# Smart mobility in smart cities
# seamless integration of networks and sevices (PPT)

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# Smart Mobility in Smart Cities

**Seamless Integration of Networks and Services**

Prof. dr. Serge Hoogendoorn



*Some background: two decades of research…*

# *Traffic Operations and Management*

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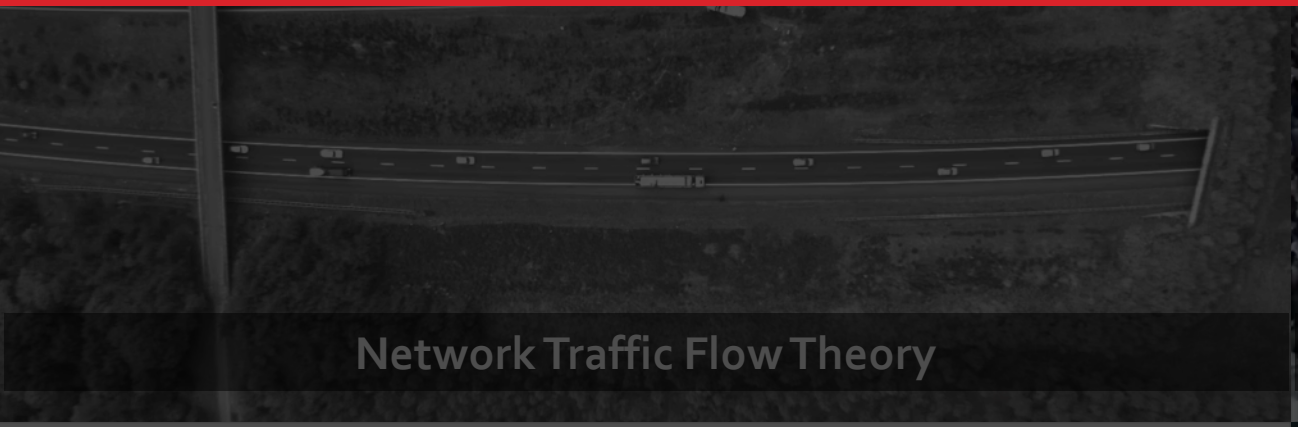
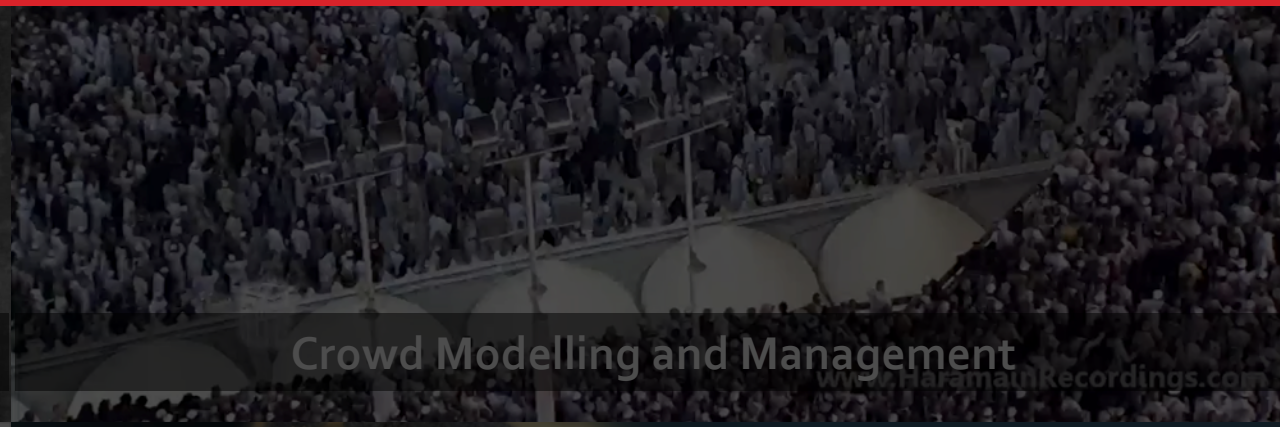
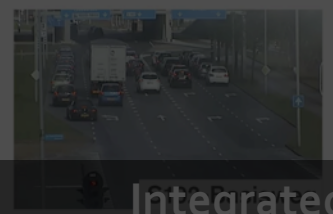
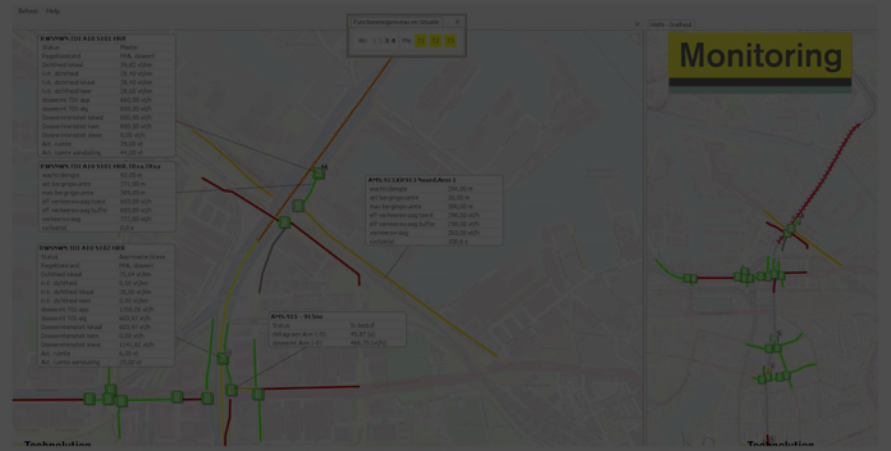


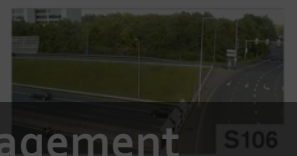
Network Traffic Flow Theory



Crowd Modelling and Management





Integrated and coordinated Traffic Management

Management and Planning of Evacuations

*Change in research focus…*

# *Towards Smart Urban Personal Mobility*

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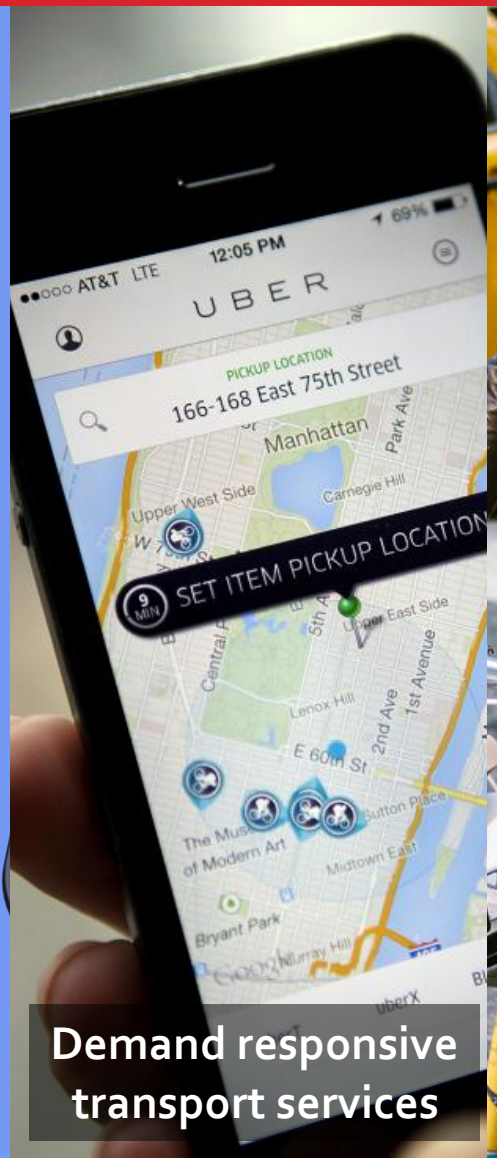
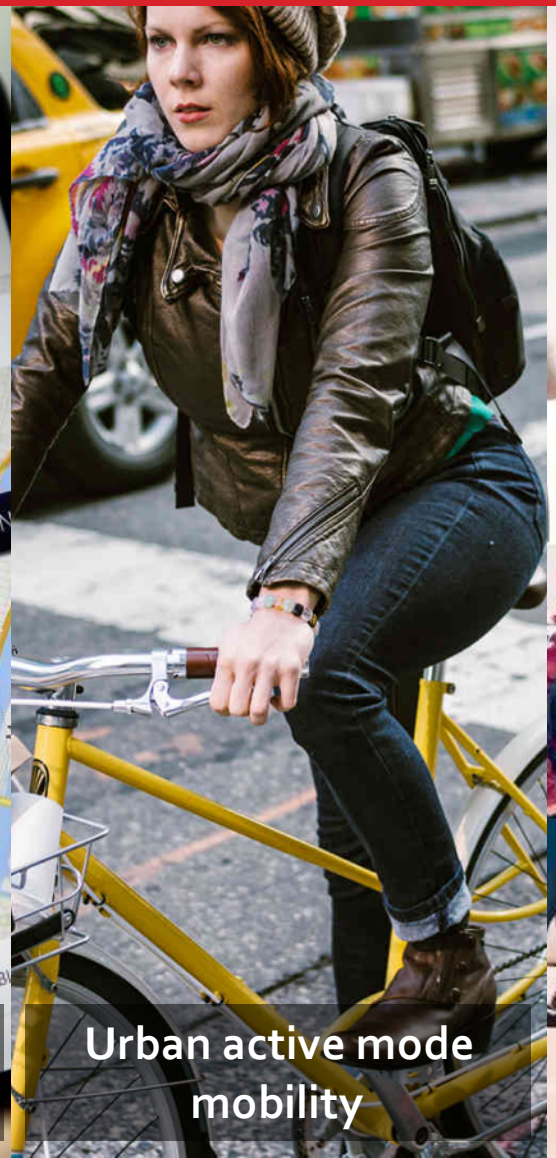
Anticipatory decentralised control




Demand responsive transport services



Urban active mode mobility

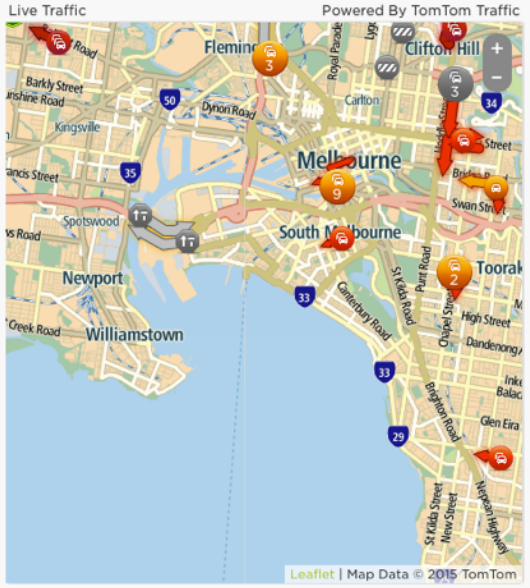
Cooperative systems and driver automation

Urban Traffic and Transport data

## MELBOURNE

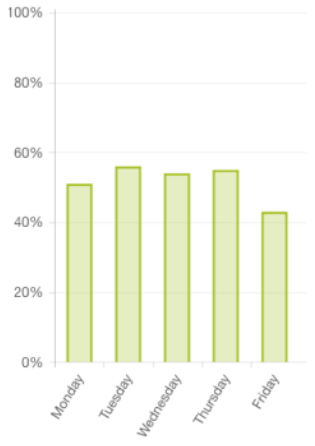
km | mi

Live Traffic — Powered By TomTom Traffic

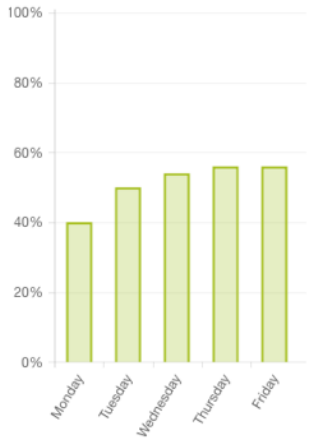



| Congestion Level | |
|---|---|
| | 28% |
| World rank compared to other large cities | 60/146 |
| Congestion Level on highways | 21% |
| Congestion Level on non-highways | 35% |
| Delay per day with a 30 min commute | 20 min |
| Delay per year with a 30 min commute | 78 hr |
| Most congested specific day | Thu 20 Nov 2014 |
| Total network length | 35 656 km |
| Total network length highways | 1 155 km |
| Total network length non-highways | 34 502 km |

Morning peak Congestion Level




Evening peak Congestion Level

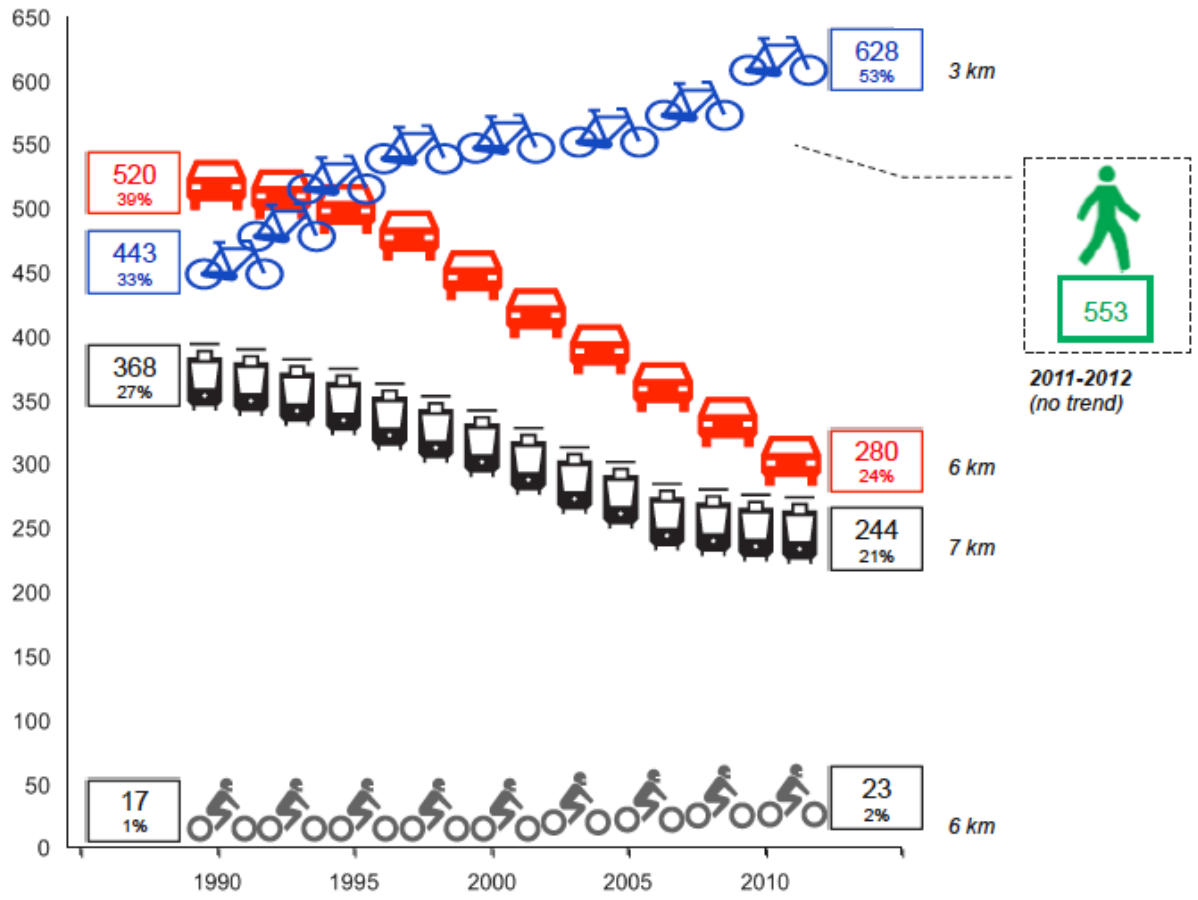



Delay per day with a 30 min commute


# *Why the change of focus?*

- Urbanisation is a global trend!
- Accessibility is a major issue in many car-centric cities and appears persistent
- Most delays are experienced on arterials (not on freeways!), speeds may drop off to below 20 km/h during peak…
- Urban space is very scarce, so building new infrastructure is generally not straightforward
- 2/3rd of traffic accidents occurs within city boundaries
- High impact (traffic-related) emissions and noise (people live near roads…)
- *Potential change is there: in some cities, low operational speed of cars in combination of pull / push measures has lead to modal shifts…*

- Cycling and walking have become **main modes of transport** in Amsterdam (and many other Dutch cities)
- For Amsterdam: big impacts on emissions (4-12% reduction), as well as on noise, accessibility and health
- Popularity of rail has increased as well (because of?): for many rail trips, cycling is used for access and egress
- But these positive trends also has some negative (but interesting) impacts…




# *Changing modal shares in The Netherlands*

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Bike congestion causing delays and hindrance


Bike congestion causing delays and dangerous behaviour at intersections


Bike parking problems & orphan bikes


Overcrowding during events and regular situations also due to tourists


Overcrowded public transport hubs


Not-so-seamless public transport

*Examples of interesting 'side-effects' of a very desirable trend…*

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The Cycling Promotion Fund


The Canberra Transport Photo


www.cyclingpromotion.com.au

# *Amsterdam Institute of Advanced Metropolitan Solutons*

- To tackle these (and other) big city issues, Amsterdam sponsored foundation of AMS
- Collaboration between MIT, TUD, WUR and industry partners with municipality of Amsterdam as main 'client'
- Annual budget 30 million EUR
- Learning by doing: **the city as a living lab!**
- Urban Mobility (and Logistics) as one of the key issues
- Developing a vision on **Smart Sustainable Urban Mobility**

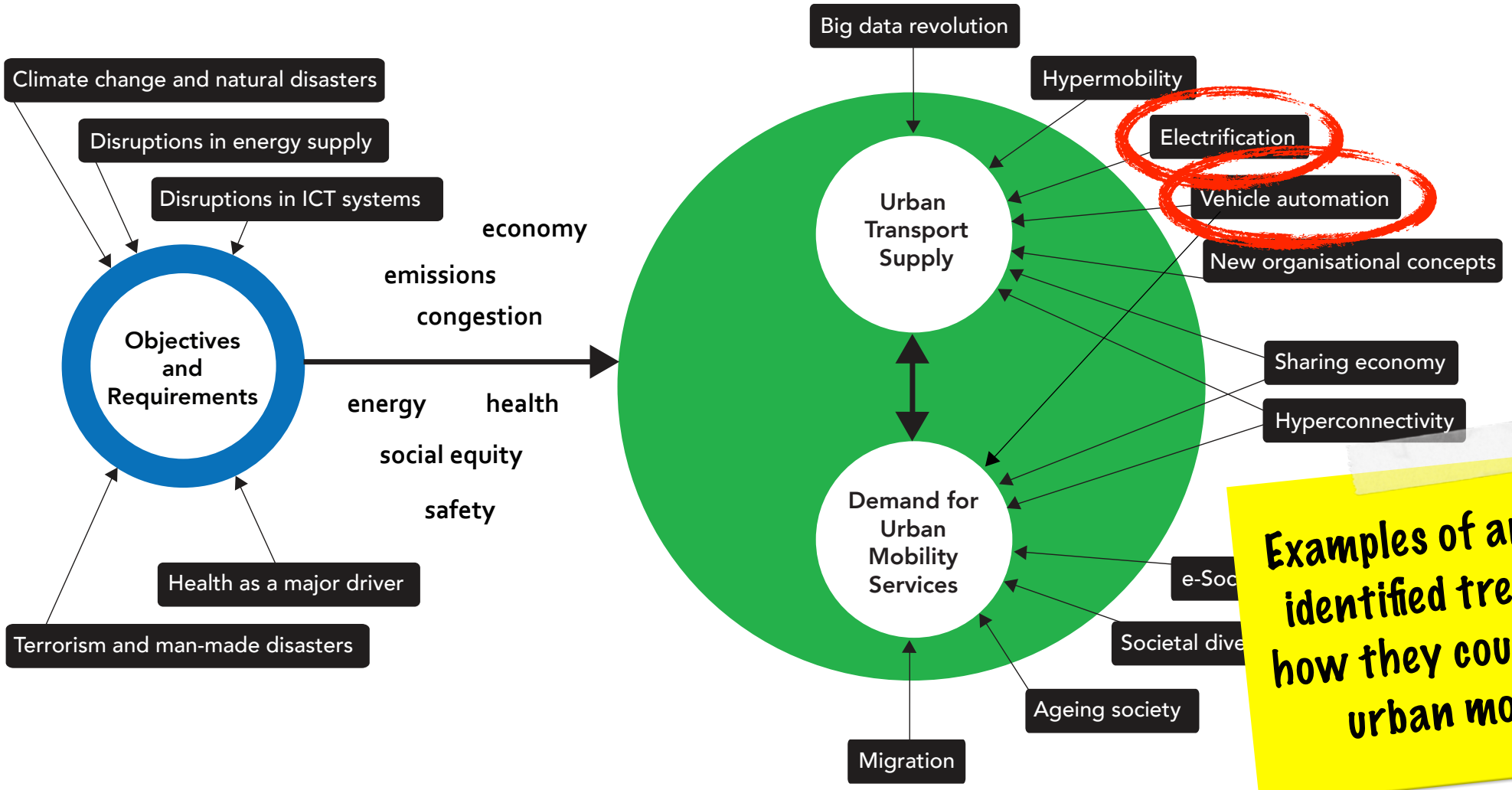
AMS
AMSTERDAM INSTITUTE FOR
ADVANCED METROPOLITAN SOLUTIONS

Engineering the future city.

# *Towards a vision on Smart Urban Mobility*

- Ingredients of a vision…
- What are expected main **trends** (next to spatial trends)?
  - trends affecting **mobility demand** (demographic changes, socio-economic developments)
  - trends affecting **supply transport modes and services** (e.g. technological trends, innovations)
  - trends that affect **aims and requirements**
- Analysis and confrontation trends: are current issues resolved? Do we see new issues? Are they in line with current en future policy objectives? Should we accelerate / decelerate certain developments?
- **What is a feasible and desirable situation and how do we get there?** What are the roles of various actors?
- *A first step (EU strategic agendas + brainstorm)…*

# Trends affecting urban mobility



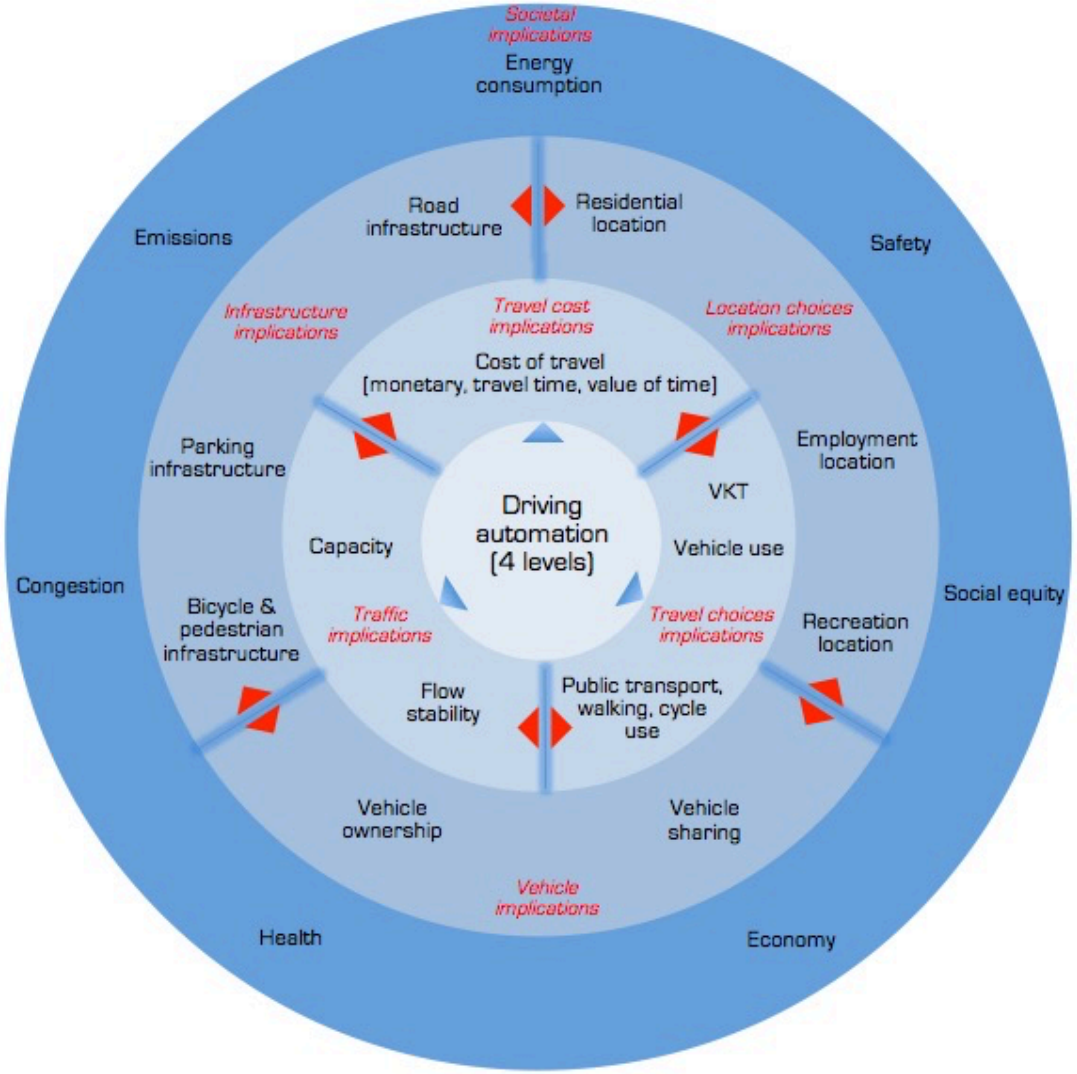
# *Example trend: electrification (or rather: the e-bike)*

- About 65% of trips are shorter than 7.5 km; about 75% are shorter than 15 km
- Acceptable distances that can be travelled by e-bike is about 15 km; for bikes it is about 7.5 km
- E-bike reduces impact of grade, and is less demanding, enabling cycling for wider audience
- Potential for e-bikes seems large, but new challenges do emerge!
  - Safety? In particular an issue for older cyclists
  - Mixing ‘normal’ cyclist / pedestrians and motorised bicycles (e.g. larger speed differences)
- The (e-) bike will not be the only answer, but can be an **important element of the system**


*Courtesy of Kevin Krizek*

# *Example trend: driving automation*

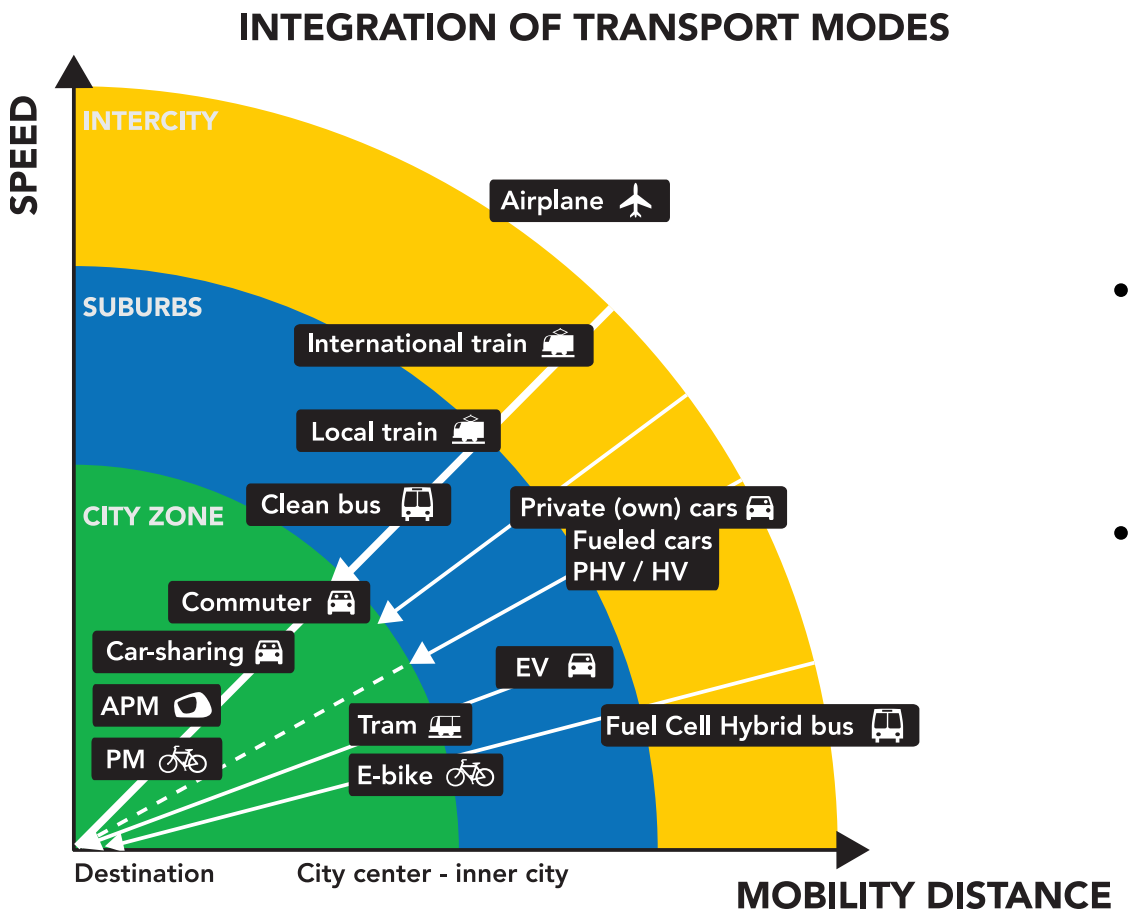
- Introduction will have huge impacts, beyond changing capacity and safety: **ripple model**
- Travel time becomes work time! Impacts of Value of Time changes on mobility patterns?
- Driving automation gaining lots of attention, but with strong focus on freeway applications
- Feasibility **in dense urban areas**?
  - Will own infrastructure be needed? Where do we find the space in our dense cities?
  - Throughput and safety impacts, also in case reduced automation when cars enter city?
  - Privately owned vehicles or shared services?
  - Interaction with vulnerable road users?
- **Driving automation not likely to be a panacea!**



# *The Dutch alternative to the self-driving car?*

Developing a comprehensive vision requires analysing all identified trends and predicting their impact on urban mobility

# *Contours of a vision:*
# *Integrated & hyper-connected urban mobility*




- Using key **technological trends** (big data, hyper-connectivity), **social trends** (e.g. attitude towards (car-) ownership), and **changing objectives / requirements** regarding urban mobility…
- **Uni-modal urban transport system not likely to achieve identified objectives / requirements** (in particular: health, sustainability, liveability)
- We believe we should foster transition to a less car-centric **urban mobility system**, with pillars:
  1. Seamless integration of mobility services, "prioritising" sustainable and healthy modes
  2. Flexible / efficient use infrastructure & space
  3. Requiring open urban multi-modal data platform

# *What does seamless integration of services entail?*

- Transfer / access / egress resistance is high (1 transfer ~ 17 min travel time)
- Reduction essential to make a multi-modal trip compete with car:
  - Seamless transfer between **appropriate modes**, also in terms of infrastructure
  - Seamless payment schemes
  - Accurate **personalised** multi-modal real-time info and advice giving **fair** information about all alternatives
- Important role of (shared) **active mode** for shorter (legs of multi-modal) trips
- Role autonomous vehicles as a **mobility service** (driverless Uber)?

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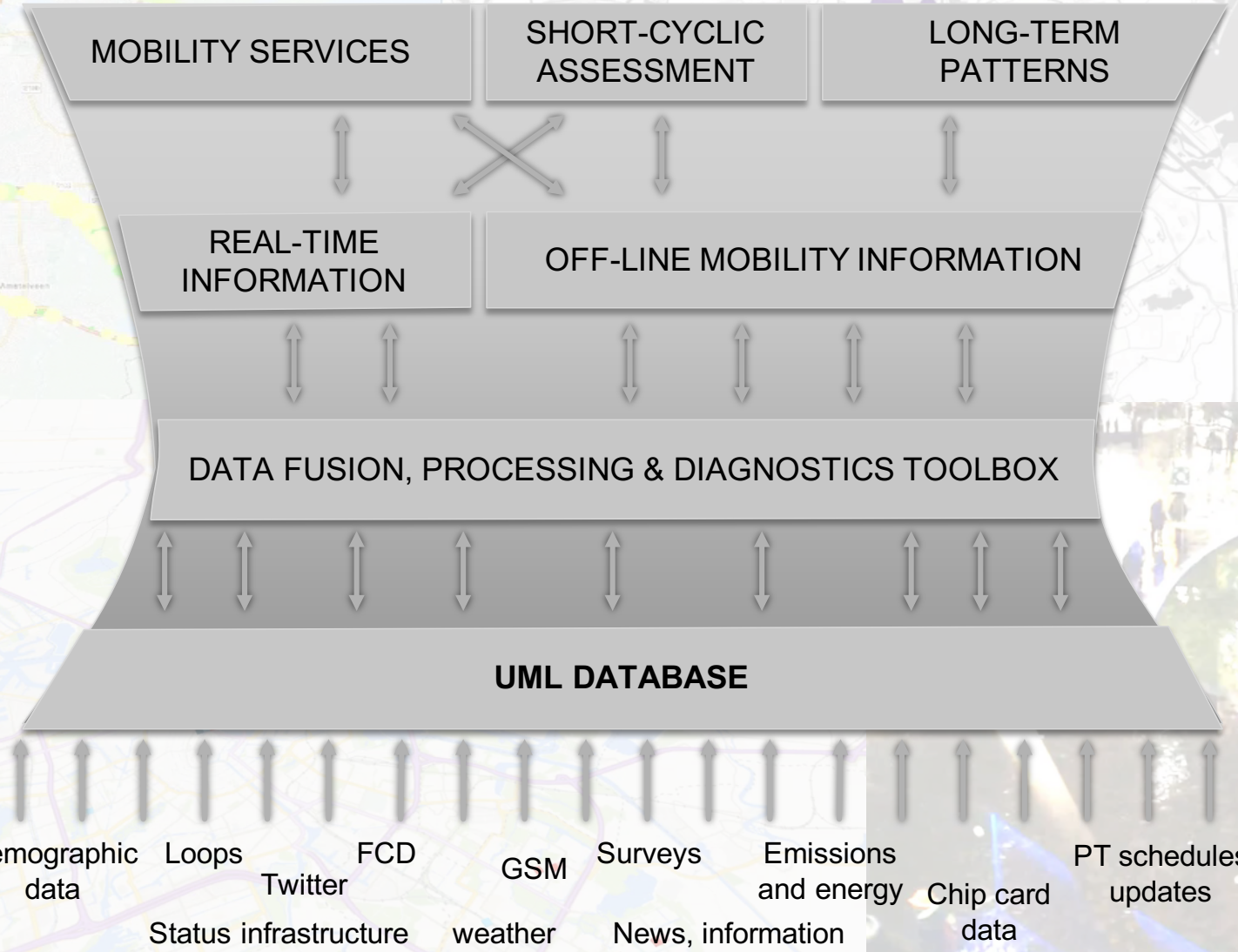
urban arterial data

Data from parking garages in and around event area



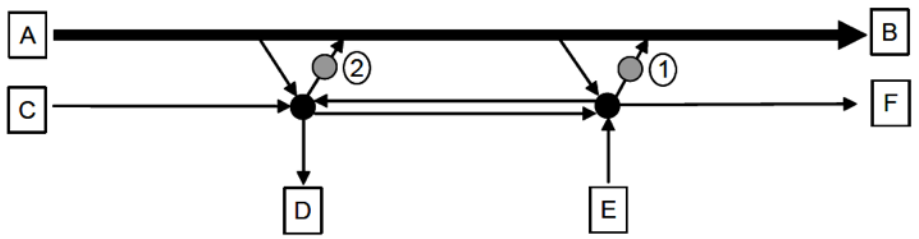

Chipcard public transport data

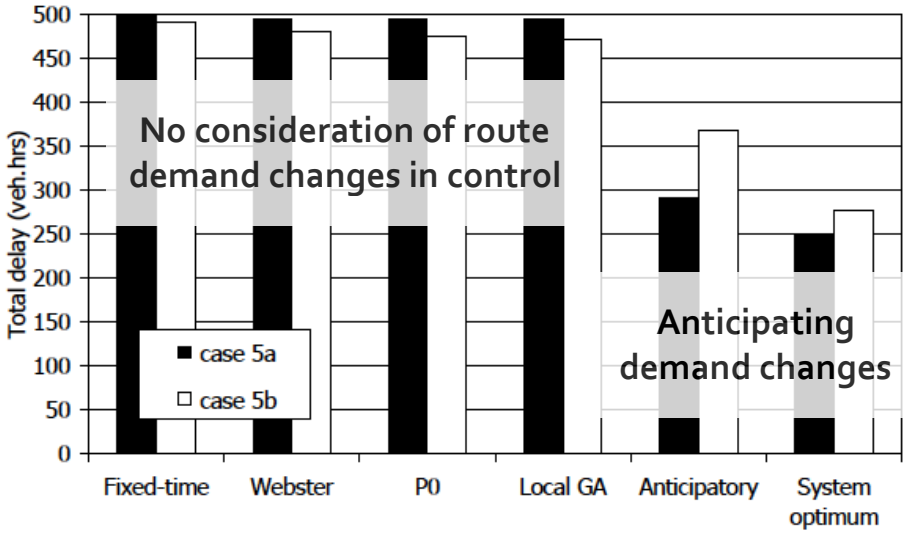
Pedestrian counts from video

# *UML: Open Multi-modal Data Platform*

- Data platform to unravel multi-modal traffic patterns
- Example application example during triple event in Arena area
- Pilot shows potential of system for multi-modal information and guidance during events

# *Flexible and efficient utilisation of network capacity*




- Key since space to build new roads in our dense cities is often not available!
- Many examples already available:
  - Integrated traffic control and management (e.g. Practical Pilot Amsterdam)
  - Integrated management of Traffic, Public Transport and Crowd management during events (SAIL)
- Major opportunity is in integrating measures influencing demand and supply (e.g. anticipatory control)
- *Note: flexible use also allows improving robustness and better dealing with extraordinary situations*

## DTM transition paths


From collective guidance to smart mix of collective and individual servi


A changing role of road-side traffic management systems

From local / regional to national traffic information and management


From business to government to business to consumer and business to

From owner of data to maximal openness and availability (private and

From government to public-private collaboration and alliances

## *Closing remark: importance of clear transition paths!*

- Development of comprehensive transition paths to enable Smart Urban Mobility:
  - Integration of current, often uni-technology / uni-modal transition paths
  - Identification of no-regret activities and developing pilots that contribute to transition
- Examples: 1) **Transition DTM** and 2) Transition driver automation

***Visions are wonderful, but there are also problems to be solved right now!***

Q&A

# What do we want our cities to be like?

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# *Trends and implications for transport modelling?*

- Days of traditional (static) transport modelling seem over, new techniques in modelling and calibration open alleyways for practical application of such models, including activity-based modelling
- With big-data, data-driven modelling will become more important
- Hyper-connectivity makes process more complex and potentially more unstable
- Importance of behaviour and human factor
- Travel time becomes work time (self-driving vehicles) or recreation / exercise time (active modes): shift in activity patterns, VoT, etc.
- Active mode transport is poorly described in many transport models, yet important in (almost) all (multi-modal) trips!
- Importance of including non-transport