montenegro
Kosovo
Bulgaria
Spain
Macedonia
Turkey
Albania
Greece

A

B

C

D


Google
light rail
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MAPS
NIEUWS
Tip: Alleen in het Nederlands zoeken. U kunt uw zoektaal instellen in de Voorkeuren
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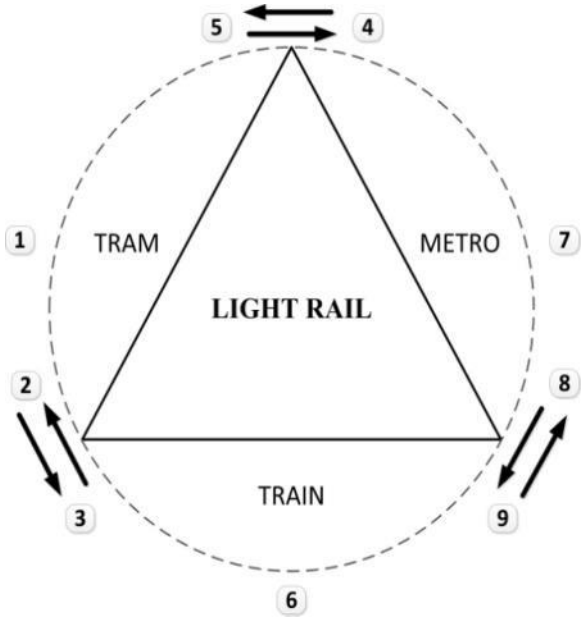
SLV 145202 3-Fase spanningsrail 2mtr ...
€ 61,92
LampenOnline.com
Gratis verzending
DM Lights HV 1 circuit track Kalu Track QPAR ...
€ 63,09
dmlights.nl

Light rail system types



	Lightrail		**Non- lightrail**
1	(Regional) tram	6	Train
2	TramTrain	7	Metro
3	TrainTram	8	MetroTrain
4	TramMetro	9	TrainMetro
5	MetroTram		

Tram-train (Type 2)

A pioneer tram-train is the famous Karlsruhe system, Germany.

Infrastructure

Vehicles

Lessons learned: 61 cases

- Light rail has been successfully implemented in many urban regions worldwide.

- Several light rail projects were not that successful or even failed.

- There is much debate on the (societal) cost-benefit ratio of these systems.

General findings: failure

Project conception

- Too few project variants or alternatives. Solutions for a good project are often found in the combination of different alternatives.

Project organization

- Innovative public tendering (e.g. DBFMO and alike) comes with risks;

Politics

- Changing political climate;

Communication

- A technocratic attitude jeopardizes the project;

General findings: succes

Project conception

- Focus on 'why' the project (short term and long term);

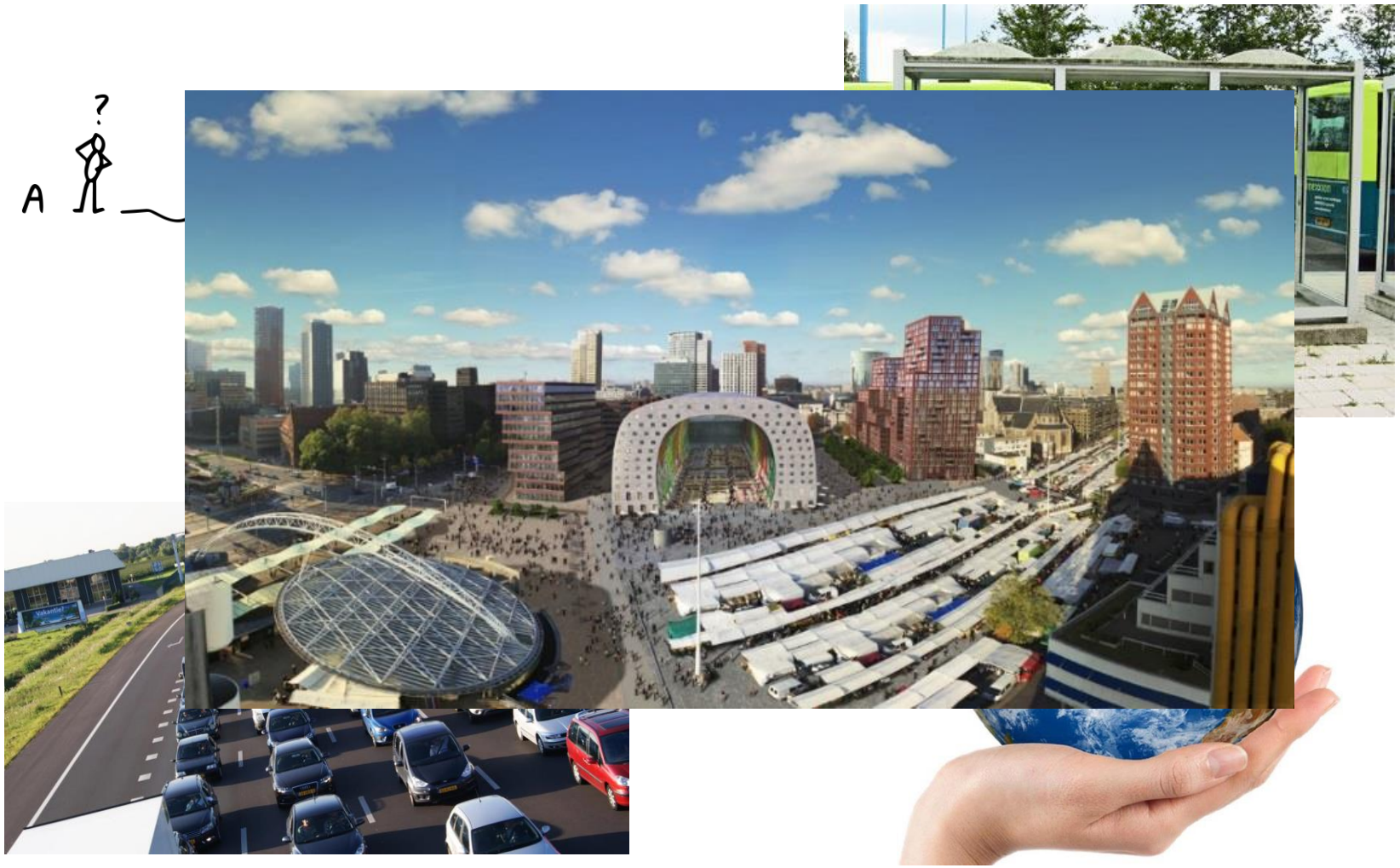
Politics

- The timeframe of contracts for the project must be consistent with political timeframes;

Communication

- Residents and citizens must be involved in the project;

Objectives of public transport



Justification of public transport

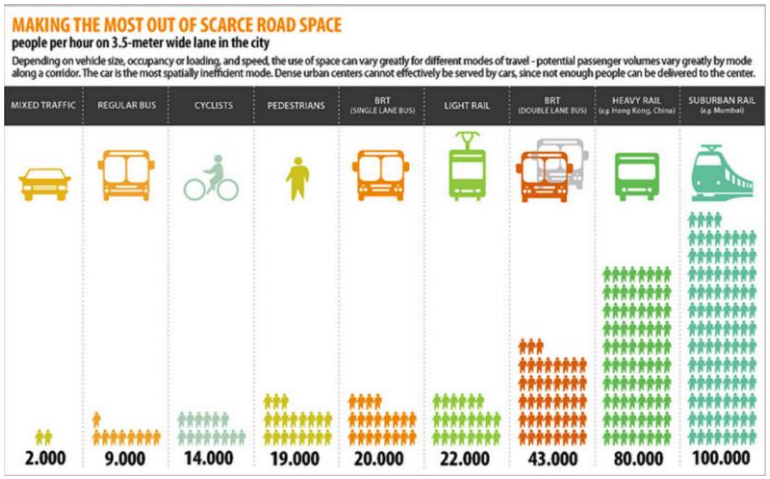
Framework of 5 E's

- Effective mobility
- Efficient city
- Environment
- Economy
- Equity

Van Oort et al. 2017

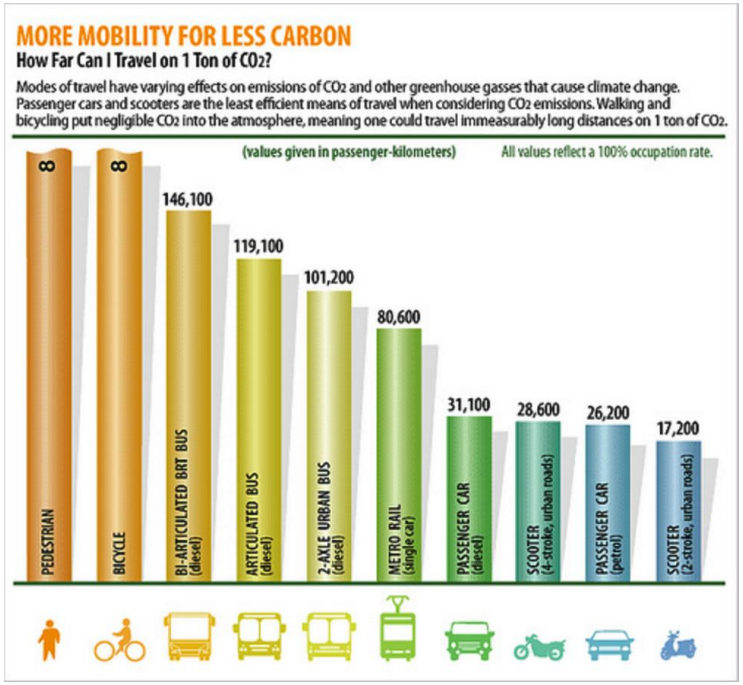
Efficient cities

- All kinds of (indirect) effects:
  - Urban planning & design
  - (Restructuring) the city
  - Quality of the city
  - Livability
  - Image & perception of the city

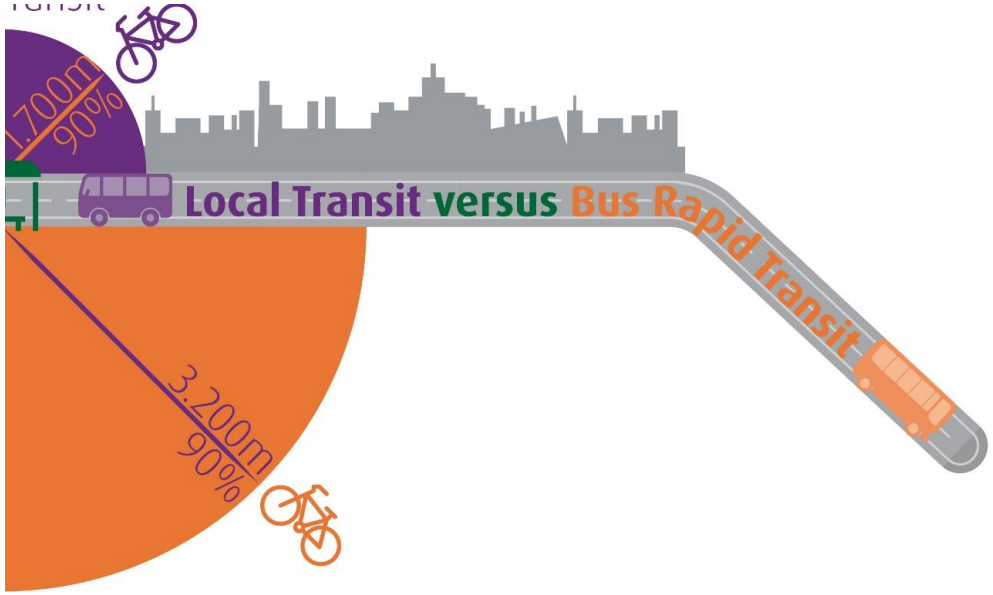


Environment+health

- More efficient regarding:
  - Energy consumption
  - (Direct) emissions
  - Land use
- Bicycle+transit



Impact of PT quality on catchment areas



Brand, J., et al. (2017)

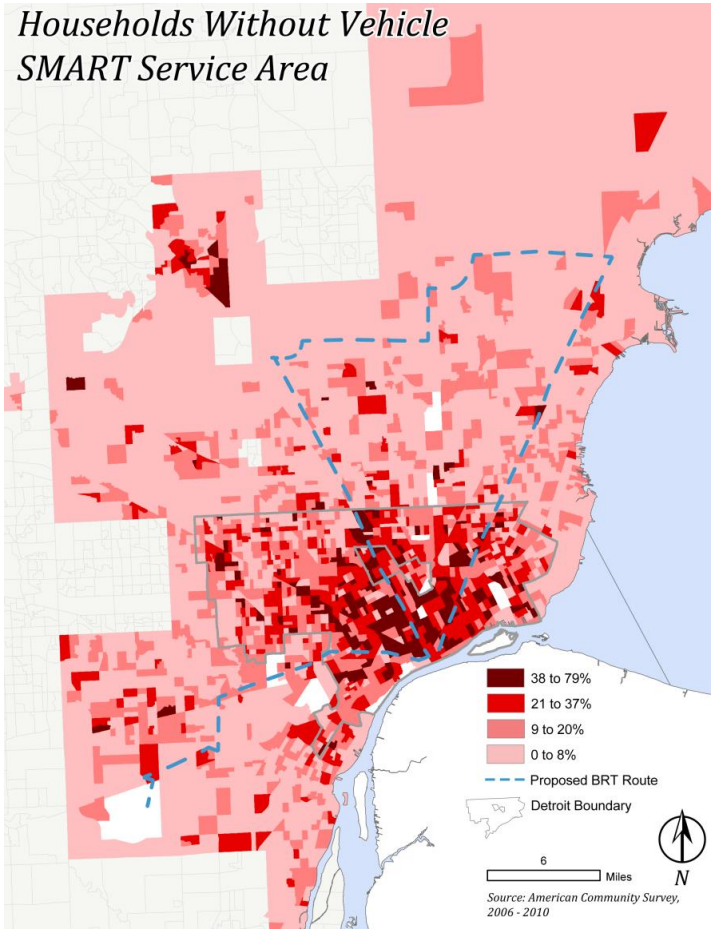
Economy

- Land value
- Real estate value
- Retail turnover & quality
- Employment
- Property development

	Increase due to high quality public transport accessibility	
Land value	+ 5%	+ 10%
House value	+ 2%	+ 5%

Equity

- Social access & connection:
  - Contra-segregation
  - Social mobility



Dutch population (>16 year)
- 6%: Hard to walk or cycle
- 2.5 million: Hard to read or write and limited digital skills

Effective mobility

- Quality of service
  - Travel speed
  - Transfers
  - Service reliability
  - Robustness
  - Comfort
  - …

A

Light rail

19 minutes

B

Bus

15 minutes

C

Streetcar

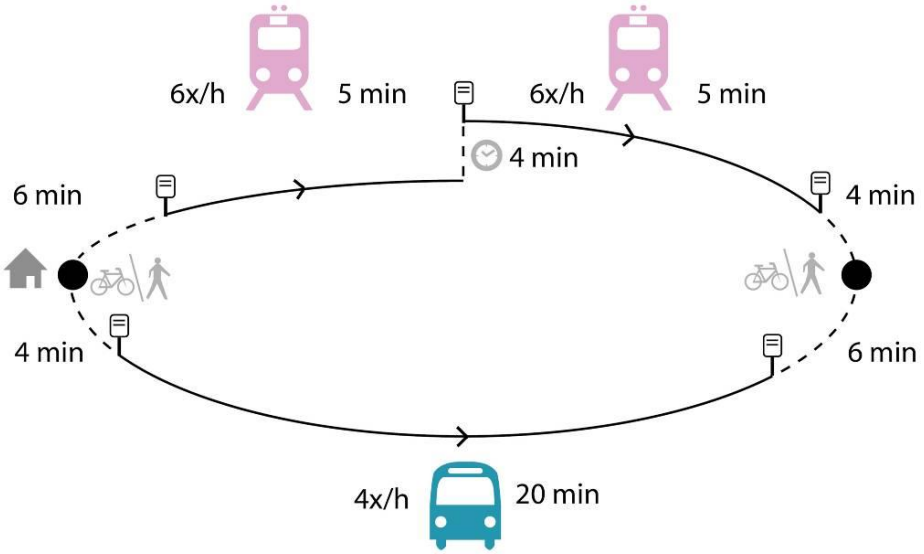
16 minutes

Rail bonus

- Research TU Delft (Bunschoten et al. 2013)
- Additional attractiveness of a rail system compared to a bus system with similar characteristics

Source	Result
Scherer (2011)	Slight pref. rail
Scherer (2009)	Slight pref. rail
Cain (2009)	Slight pref. rail
Bovy en Hoogendoorn-Lanser (2005)	Preference rail
Currie (2004)	Slight pref. rail
Ben Akiva (2002)	No difference
Welschen (2002)	0-10%
Kasch en Vogts (2002)	Preference rail
Megel (2001)	Slight pref. rail
Axhausen (2001)	Slight pref. rail
Berschin (1998)	+30%
Arnold en Lohrmann (1997)	+15%
Hüsler (1996)	+54%

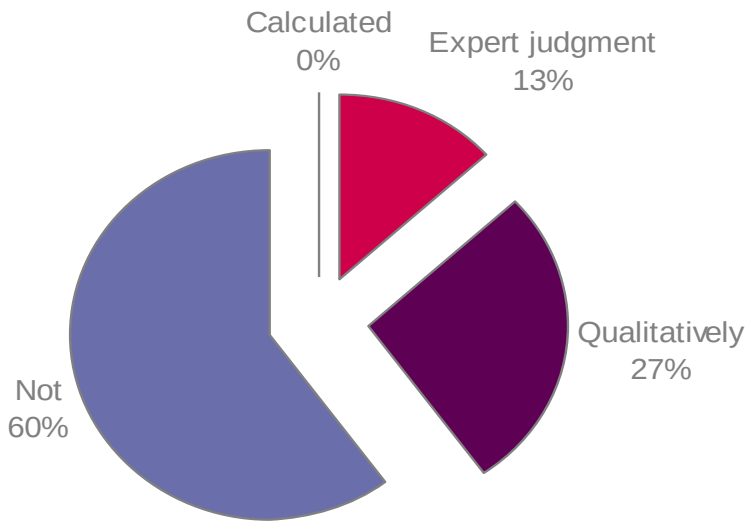
Rail Bonus: approx. 5-15%



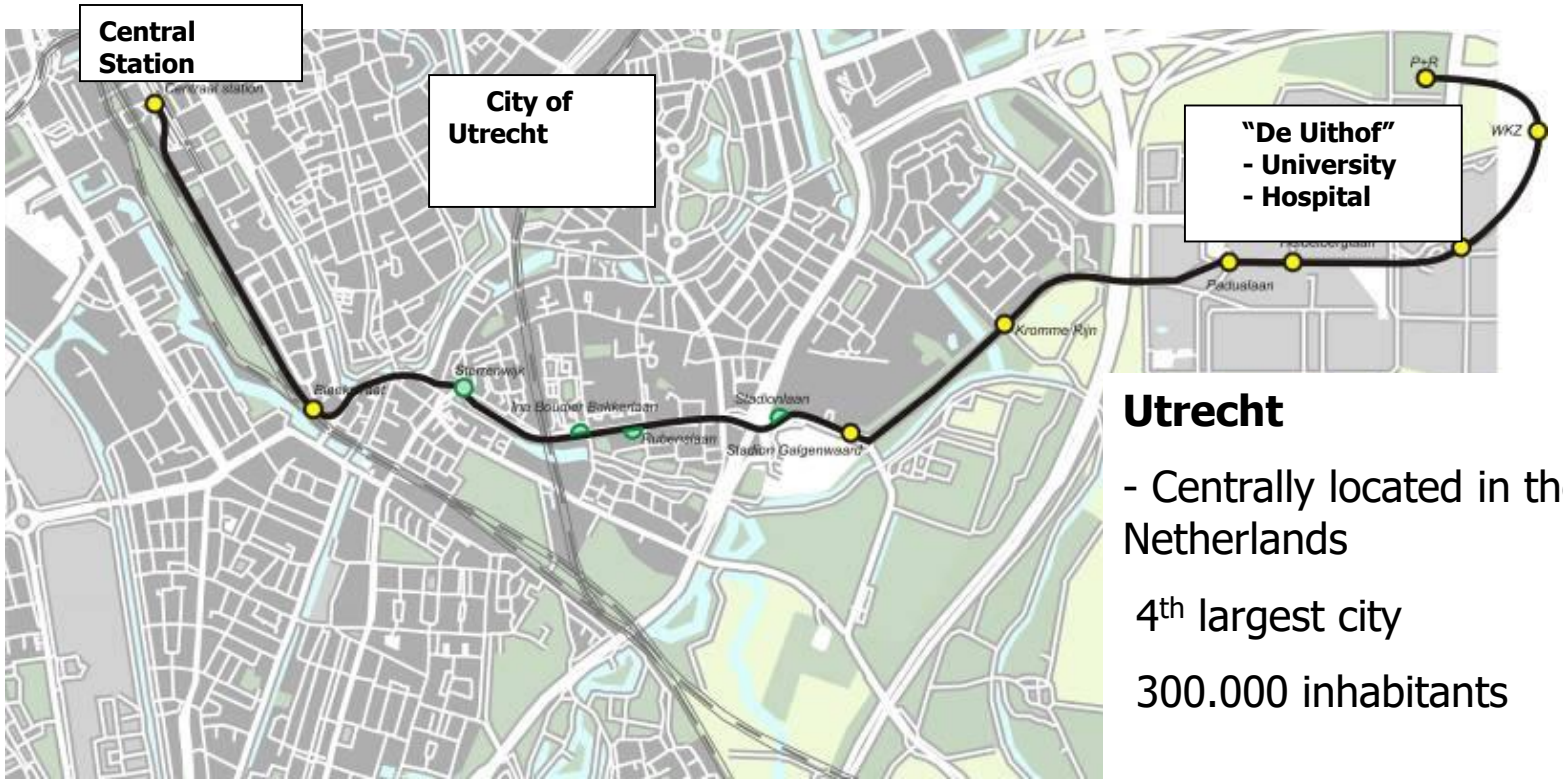
Case 1: Utrecht Uithoflijn

Decision making in public transport

- Most PT 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

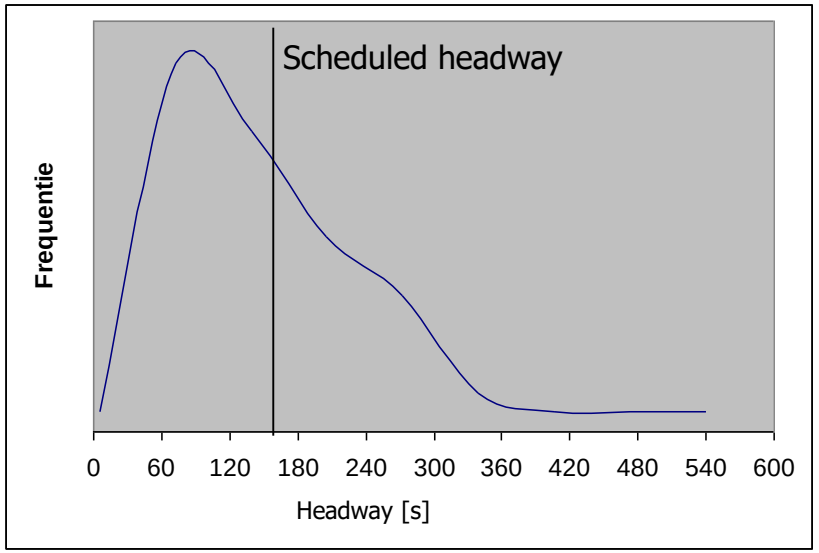
Problem analysis

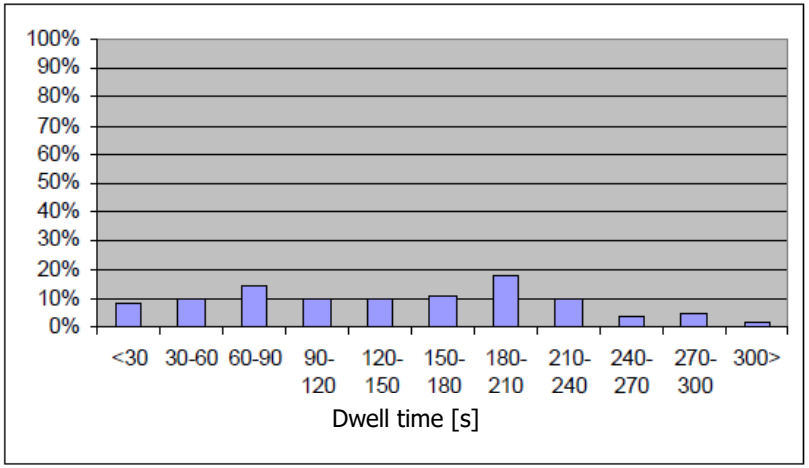
- Busiest bus line in the Netherlands: 27.000 passengers per day
- Frequency of 23x/hour/direction using double-articulated buses: 30x/hour/direction necessary
- Poor reliability and lack of capacity

- Mobility is still growing
  - +25% planned property in the Uithof: +8.000 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

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

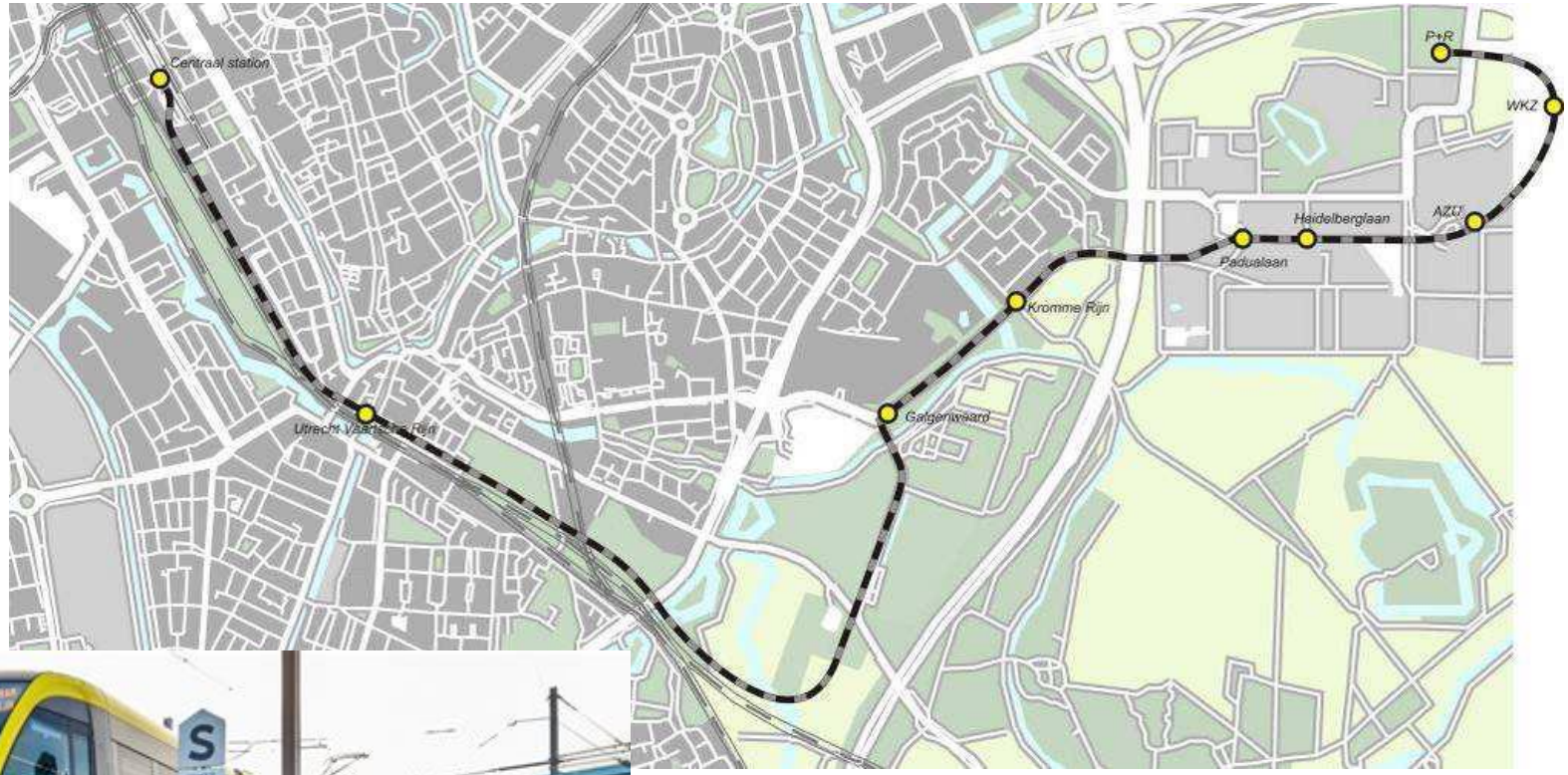
Poor reliability





Avg. =2,5 min; σ= 1,3 min

New tram line

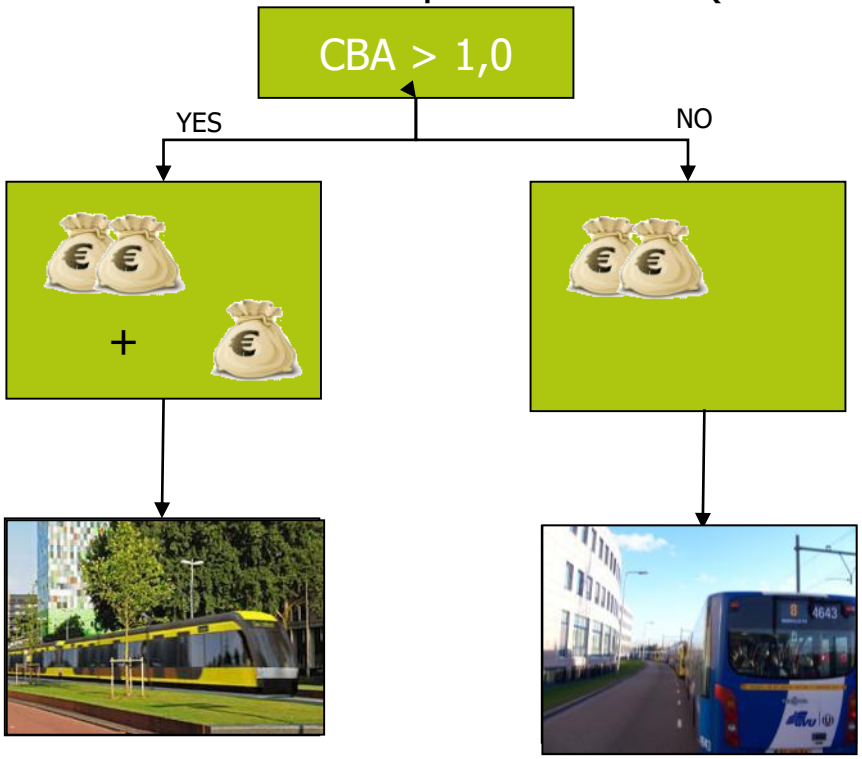


7,5 km
Operations are planned to start in 2018;
delayed to 2019

Connected CAF vehicles (2x37,5 m)

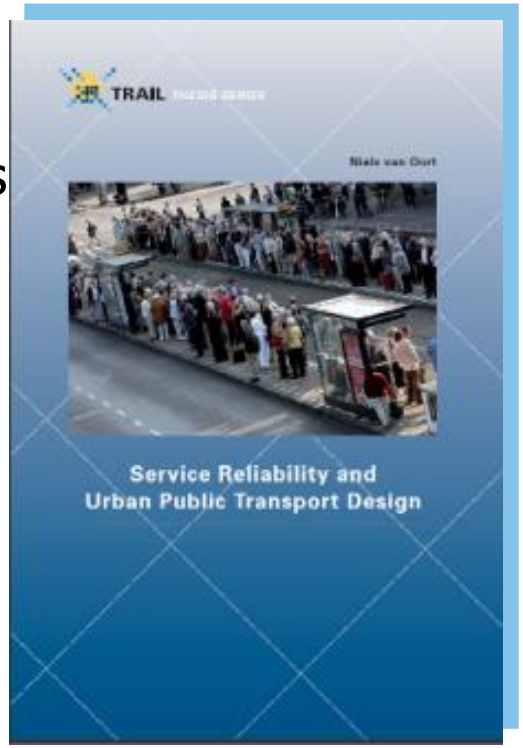
Ministry requires CBA

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



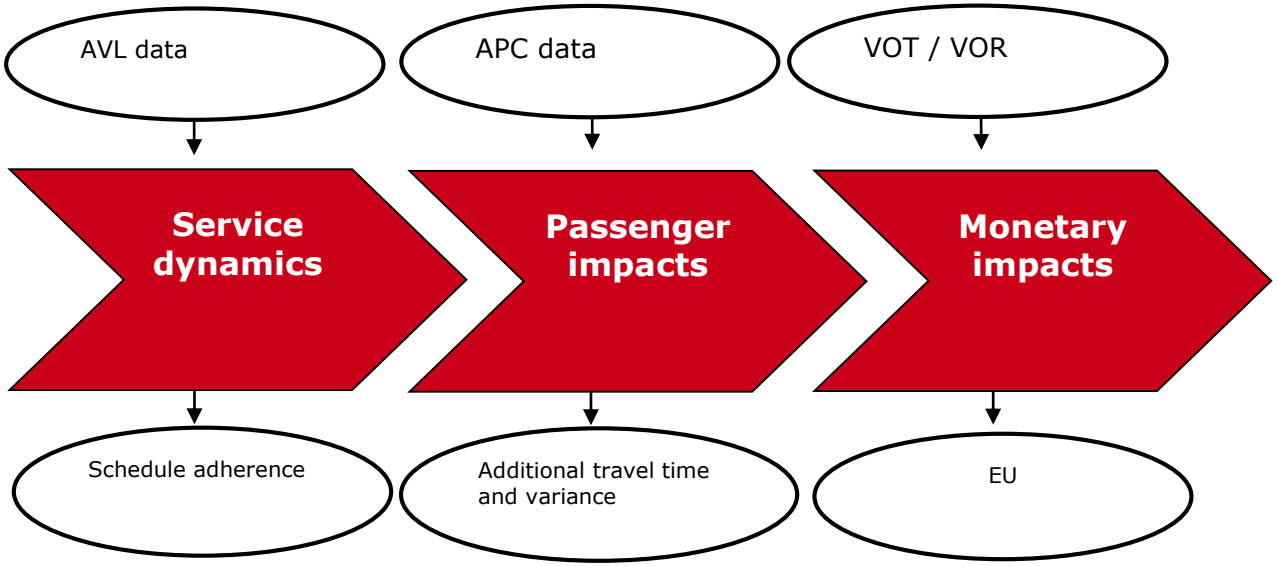
Our approach

- **Calculations of:**
  - Future demand, including tram bonus impacts
  - Costs (infrastructure and operations)
  - Benefits
    - Travel time gains
    - **Reliability gains**



Van Oort, 2011

Three step approach



Van Oort, 2016

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!

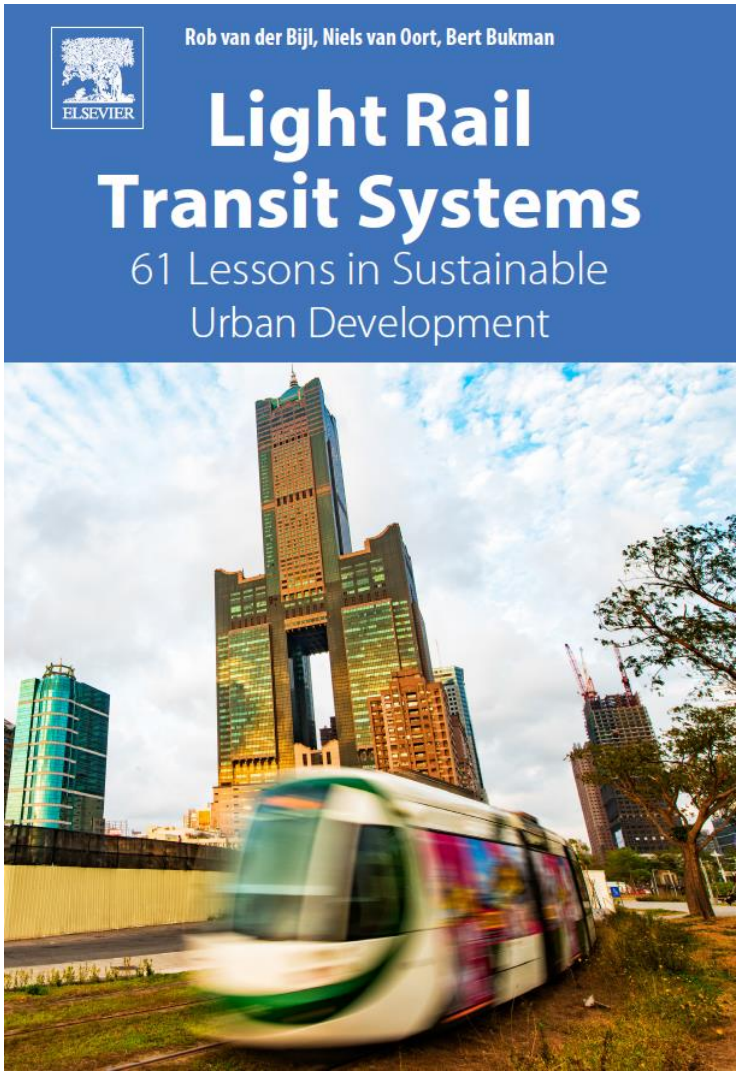
This method was approved by the Dutch Ministry and the Minister provided the €110 million

Summary

- Light rail is a valuable addition to the PT planning tool box
- Light rail is flexible and hybrid
- Lessons from light rail projects: justification and broader scope than transport
- Framework of 5 E's
  - Efficiency
  - Effectiveness
  - Economy
  - Environment
  - Equity

Cases

- Light rail enables increase in service realibility
- Little attention to service reliability in cost-benefit analyses
- Service reliability benefits made the difference in Utrecht



Van der Bijl, Van Oort, Bukman 2018

Elsevier

Available via www.Elsevier.com

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Questions / contact

dr. ir. Niels van Oort
N.vanOort@TUDelft.nl

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