Principles of a Sustainable Traffic Management

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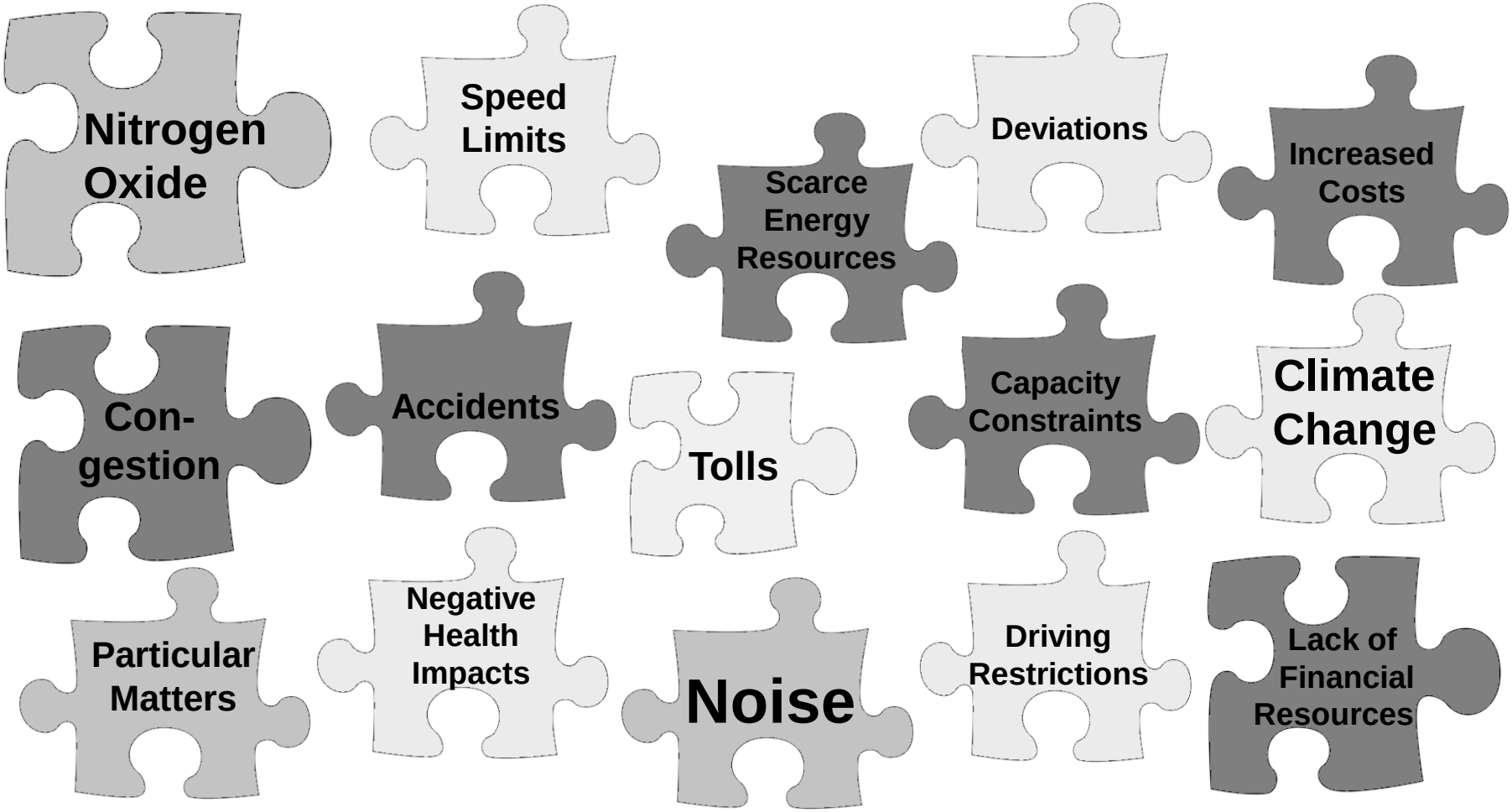
Fachgebiet Verkehrsplanung und Verkehrstechnik

Transport Problems Need Attention



Need for Traffic Management

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- **Mobility** is a major value for people in our societies, and it should not be restricted.
- **Travel demand** continues to increase.
  (Needs a differentiated look in details!)
- **Appropriate infrastructure** is important.
  But infrastructure alone cannot solve the problems.

- **"Capacity"** is not to be defined by traffic flow characteristics, only. Instead, it must consider also other aspects such as accepted levels of noise and air pollution along an infrastructure.

The need to balance travel demand and transport supply will increase.

Traffic Management – Definition and Principle Objectives

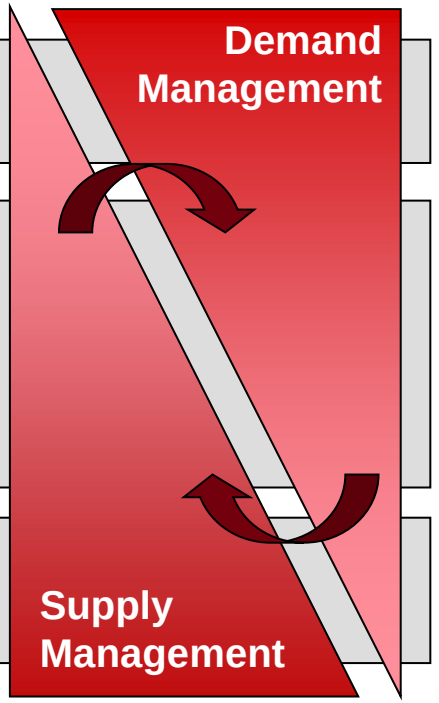
Traffic management influences the supply of traffic and transport systems as well as the demand for travel and transport through a bundle of measures with the aim to optimize the positive and negative impacts of traffic and transport.

Avoid traffic

Shift traffic

- **departure time**
- **mode**
- **destination**

Control traffic



Control of Supply and Control of Demand in Traffic Management

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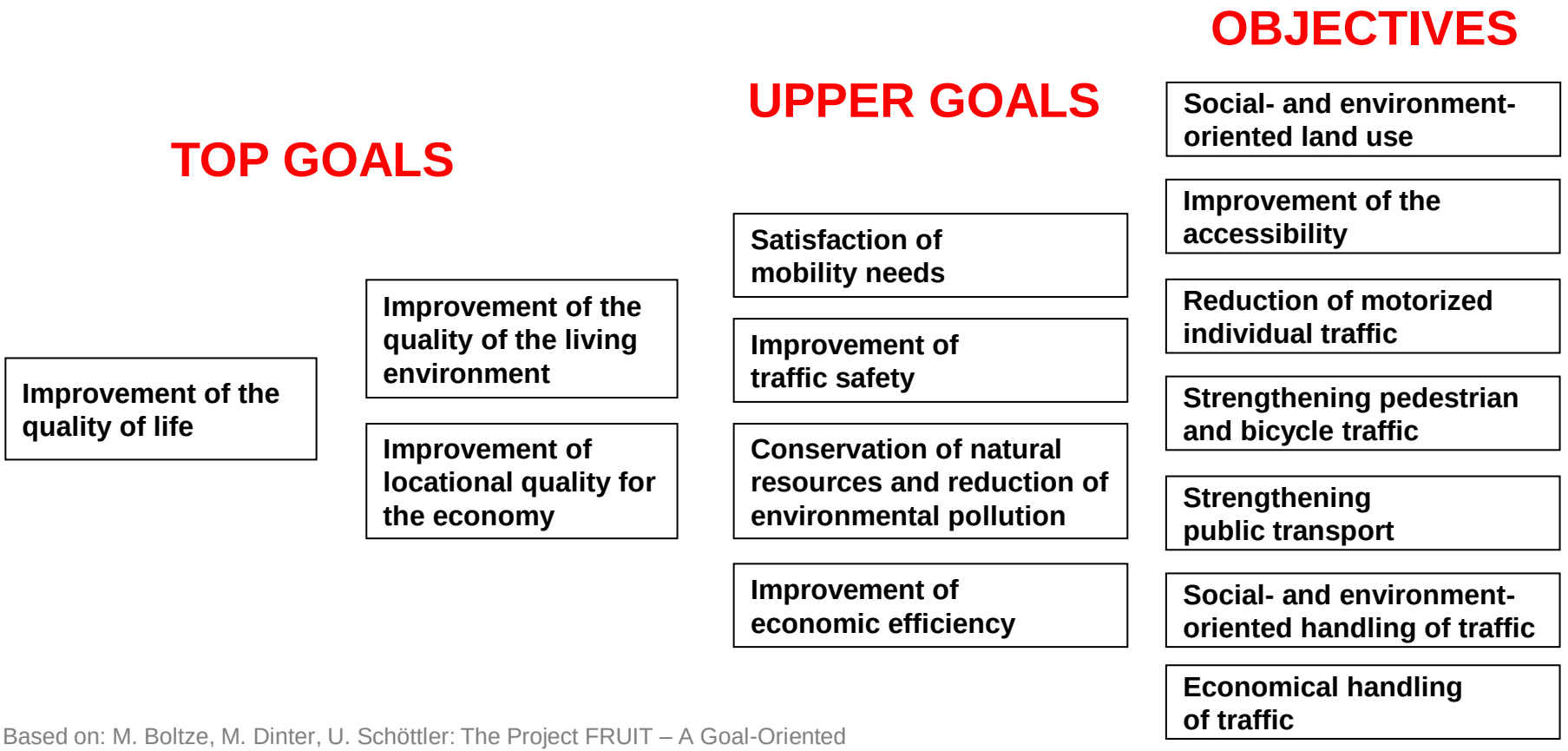
Traffic Management	Passenger Traffic	Freight Traffic
Control of Supply	Provision and Operation of Traffic Systems	
Control of Demand	Mobility Demand Management	Freight Transport Demand Management


Bus in Colcata (2000)


„Bus“ in Kuba (2000)


Congestion in Istanbul (2007)

Goal Concept for Traffic Management



Based on: M. Boltze, M. Dinter, U. Schöttler: The Project FRUIT – A Goal-Oriented Approach to Traffic Management in Frankfurt am Main and the Rhein-Main Region. In: Traffic Engineering + Control 35, 7/8, London 1994, p. 437-444

Principle 1

Provide sufficient and sustainable financing for transport.

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- **Asset erosion and reduced functionality** of the infrastructure must be avoided.
- **Financing of public transport** must be secured and sustainable.
- **Additional payments** only seem to be acceptable to travellers, if such new income is clearly used to improve the transport system and not compensated by cutting other financial sources.
- There are some options, to involve not only the users of the transport systems in financing but also **other beneficiaries**. (e.g. commerce in the neighbourhood)
- The impacts of pricing instruments must be **carefully assessed** and balanced in each case.

www.toll-collect.de


FGVV: London 2007.

Principle 1

Provide sufficient and sustainable financing for transport.


Mautstation an der Sydney Harbour Bridge (2014)

Parkentgelte in New York (2015)


City Maut in London (2007)


Darmstadt, B3 (2012)

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Principle 2

Control transport demand and modal choice.

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- **Capacity of transport systems** cannot be extended according to demand.
- **Land-use control** is a most powerful tool, but usually limited to long-term effects.
- **Control demand** with accurate aims: Influence departure time, transport mode, route, destination …
- **Information systems** will contribute significantly to optimize the distribution of travel demand by time and location.
- Influencing demand must address not only passenger transport (***Mobility Management***) but also freight transport (***Freight Transport Demand Management***).

Principle 2

Control transport demand and modal choice.

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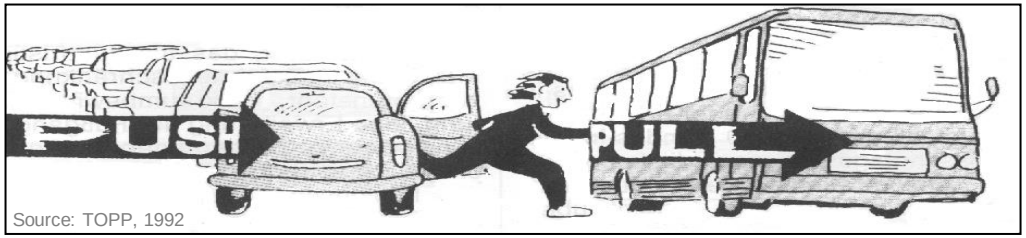
- **“Push and Pull”**



Source: TOPP, 1992

- **PULL: Care for attractive alternatives**.
- **Allow intermodal travel.**
- **PUSH: Apply efficient measures:**
  - access control
  - parking management
  - road pricing

BUT: To **deteriorate traffic flow** for motorized vehicles in urban areas **is not an appropriate mean** to control mode choice.

Excursus

Increasing Acceptance of Restrictive Measures

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"The most important limitation to the transport development in the near future seems to be the decreasing acceptance of negative side effects of transport." Translated from LÜBBE, H.: Mobilität - vorerst unaufhaltsam. Internationales Verkehrswesen 11(1993)

Principle 3

Use the instruments of mobility pricing to control demand.

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- **Congestion is the worst instrument** to control demand!
- **Pricing** must be understood not just as an instrument for financing but also as **a most efficient tool to control demand**.
- **Many examples**! (vehicle and fuel taxes, city tolls, parking fees, public transport tariffs, student / job tickets for public transport, ...)
- **Variable prices** adapted to current demand should be used in public transport, for parking, and also in road pricing.
- **Road pricing** must not only influence mode choice and spatial distribution of traffic but also the **distribution of departure times**.

  In this regard, simple pricing systems such as paying a flat rate per year or even per day cannot help much.

FGVV: Florida


FGVV: London 2007.

Principle 3

Use the instruments of mobility pricing to control demand.

By Chevy111 - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=47401318

Road Pricing near Osaka, Japan (Boltze 2000)

IDENTIFY FARE PERIODS

Monday-Thursday	
5:00 a.m. – 9:30 a.m.	Peak
9:30 a.m. – 3:00 p.m.	Off-Peak
3:00 p.m. – 7:00 p.m.	Peak
7:00 p.m. – Midnight	Off-Peak
Friday	
5:00 a.m. – 9:30 a.m.	Peak
9:30 a.m. – 3:00 p.m.	Off-Peak
Saturday	
7:00 a.m. – Midnight	Off-Peak
Sunday	
7:00 a.m. – Midnight	Off-Peak
Federal Holidays	Off-Peak

Fares are based on entry time.

Washington D.C., USA (Boltze 2017)

ERP in Singapore (Source: www.lta.gov.sg)

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Principle 4

Ensure a future-proof design of transport infrastructure.

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Our transport systems are changing rapidly.
New requirements are emerging.

Examples:

- Emerging **long-distance bus travel** in Germany.
- New requirements for the **cycling infrastructure.**
- **Mobility stations** for car-sharing, car-rental/bike-rental systems.
- **Charging stations** for electric vehicles.
- Changing needs of an **aging society.**
- Requirements of **automated vehicles** (lane width, road construction, road markings, parking space in city centres, …)

Transport infrastructure must be flexible and robust against changing requirements.

Principle 5

Operate transport infrastructure dynamically and situation-responsive.

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- Major aim is the **efficient use of the infrastructure** under conditions which are changing by time and location.

- Available resources in public transport and in individual transport must be used in a flexible way, **depending on time and situation**.

  Examples: Tidal flow systems, actuated traffic signal control, dynamic speed limits, dynamic route signs, on-demand public transport services, ...

- **Detection of the current situation** and effective control are only feasible by using advanced technologies.

- **Congestion** should be consequently avoided, at least counter-actions shall be taken quickly.

- **Dynamic strategies** for traffic management must be **planned in advance**, evaluated and agreed upon by all involved institutions.

Principle 5

Operate transport infrastructure dynamically and situation-responsive.

Richtungswechselbetrieb in Rio de Janeiro (2012)

VZH, 2005

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Principle 6

Improve traffic safety.

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- **Traffic Safety** remains a most important issue.
- **1,250,000 road deaths worldwide** in 2015, highest fatality rates in low-income countries. (Global Status Report on Road Safety 2015)
- **26,000 fatalities on EU roads in 2015.** (5,500 less than in 2010)
- **Significant improvements achieved** in many countries.
- **Growing motorization in developing and emerging countries.**
- **New problems arising.** (e.g. use of mobile phones while driving)
- **Ambitious political goals.** (e.g. “Vision Zero”)
- Need for measures in **Engineering, Education, Enforcement.**

Pictures: Feuerwehr Wörth (2004)

Principle 7

Apply measures to protect environment and climate.

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- **Air pollution leads to 467.000 premature deaths in Europe.**
  (European Environment Agency: Air quality in Europe - 2016 report.)
- The number of early deaths due to **traffic noise and traffic-borne air pollution** beats the number of traffic accident fatalities!
- **Many measures** to protect from noise and air pollution.
  (heavy vehicle bans, low emission zones, speed limits, priority at traffic signals, ...)
- **Traffic management must be dynamic and environment-responsive**.
- **Low emission vehicles** (e.g. electrical vehicles) bear a good perspective for environmental compatibility. But sufficient market penetration will need time.
- **Climate Protection** is another important field of action. **Freight traffic** needs special attention.

Excursus

Electric Heavy Vehicles: eHighway

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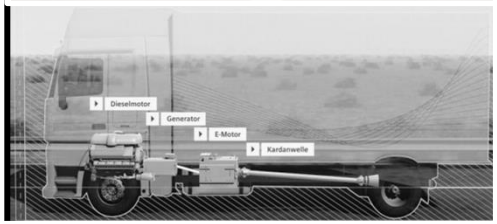

Quelle und Copyright: SIEMENS AG

Foto: Boltze 2017

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Principle 8

Consider health impacts.

- People consider **HEALTH** as a major value.
- **Traffic influences health** in many ways – positive and negative:
  - Noise and Air Pollution
  - Accidents and Injuries
  - Fitness and Stress
- **Exposure** depends on many factors:
  - Trip frequency and distance
  - Mode choice
  - Route choice …
- **Future traffic management** must consider and balance these impacts on health.


Smog in Beijing, China
Source: www.zmescience.com


HCMC, Vietnam (2012)

Excursus

Particle Concentrations Using the Car – Route A5 from Frankfurt to Darmstadt

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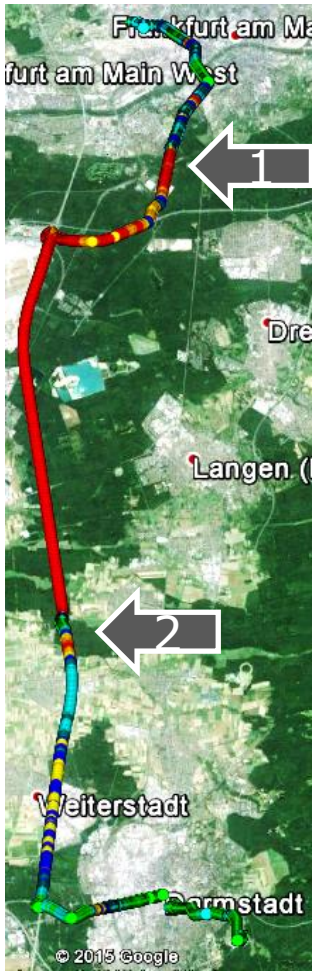
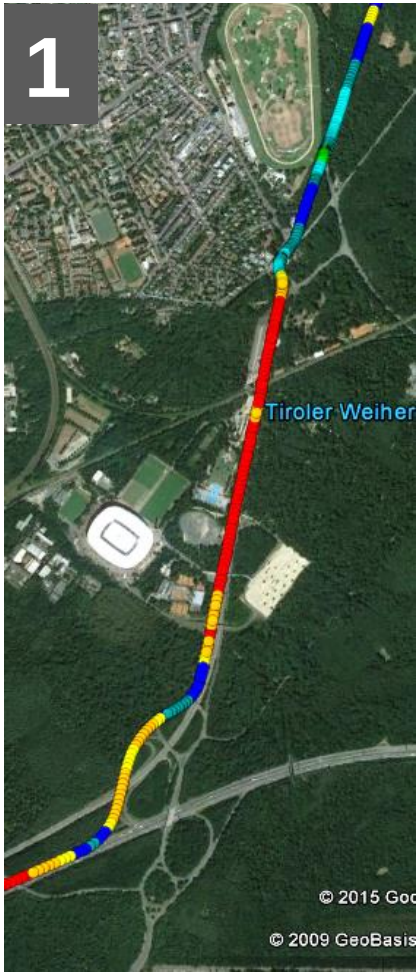
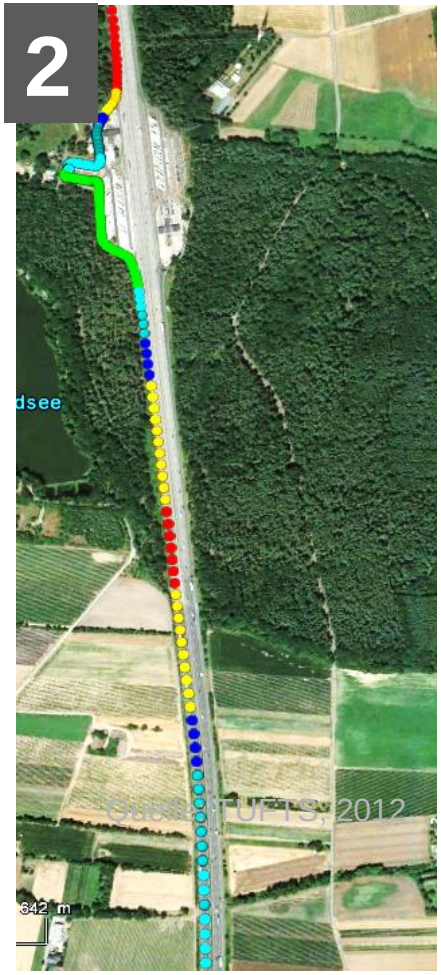


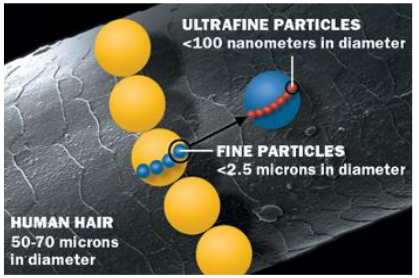




Legend

Particle Concentration [Particles/cm³]

25375
50750
76125
101500
126875
152250
177625



Date: 17.07.2015
Departure Time: 08:37 h

Wind: moderate from WSW
Temperature: 25 - 28° C
Dry

Excursus

Particle Concentrations Using the Car – Influence of the Air Circulation Inside the Car

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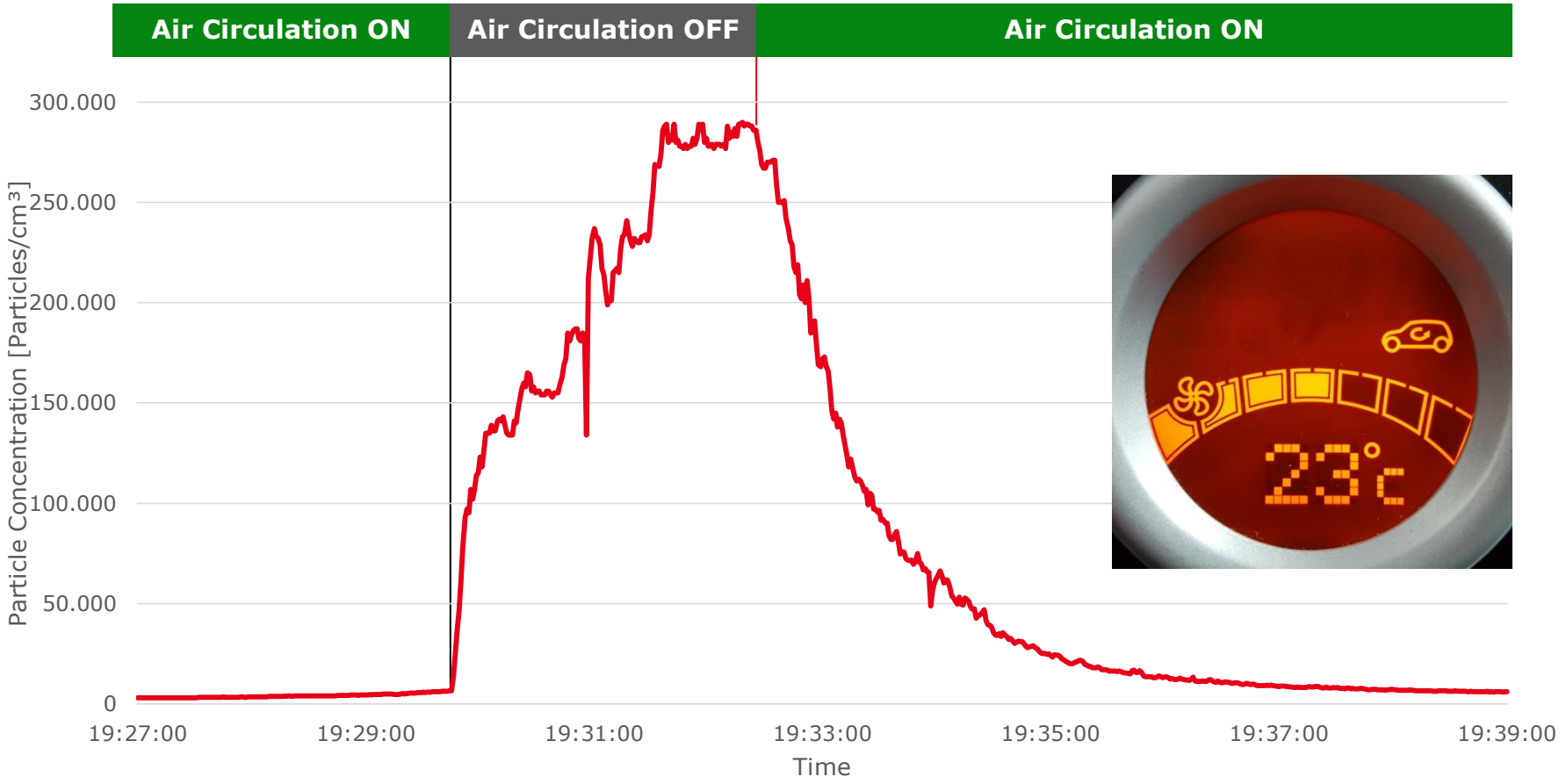

Excursus

Particle Concentrations Using the Car – Route A5 and A661 from Frankfurt to Darmstadt

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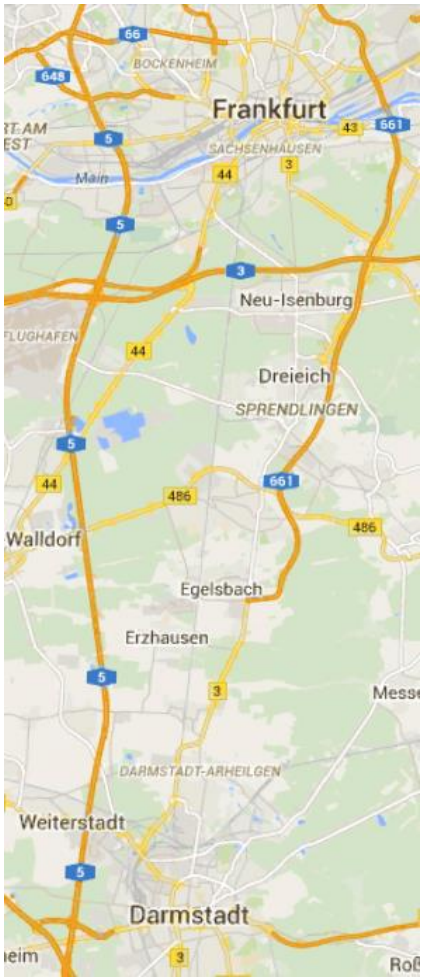
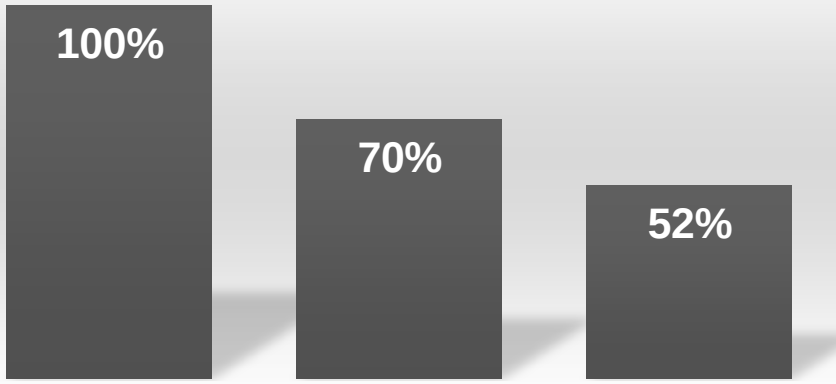


	A5	A661	A5*
Duration [min]	29	59	29
Average Concentration [#/cm³]	83 999	18 638	4 000

Daily Exposition
(24h typical office day)

* Air Circulation



Principle 9

Promote new concepts of mobility.

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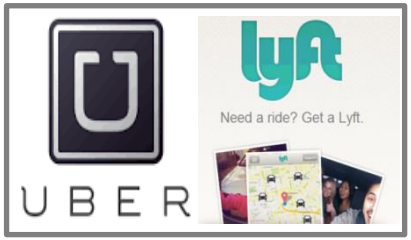
- **Individual value systems** and **mobility behaviour** are changing, specifically in the younger generation.
- **New technologies** enable changes.
  Internet, smart phones, satellite navigation, and new applications (“Apps”) are playing a major role.
- They allow an easy, spontaneous access to **individualised information and services.**
  (e.g. traffic information services, multimodal routing services, car rental, car sharing, bike rental, ride sharing, taxi sharing, pedestrian navigation, ...)
- The **flexible, situation-responsive behaviour** reduces traffic problems and should be supported.



Principle 10

Aim at a fair balance between multiple impacts.

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- Traffic Management shall **consider the various impacts on all road user groups** comprehensively

Goals and criteria in traffic signal control

Satisfaction of mobility needs

- delay for vehicles (motorized and not motorized)
- delay for individuals
- number of stops
- queue lengths
- comfort

Increase of traffic safety

- number of traffic accidents
- number of slight injuries
- number of severe injuries
- number of fatalities

Improvement of economic efficiency

- average travel speed
- saturation degree of green times

Reduction of environmental pollution

- emission of air pollutants
- ambient air quality
- noise level
- energy consumption, CO_2 emission

Principle 10

Aim at a fair balance between multiple impacts.

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- Contrary requirements and **goal conflicts cannot be avoided**.

  Significant negative impacts shall be elaborated transparently and considered carefully by comparing with the advantages of the measure.

- **No absolute priority** for one single traffic mode shall be given.

  Inadequate negative impacts on other modes must always be avoided.

- A **fair balance** of different impacts must be achieved.

Traffic sign allocating vehicle types to lanes, Vietnam

Excursus

Concept of Weights for Parameters

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Converted into monetary value

Particular weight of transport policy : None

Methods for impact assessment:

Microscopic traffic flow simulation with Vissim

Emission modelling with ENVIVER

Accident analysis based on historical accident data

Cost factors:

Value of waiting time	based on MiD 2008 und the assessment method for BVWP 2030
Environmental costs	according to Schwermer 2012
Accident costs	according to BASt 2016 (price level 2012)

Value of waiting time	Walking		4.2	€/P-h
	Cycling		4.4	€/P-h
	Public transport	Driver	20.1	€/P-h
		Passenger	4.4	€/P-h
	Motorised individual traffic	Passenger car	4.9	€/P-h
		Van	17.6	€/P-h
	Heavy traffic		20.1	€/P-h
Accident costs*	e.g. fatality		1,161,892	€/P
Fuel and environmental costs	PM_{10}		364,100	€/t
	NO_x		15,400	€/t
	CO_2		80	€/t
	Fuel consumption		0.71	€/l

* The cost factor for fatalities is shown as an example.

Excursus

Cost Components 4-leg Intersection

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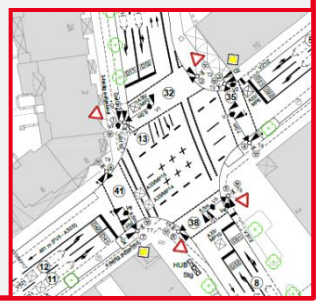
Current traffic signal program

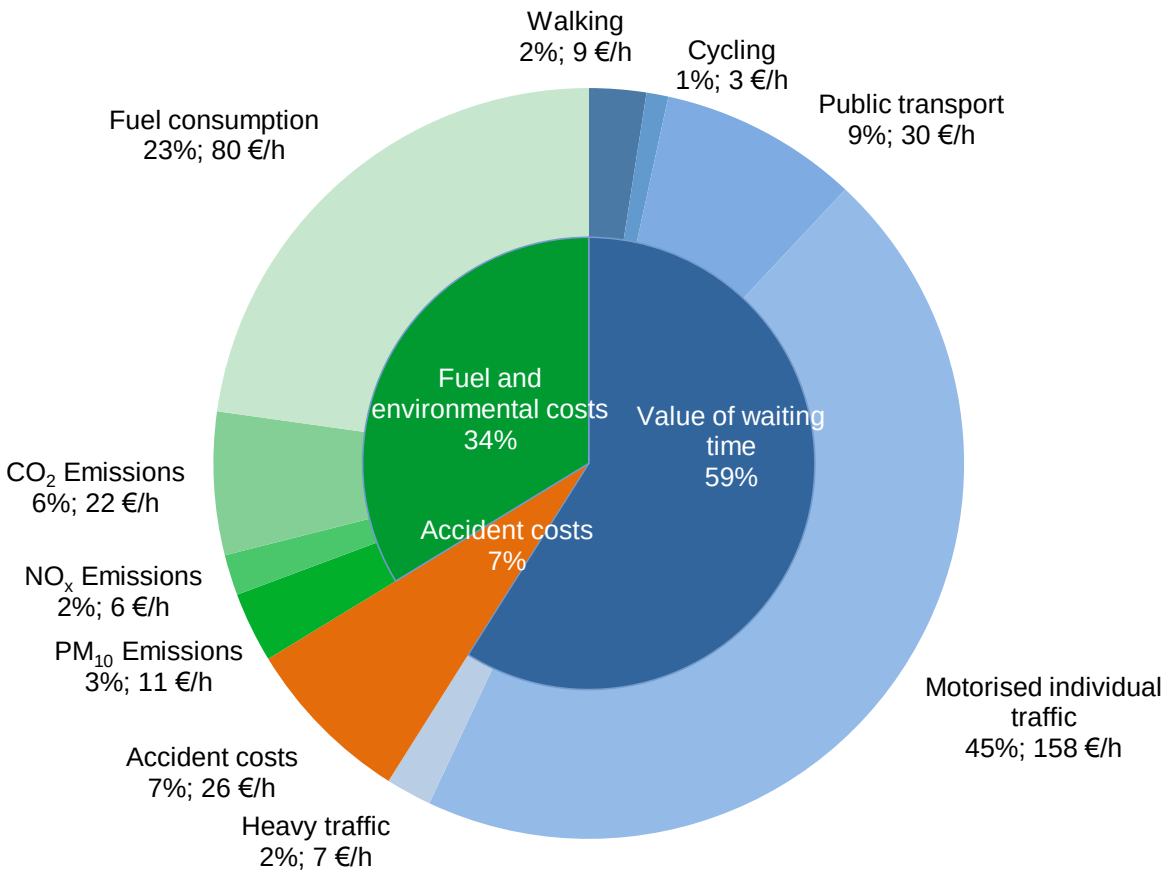
Evening peak hour traffic-actuated control

Traffic volume in the investigated hour:

257 pedestrians
105 cyclists
23 PT vehicles (buses)
1981 passenger cars
32 heavy vehicles

Calculated total costs:
350 €/h





Excursus

Cost Components Signalized Crosswalk

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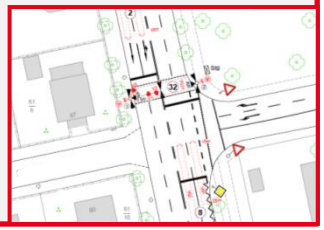
Current traffic signal program

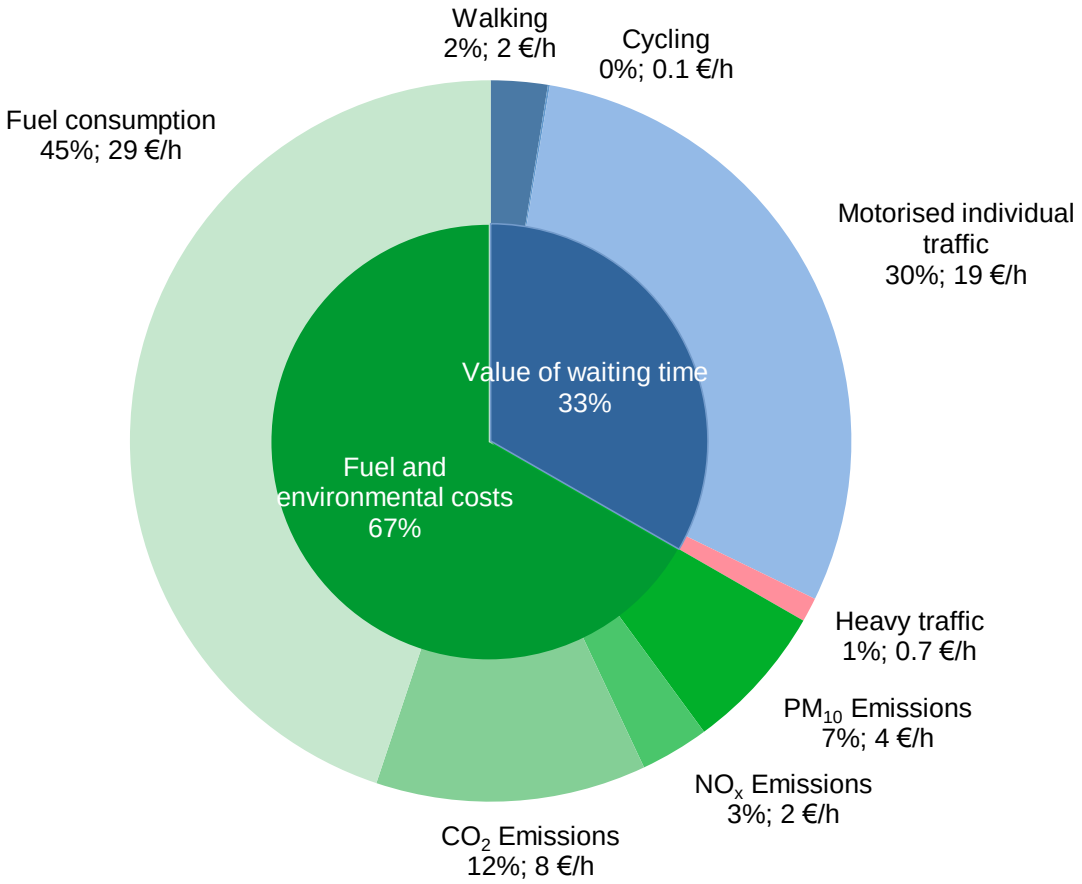
Morning peak hour
variable cycle time
active pedestrian requests
no coordination of traffic lights

Traffic volume
in the investigated hour:

106 pedestrians
7 cyclists
0 PT vehicles (buses)
1251 passenger cars
17 heavy vehicles

Calculated total costs:
65 €/h





Excursus

Cost Components Signalized Crosswalk

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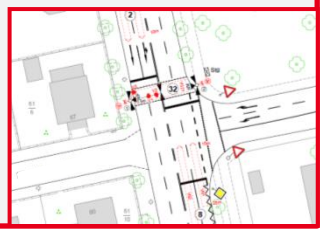
Cost-optimised traffic signal program

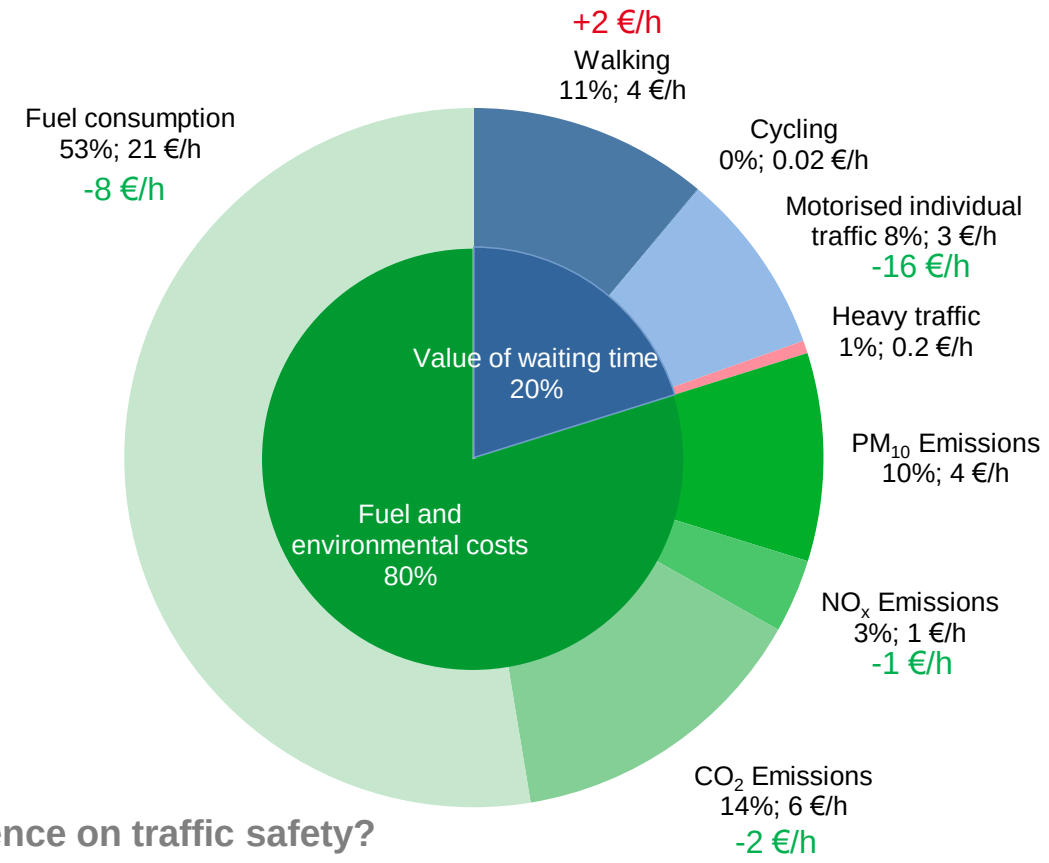
Morning peak hour
cycle time 90 s
no pedestrian requests
coordination of traffic lights

Traffic volume
in the investigated hour:

106 pedestrians
7 cyclists
0 PT vehicles (buses)
1251 passenger cars
17 heavy vehicles

Calculated total costs:
39 €/h





Influence on traffic safety?
Influence on modal choice?

Principle 11

Make the quality of traffic transparent and improve it continuously.

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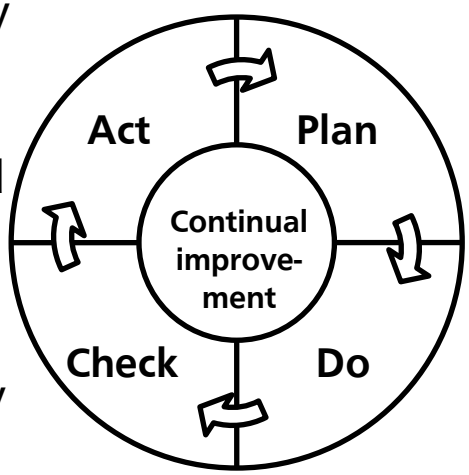
- Very often, the real **quality of traffic is not known**, specifically in urban traffic. (e.g. average delay, travel speed, duration until resolving a failure, etc.)

- The interrelations between used resources and traffic quality are **not transparent**.



- **Performance measurements** in traffic and transport should be conducted by independent parties. Execution and supervision should be separated, also in road operations.
- **Frequent quality reports** should prove the achieved quality and support decisions to allocate resources.
- The principles of **quality management** should be applied throughout all fields of traffic and transport!

Principle 12

Create the right institutional framework for intermodal traffic.

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- Traffic and Transport must be understood as an **holistic system**.
- The supplies of different traffic and transport systems must be closely **coordinated** to allow mobility and transport in every situation.

  Example London: Road traffic and public transport are managed by “Transport for London”. To optimise the whole urban transport system also cross-financing is used.
- **Associations of public transport authorities** may provide a good starting point for further development.
- Need for an **integrated traffic management authority** which brings together the competences in public transport and road network operation, not only on a local but on a regional level.

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Manfred Boltze
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1. **Provide sufficient and sustainable financing of transport.**
2. **Control transport demand and modal choice.**
3. **Use the instruments of mobility pricing to control demand.**
4. **Ensure a future-proof design of transport infrastructure.**
5. **Operate transport infrastructure dynamically and situation-responsive.**
6. **Improve traffic safety.**
7. **Apply measures to protect environment and climate.**
8. **Consider health impacts.**
9. **Promote new concepts of mobility.**
10. **Aim at a fair balance between multiple impacts.**
11. **Make traffic quality transparent and improve it continuously.**
12. **Create the right institutional framework for intermodal traffic.**