A generic code of urban mobility: how cities can achieve sustainable development

A study based on the R&D project “What Cities Want” on behalf of MAN SE

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Chair of Urban Structure and Transport Planning

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mobil.TUM 2014

High diversity among cities and their transport systems…

Copenhagen
Saint Petersburg
London
Munich
Lyon
Istanbul
Beirut
Ahmedabad
Shanghai
Los Angeles
Bogota
Singapore
Sao Paulo
Johannesburg
Melbourne

…but common challenges

Urbanization

Motorization

Environmental constraints

Hypothesis

Cities and their transport systems may look different but…

they are comprised of the same components and driven by the same processes –

Hence, there is a *generic code* of urban mobility.

Study objectives

- Describe and explain the complex system of urban mobility by a qualitative model approach

- Verify model assumptions for international case-study cities

- Identify future strategies for sustainable urban mobility

Methodology: 3 modules

1. Buliding up a system model „urban mobility“ using the sensitivity model by Frederic Vester

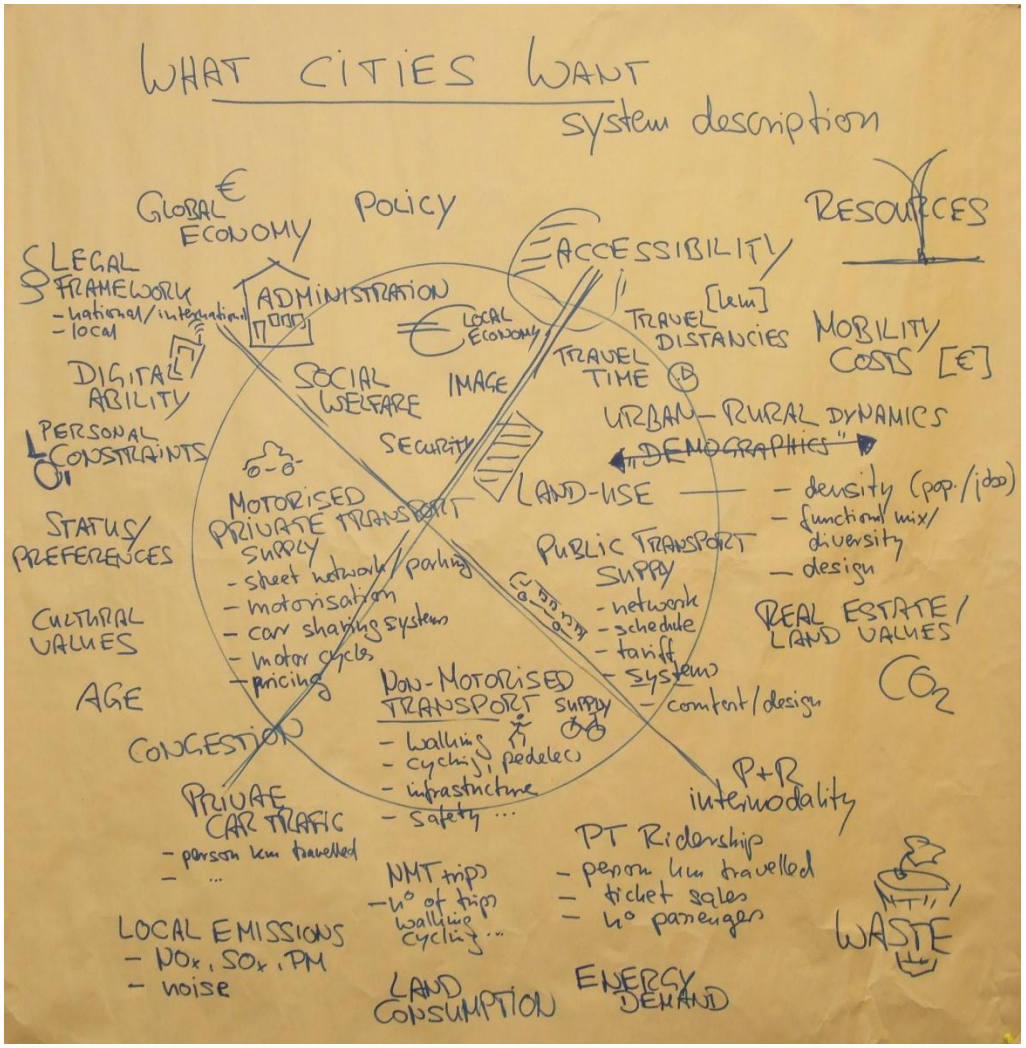
2. Survey of local experts from 15 cities worldwide on the perspectives of transport and urban development

3. Roundtable workshop with representatives from all surveyed cities on October 8/9, 2012 in Munich

Methodology: Sensitivity model by F. Vester

- Development since 1970s by Frederic Vester
- Tool helping to explain complex systems
- Typical problems when dealing with complex systems
  - curing the symptoms and not the disease
  - involuntary side effects
  - too much intervention
- Biocybernetics as problem-solving approach → Learning from nature

1. System description



- Create a system picture
- Visualization improves understanding
- Helps to identify system elements and processes

2. Set of variables

List of variables	
1	legal framework
2	city policies
3	organisation & administration
4	public budget
5	local economy
6	urban density
7	urban-rural dynamics
8	real estate values
9	socio-economic pop. structure
10	sustain. mobility orientation
11	city image
12	road infrastructure
13	car ownership
14	(congestion) traffic flow
15	trip duration
16	PT infrastructure
17	PT service quality
18	NMT infrastructure
19	intermodality
20	new mobility services
21	ICT for mobility services
22	mot. private mode share
23	PT mode share
24	NMT mode share
25	mobility costs
26	transport safety and security
27	social equity
28	transport energy demand
29	environmental impacts

Variablenbeschreibung
1 legal framework
legal framework on international (e.g. EU), national and regional regional level concerning sustainable mobility.

- Define influencing variables
- Operationalize the system picture
- Both types of variables, quantitative and qualitative ones
- As much as necessary, as little as possible
- Explanation for common understanding needed

3. Impact matrix

Influence by variable ↓ on variable →		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	legal framework	X	2	2	1	1	1	1	1	0	1	0	2	1	0	0	2	
2	city policies	1	X	3	2	1	3	1	2	1	1	3	2	0	0	0	3	
3	organisation & administration	1	2	X	1	0	0	1	1	0	1	3	2	1	2	2	2	
4	public budget	1	3	2	X	0	0	0	0	0	0	0	2	0	0	0	3	
5	local economy	0	1	1	1	X	1	3	2	3	1	0	0	3	0	0	0	
6	urban density	1	1	0	1	0	X	2	3	1	2	2	3	2	2	1	2	
7	urban-rural dynamics	1	1	1	3	3	2	X	2	2	2	1	2	3	3	2	2	
8	real estate values	0	0	0	1	2	3	3	X	2	0	0	0	1	0	0	0	
9	socio-economic pop. structure	1	1	0	2	2	1	2	1	X	1	2	0	2	0	1	0	
10	sustain. mobility orientation	1	1	1	0	0	1	1	0	1	X	3	0	2	1	1	1	
11	city image	0	3	1	0	1	1	1	1	2	1	X	0	1	0	0	0	
12	road infrastructure	2	1	1	2	1	1	3	1	0	1	2	X	1	3	2	2	
13	car ownership	0	1	1	0	0	1	2	3	1	3	1	0	X	1	1	0	
14	(congestion) traffic flow	1	3	2	1	1	0	3	1	0	2	3	3	1	X	3	0	
15	trip duration	0	1	1	1	1	0	2	1	0	1	1	0	1	0	X	1	
16	PT infrastructure	1	1	2	2	1	1	3	2	1	2	3	1	1	1	2	X	
17	PT service quality	0	1	2	1	1	1	2	1	0	2	1	1	1	1	3	2	

- Assess the effect relationship between variables
- Focus on the strength of the effect not on its direction

3. Impact matrix

Influence by variable ↓ on variable →		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	AS
1	legal framework	X	2	2	1	1	1	1	1	0	1	0	2	1	0	0	2	1	1	0	2	1	0	0	0	2	1	0	0	1	24
2	city policies	1	X	3	2	1	3	1	2	1	1	3	2	0	0	0	3	3	3	2	2	1	1	1	1	1	1	1	1	2	43
3	organisation & administration	1	2	X	1	0	0	1	1	0	1	3	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	0	41
4	public budget	1	3	2	X	0	0	0	0	0	0	0	2	0	0	0	3	3	2	1	1	0	0	0	0	1	1	2	0	0	22
5	local economy	0	1	1	1	X	1	3	2	3	1	0	0	3	0	0	0	0	0	0	1	1	2	2	1	2	0	3	0	0	28
6	urban density	1	1	0	1	0	X	2	3	1	2	2	3	2	2	1	2	2	2	2	2	1	2	2	3	0	1	1	2	1	44
7	urban-rural dynamics	1	1	1	3	3	2	X	2	2	2	1	2	3	3	2	2	1	2	3	2	2	3	2	3	2	0	1	2	2	55
8	real estate values	0	0	0	1	2	3	3	X	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
9	socio-economic pop. structure	1	1	0	2	2	1	2	1	X	1	2	0	2	0	1	0	1	1	0	1	2	2	2	2	0	1	1	0	0	29
10	sustain. mobility orientation	1	1	1	0	0	1	1	0	1	X	3	0	2	1	1	1	2	1	2	2	2	3	3	3	0	1	1	2	2	38
11	city image	0	3	1	0	1	1	1	1	2	1	X	0	1	0	0	0	0	0	0	1	3	1	1	2	1	1	1	0	0	23
12	road infrastructure	2	1	1	2	1	1	3	1	0	1	2	X	1	3	2	2	2	2	1	1	1	3	1	3	1	3	1	0	1	43
13	car ownership	0	1	1	0	0	1	2	3	1	3	1	0	X	1	1	0	0	1	2	2	3	3	3	2	2	0	3	1	1	38
14	(congestion) traffic flow	1	3	2	1	1	0	3	1	0	2	3	3	1	X	3	0	0	0	3	1	3	2	2	1	0	1	1	2	3	43
15	trip duration	0	1	1	1	1	0	2	1	0	1	1	0	1	0	X	1	1	0	1	1	2	2	2	1	0	1	1	2	0	25
16	PT infrastructure	1	1	2	2	1	1	3	2	1	2	3	1	1	1	2	X	3	1	3	2	3	3	3	3	1	2	3	2	0	53
17	PT service quality	0	1	2	1	1	1	2	1	0	2	1	1	1	1	3	2	X	1	2	1	3	1	3	3	1	0	1	2	1	39
18	NMT infrastructure	1	3	1	1	1	2	1	2	1	1	2	3	1	1	1	1	2	X	3	1	1	1	2	3	0	3	1	1	1	42
19	intermodality	0	1	2	1	0	1	1	1	0	1	1	1	1	2	2	0	2	1	X	1	3	2	2	2	1	1	0	1	1	32
20	new mobility services	1	1	2	0	0	1	1	1	1	1	3	0	2	1	2	1	2	1	3	X	2	2	2	2	1	1	1	0	1	36
21	ICT for mobility services	0	0	2	0	1	0	1	1	1	1	1	1	1	1	2	1	2	1	3	3	X	1	2	2	1	1	1	1	0	32
22	mot. private mode share	1	2	2	0	0	0	1	0	1	3	3	2	1	2	0	1	1	1	1	3	2	X	2	3	1	1	0	2	2	38
23	PT mode share	2	2	2	0	0	0	0	0	1	3	3	0	1	2	0	1	2	0	1	3	2	2	X	2	2	1	0	2	2	36
24	NMT mode share	2	2	2	0	0	1	0	0	0	3	3	1	1	2	0	2	1	1	2	1	2	1	1	X	2	1	1	2	2	36
25	mobility costs	1	2	1	1	1	2	3	1	1	1	0	0	2	0	0	0	1	0	0	3	2	2	2	3	X	0	1	0	0	30
26	transport safety and security	2	1	2	1	0	1	1	1	1	0	3	1	2	1	1	1	1	0	1	1	3	2	2	3	0	X	2	0	0	34
27	social equity	2	1	1	1	1	0	3	1	2	0	2	0	1	0	0	1	2	0	0	0	1	0	0	0	1	0	X	0	0	20
28	transport energy demand	2	2	0	1	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	1	1	0	0	0	2	0	0	X	2	15
29	environmental impacts	2	3	0	1	0	0	1	1	1	1	3	0	0	0	0	0	0	0	1	2	1	1	2	2	1	0	2	0	X	25
	PS	27	43	37	26	19	25	43	31	24	37	50	27	34	26	26	30	38	24	39	43	50	44	46	52	28	25	31	26	25	

Active sum

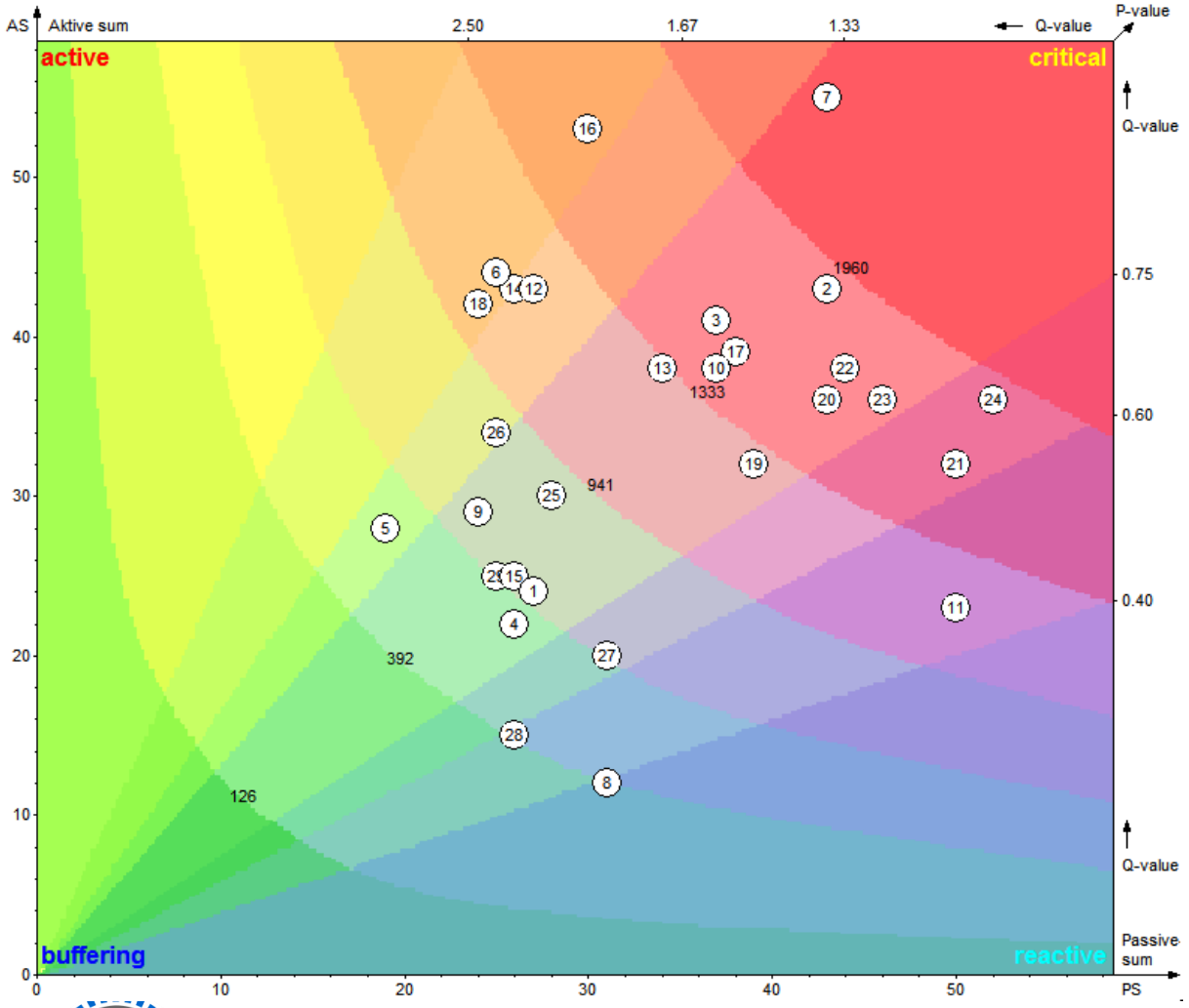
Passive sum

Consensus | Compare with

A B C D E F | A B C D E F

Δ car ownership has a strong effect on mot. private mode share

4. Systemic role



– *Active*

PT infrastructure (16)

– *Reactive / passive*

image (sustain. mobility) (11)

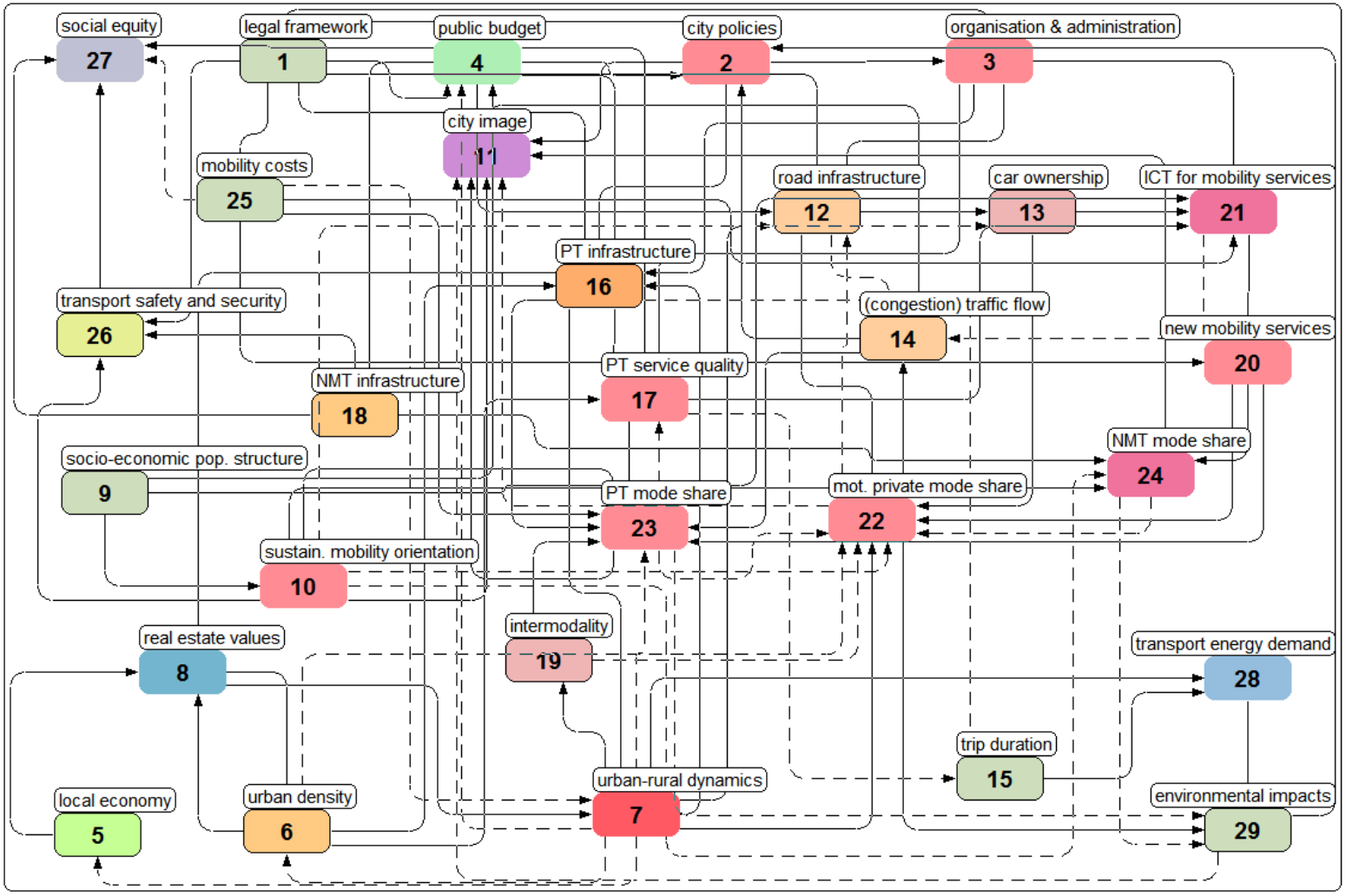
– *Critical*

urban-rural dynamics (7)

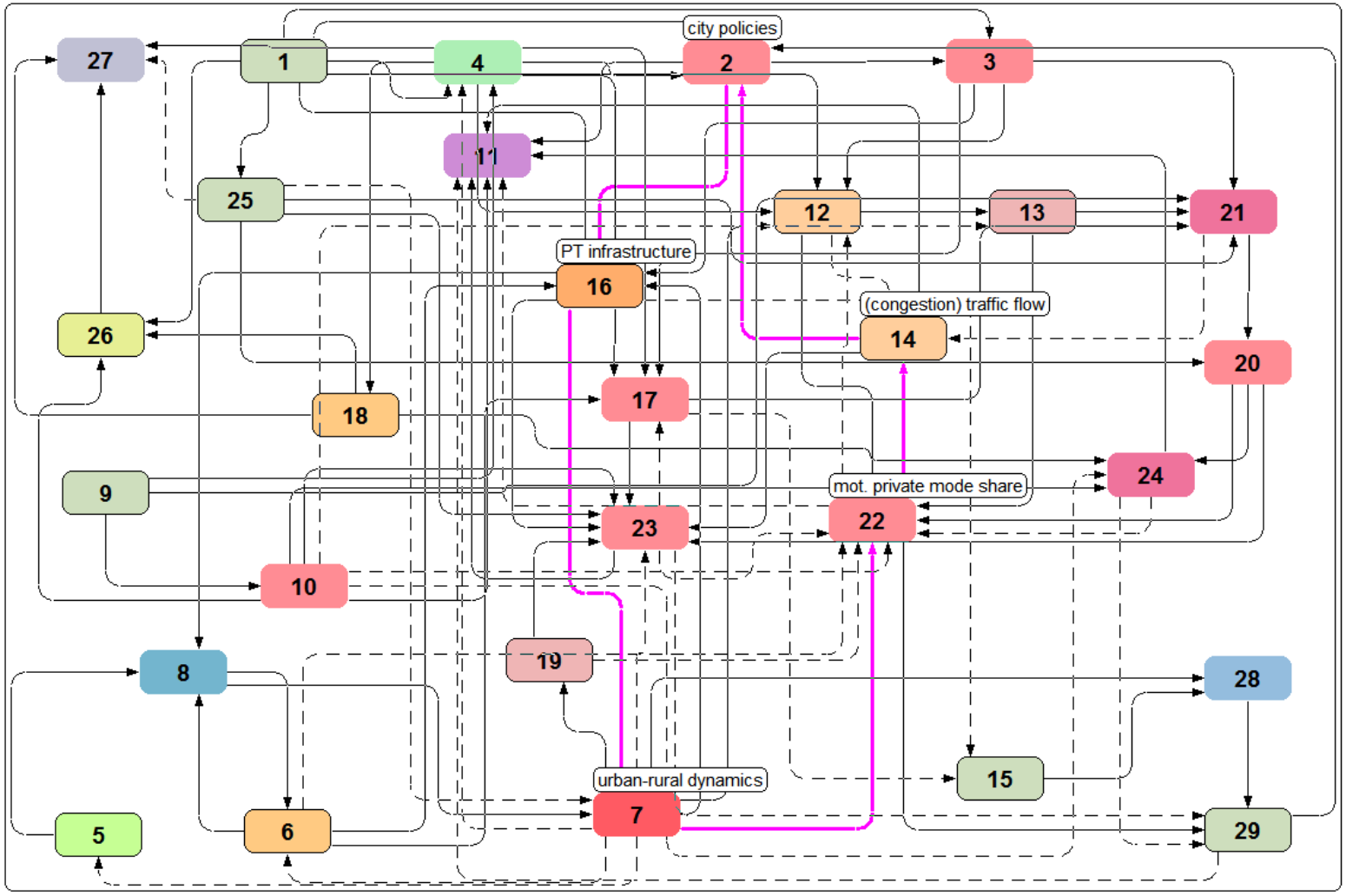
– *Buffering*

real estate values (8)

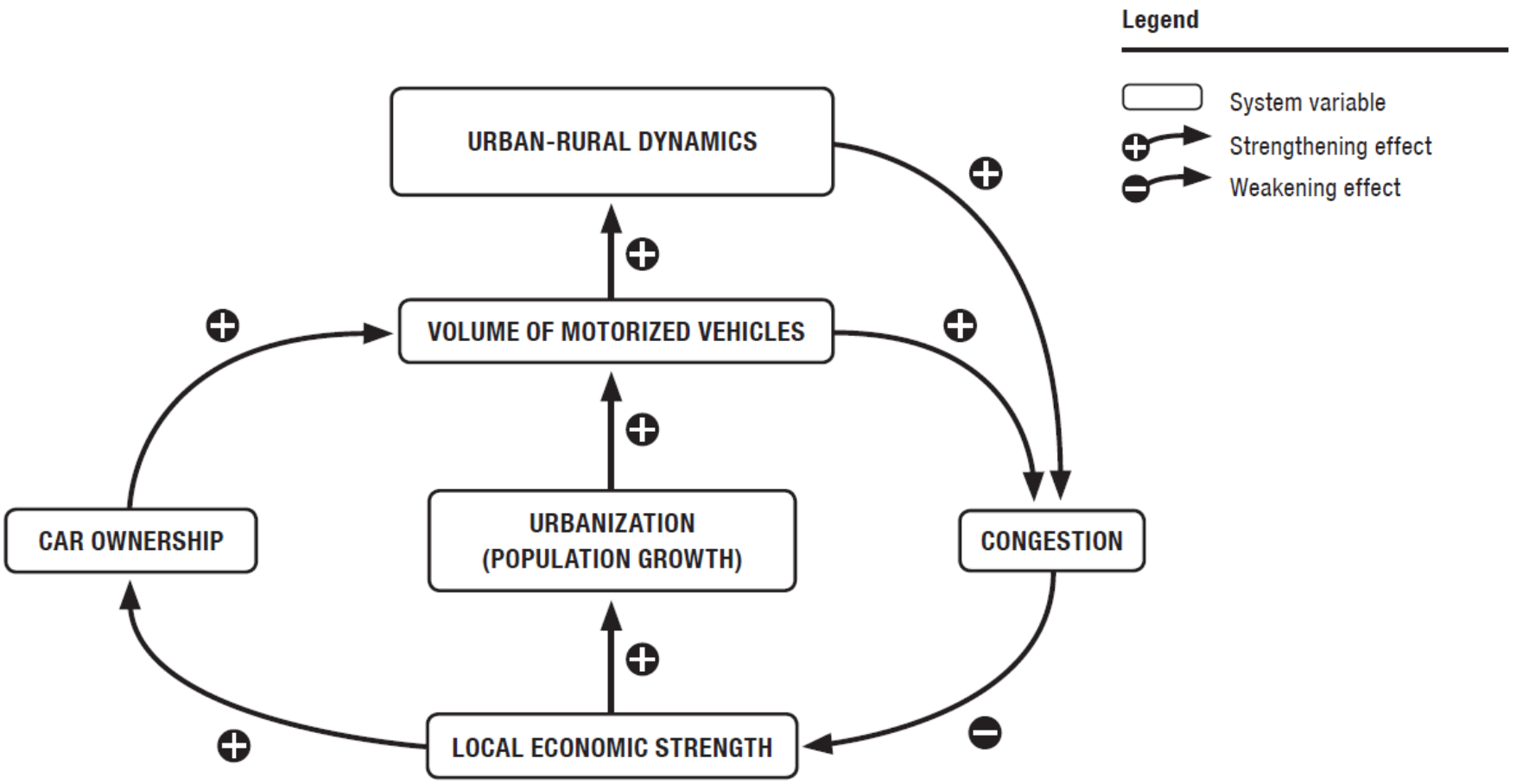
5. Effect system (Generic code)



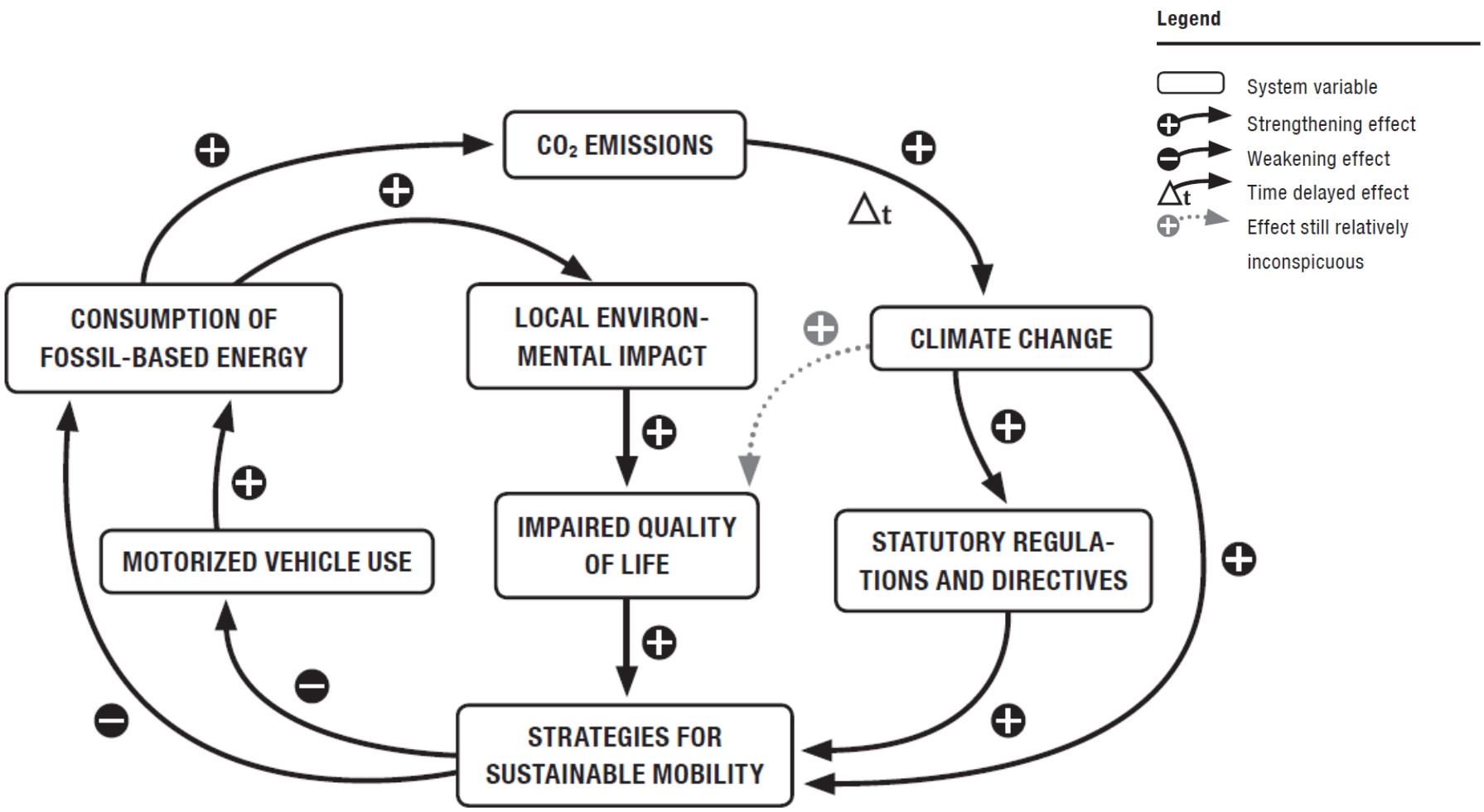
5. Effect system (Generic code)



Economic development and urbanization

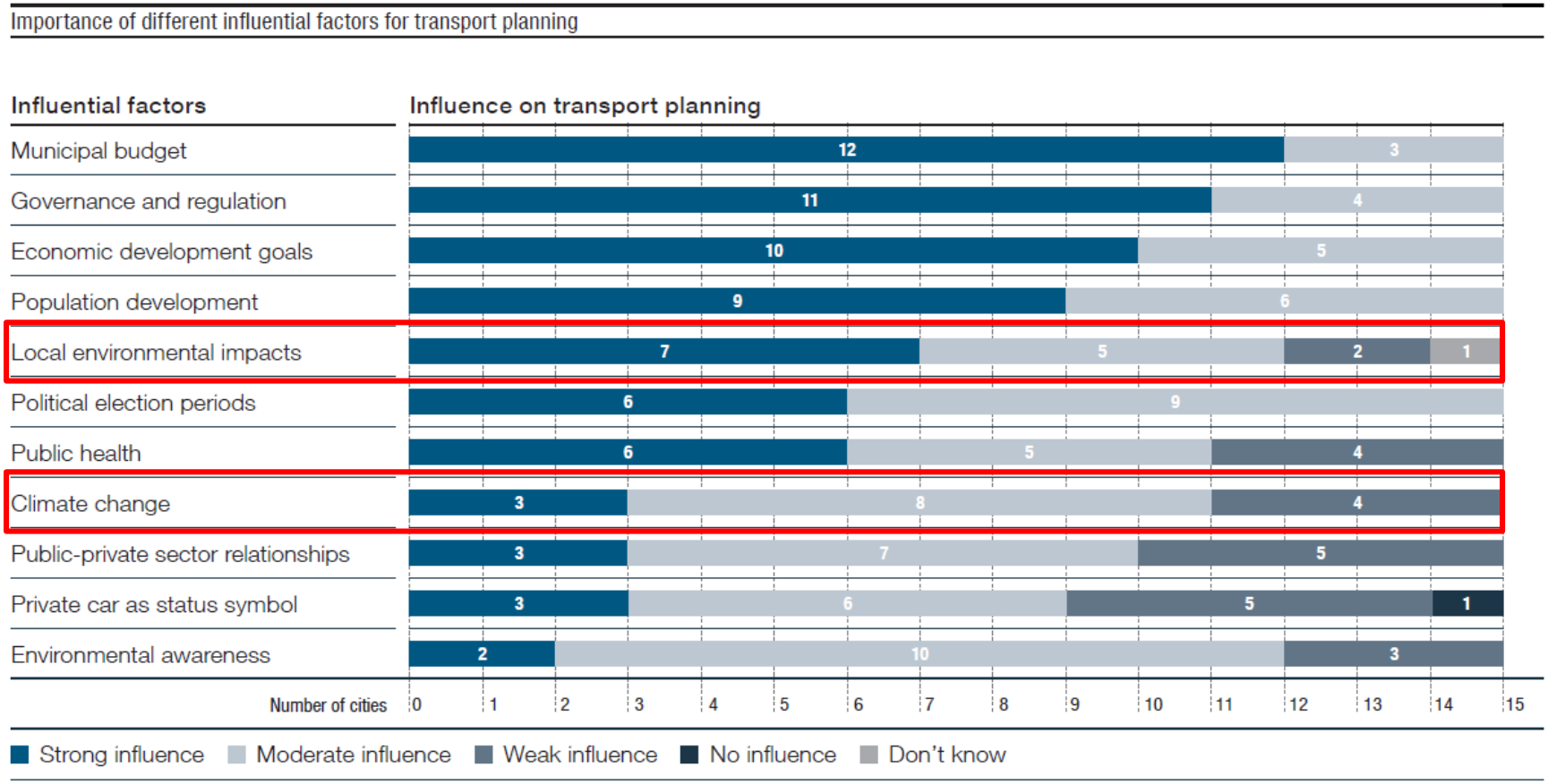


Environmental impact and climate change



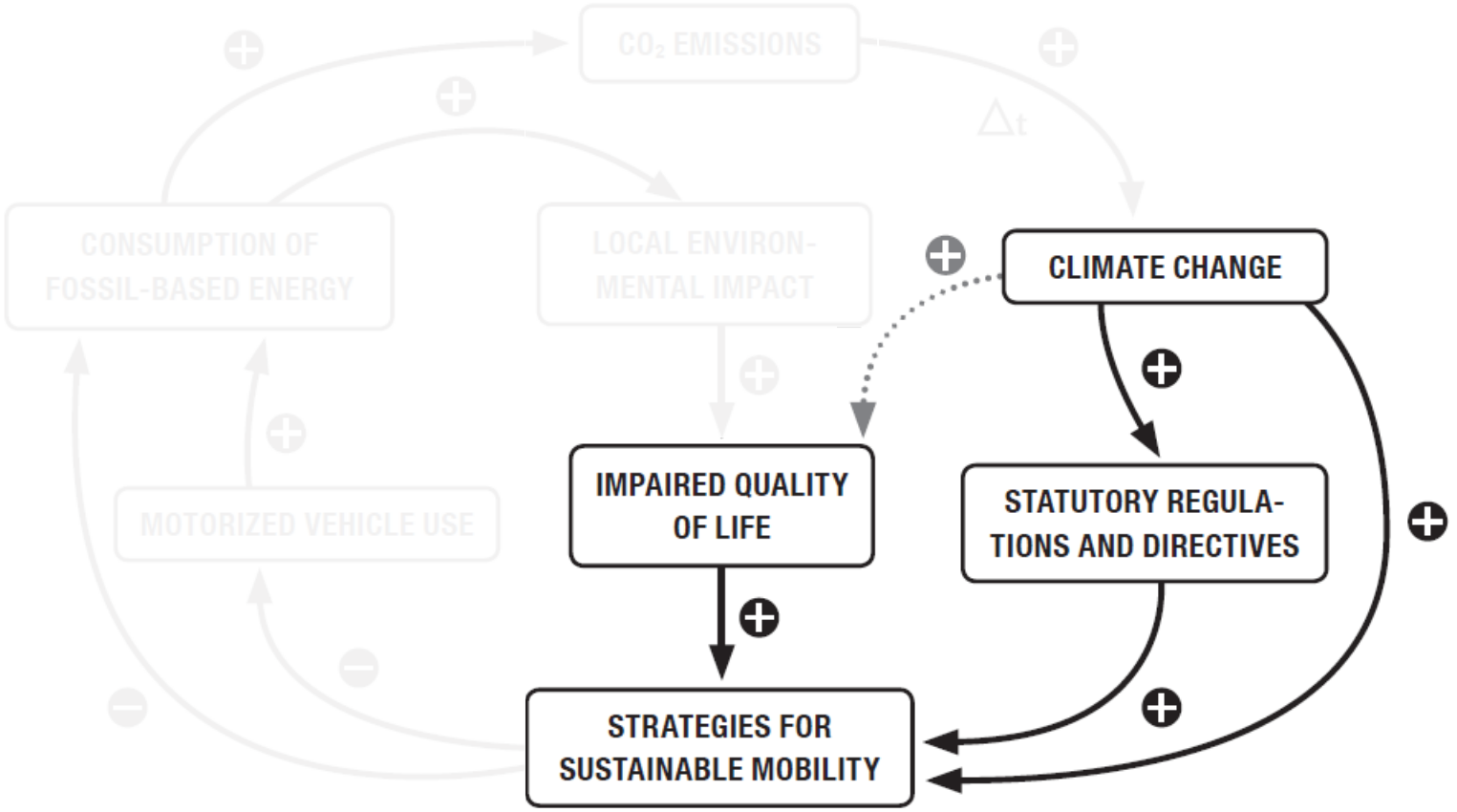
Environmental impact and climate change

Local environmental impacts have a stronger influence on transport planning than climate change

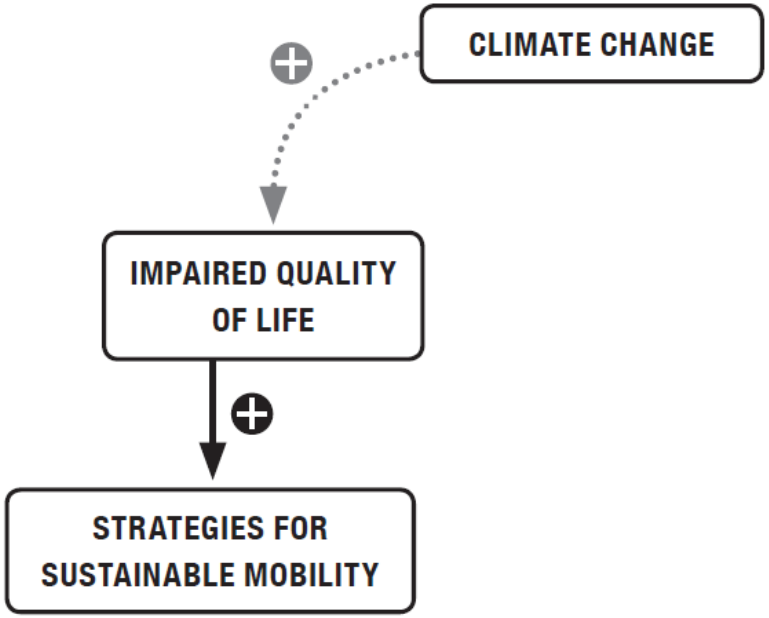


Environmental impact and climate change

How do cities cities with the challenge of climate change?



Environmental impact and climate change



Not yet noticeable in most case-study cities, but

- Concerns in Singapore about rising sea level
- Melbourne expects increased risk of bushfires

Environmental impact and climate change

Example: Sao Paulo

CLIMATE CHANGE

⊕

STATUTORY REGULATIONS AND DIRECTIVES

⊕

STRATEGIES FOR SUSTAINABLE MOBILITY

ENVIRONMENTAL REGULATIONS

Federal

CONAMA – Resolução 418/09
PCPV / In Use Vehicles Inspection

+

Municipal

Law Nº 14.933/09 (Climate changes prevention)
2018 – bus fleet must run on 100% renewable fuels
2009 – start Program substituting 10% each year

PCPV
Vehicle Pollution Control Plan

SPTrans

CITY HALL SÃO PAULO

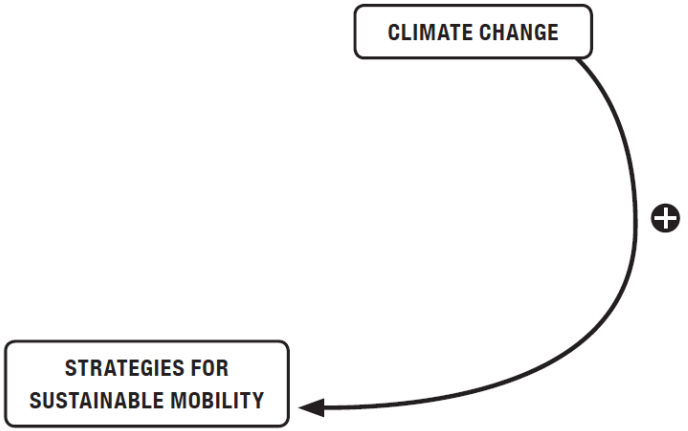
ecofrota

✓ Diesel

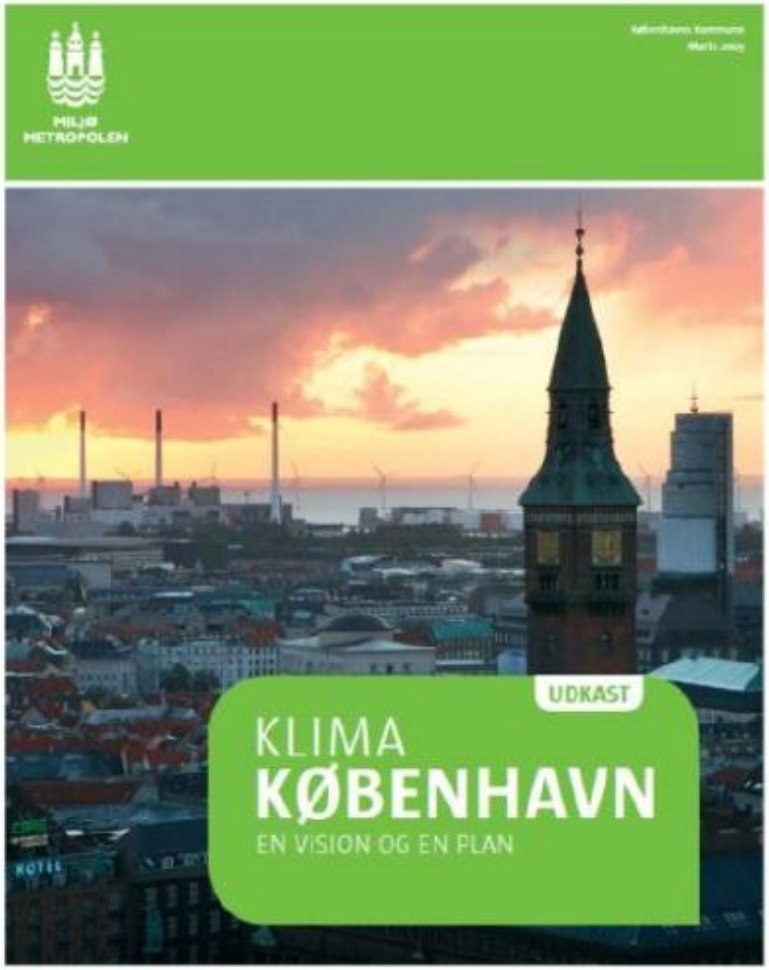
✓ Biodiesel
✓ Ethanol
✓ Sugar Cane Diesel

✓ Trolleybus
✓ Hybrid
✓ Battery
✓ Fuel Cell Bus

Environmental impact and climate change



Example: Copenhagen



Copenhagen Climate Plan

-20% CO2-reduction 2005-2015
-CO2 neutral by 2025

Copenhagen‘s ambitious plans:

36%

of all trips to work or educational institutions in Copenhagen are by bicycle,* *equalling* **0 tonnes of CO_2** emissions.

This high percentage of the modal share is a key element in the declared goal of making Copenhagen

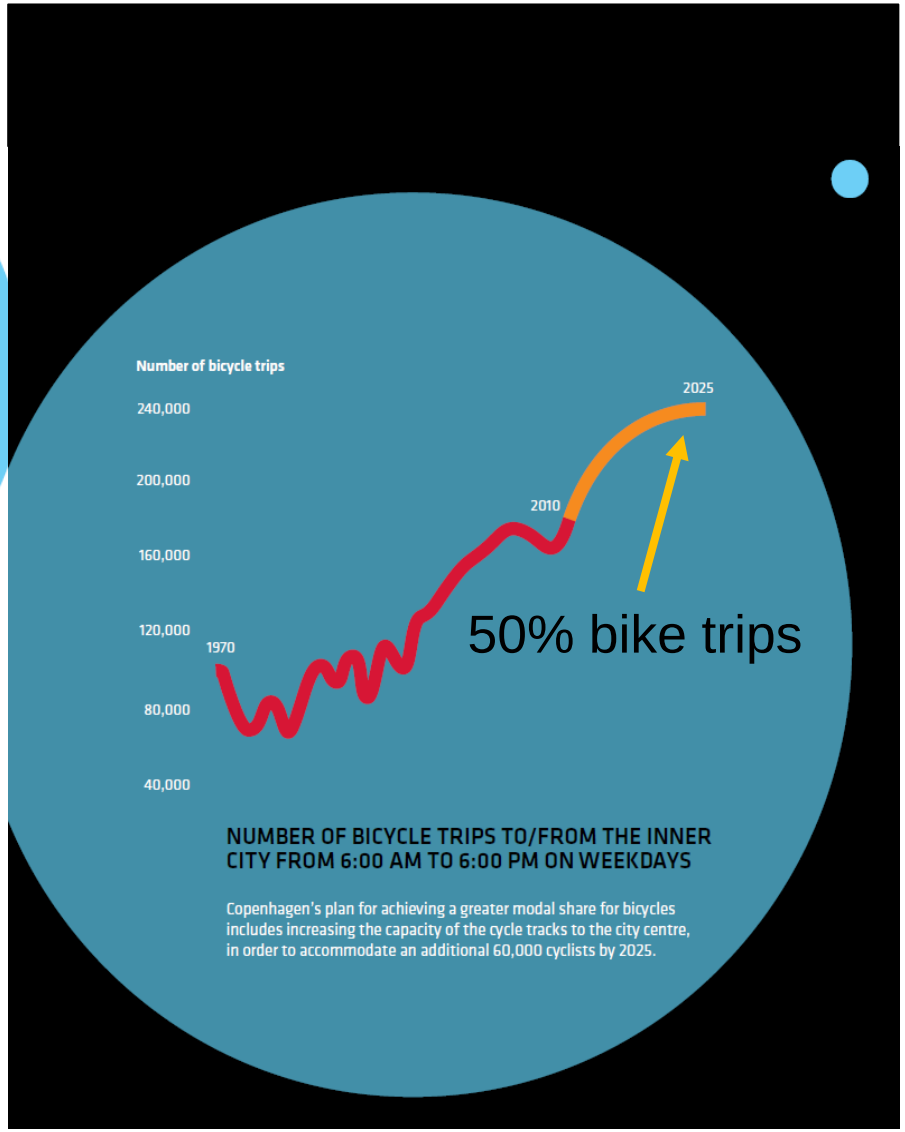
CO_2-neutral
by 2025

**Average 2008-2010*

A BETTER **BICYCLE** CITY A MORE **LIVEABLE** CITY

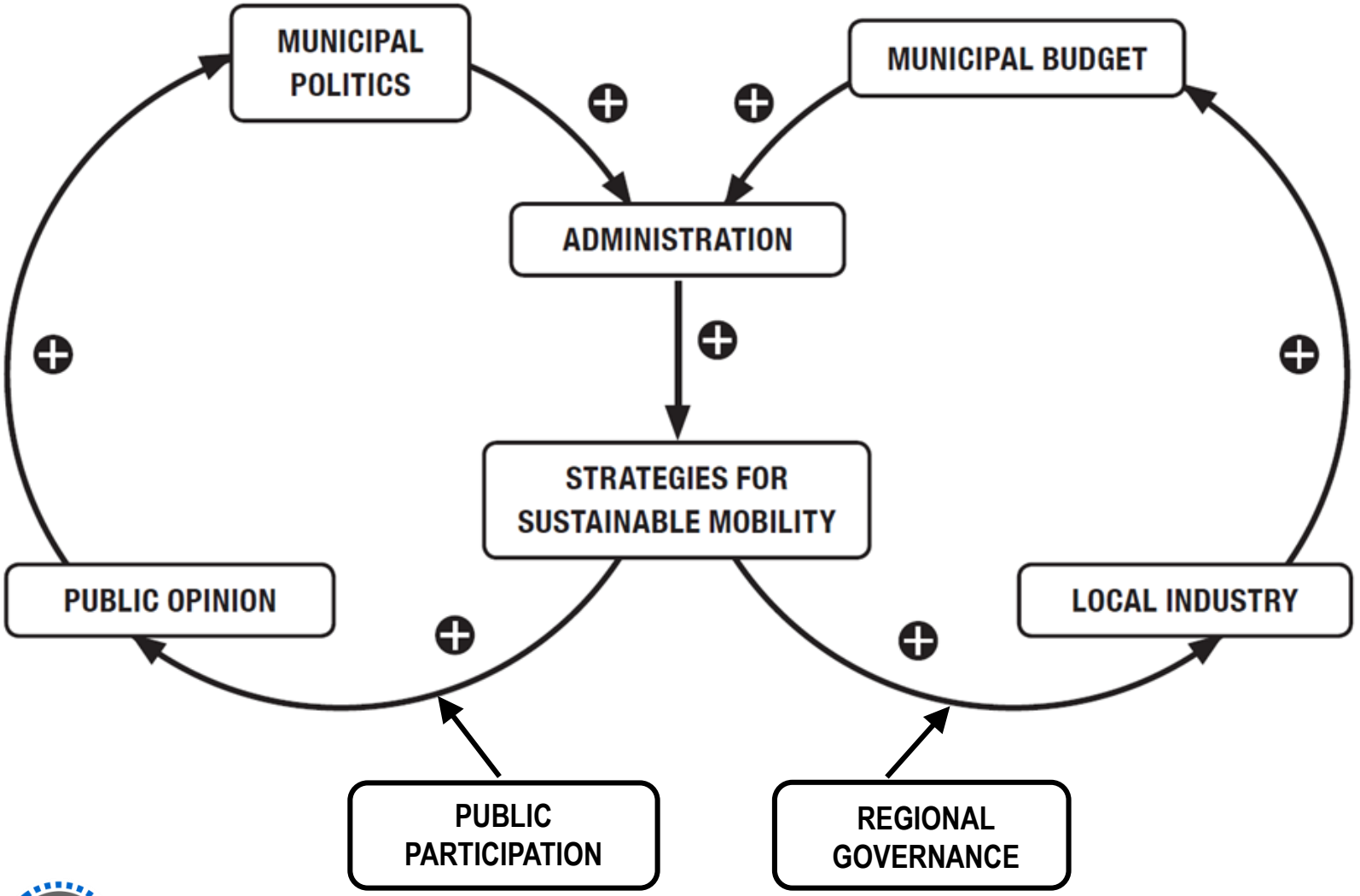
A bicycle-friendly city is a city with more space, less noise, cleaner air, healthier citizens and a better economy. It's a city that is a nicer place to be in and where individuals have a higher quality of life. Where accessibility is high and there is a short route from thought to action if one wants to head out into nature, participate in cultural or sports activities or buy locally. Bicycle traffic is therefore not a singular goal but rather an effective tool to use when creating a liveable city with space for diversity and development.

Fortunately, it pays off to invest in urban cycling. Increased cycling levels give society less congestion, fewer sick days, longer life expectancy, less wear and tear on the roads and less pollution. Cycling initiatives are also inexpensive compared with other transport investments.



Source: „Good, Better, Best“ The City of Copenhagen’s Bicycle strategy 2011-2025

Implementation of strategies



Thank you very much for you attention!

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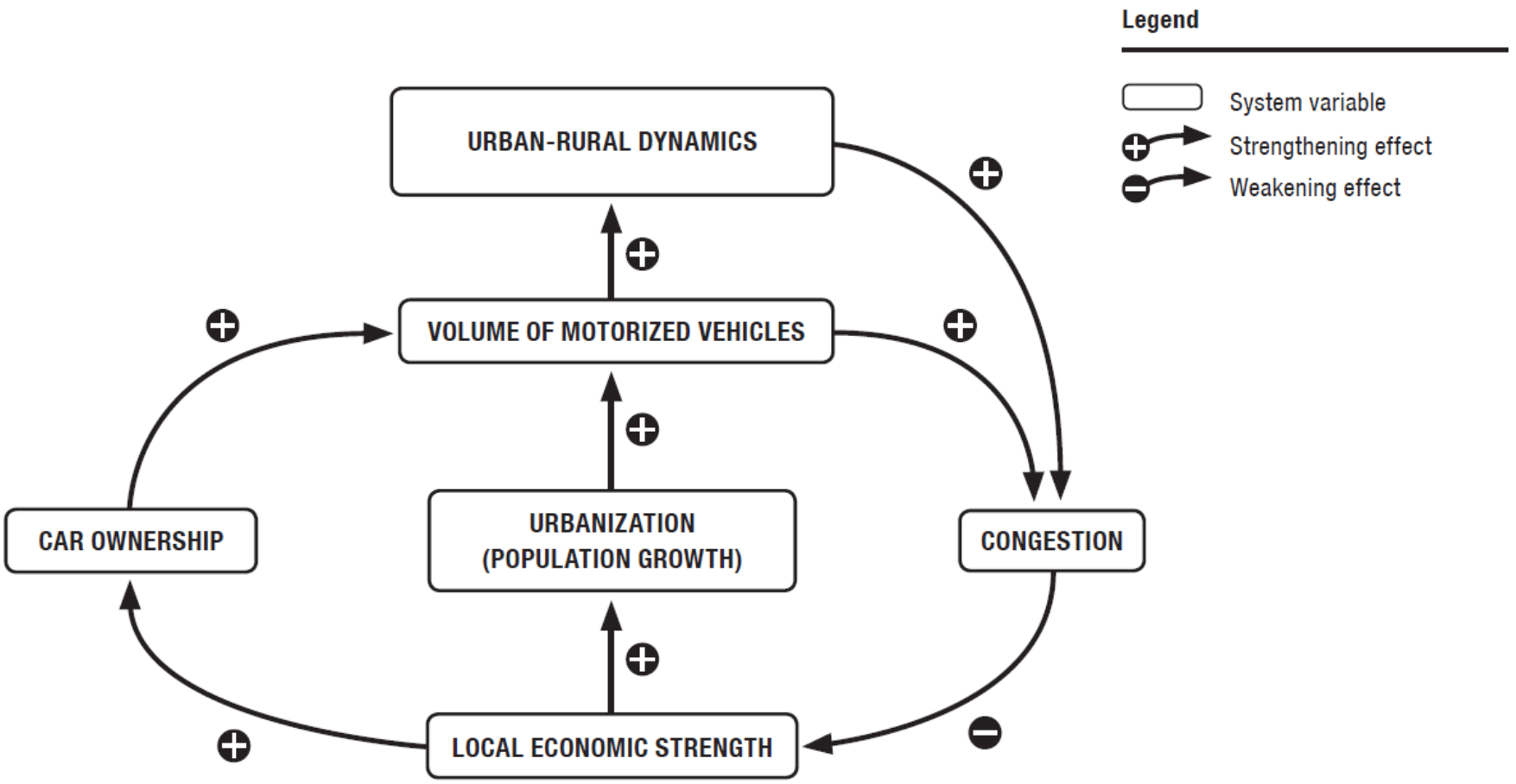
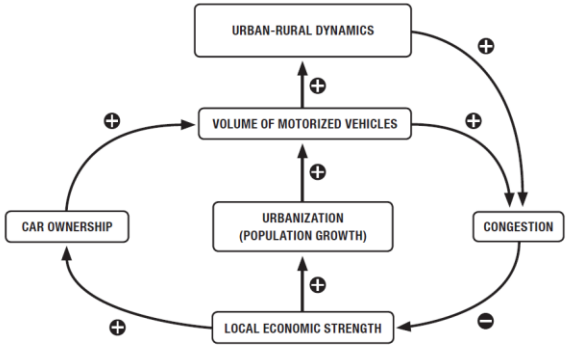
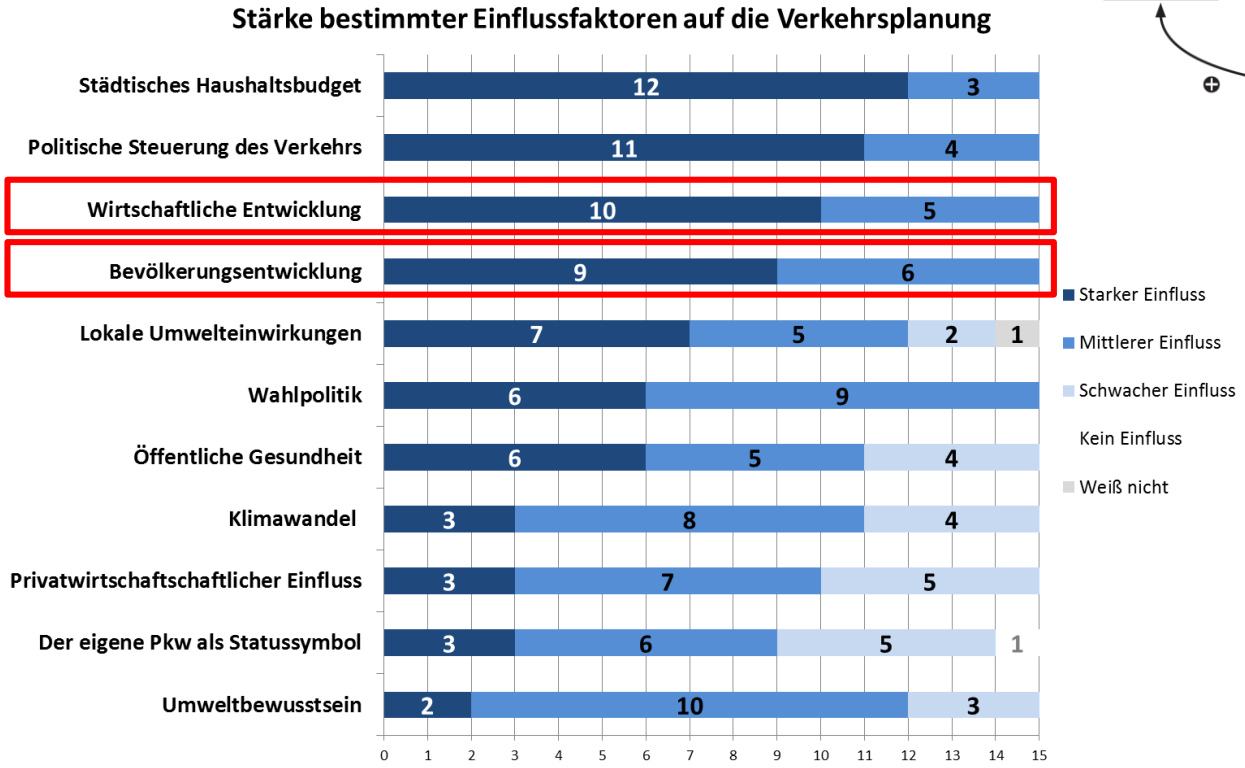
The economic development and urbanization control loop



The economic development and urbanization control loop

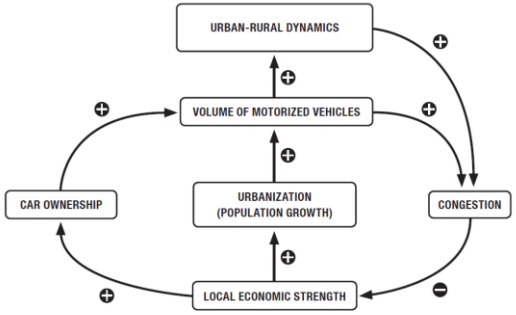
Ökonomische Situation und Bevölkerungswachstum sind Treiber der lokalen Verkehrsplanung

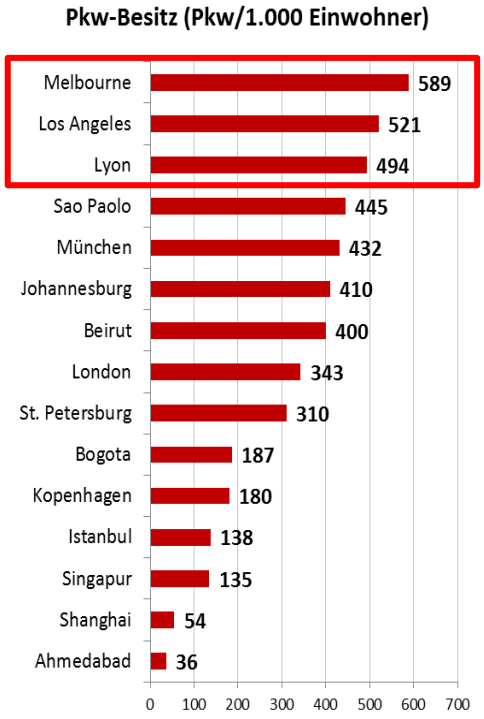


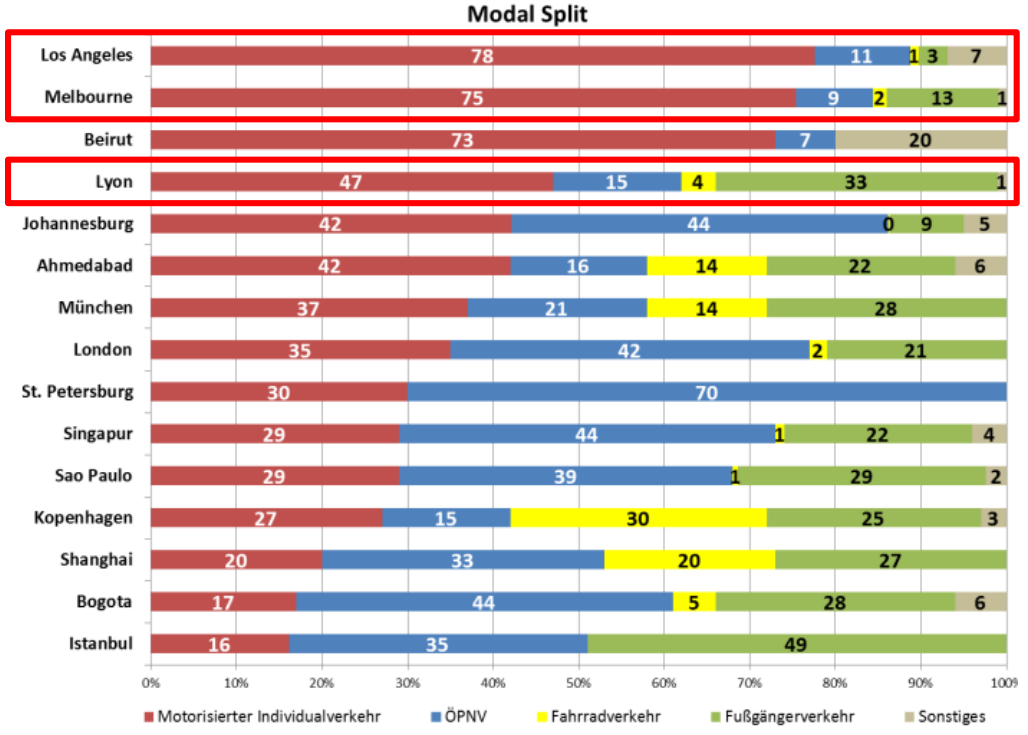


The economic development and urbanization control loop

Städte mit hohem Pkw-Besitz zeigen auch die höchsten Pkw-Verkehrsanteile

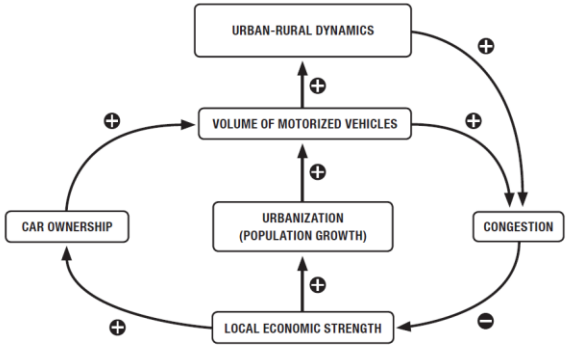


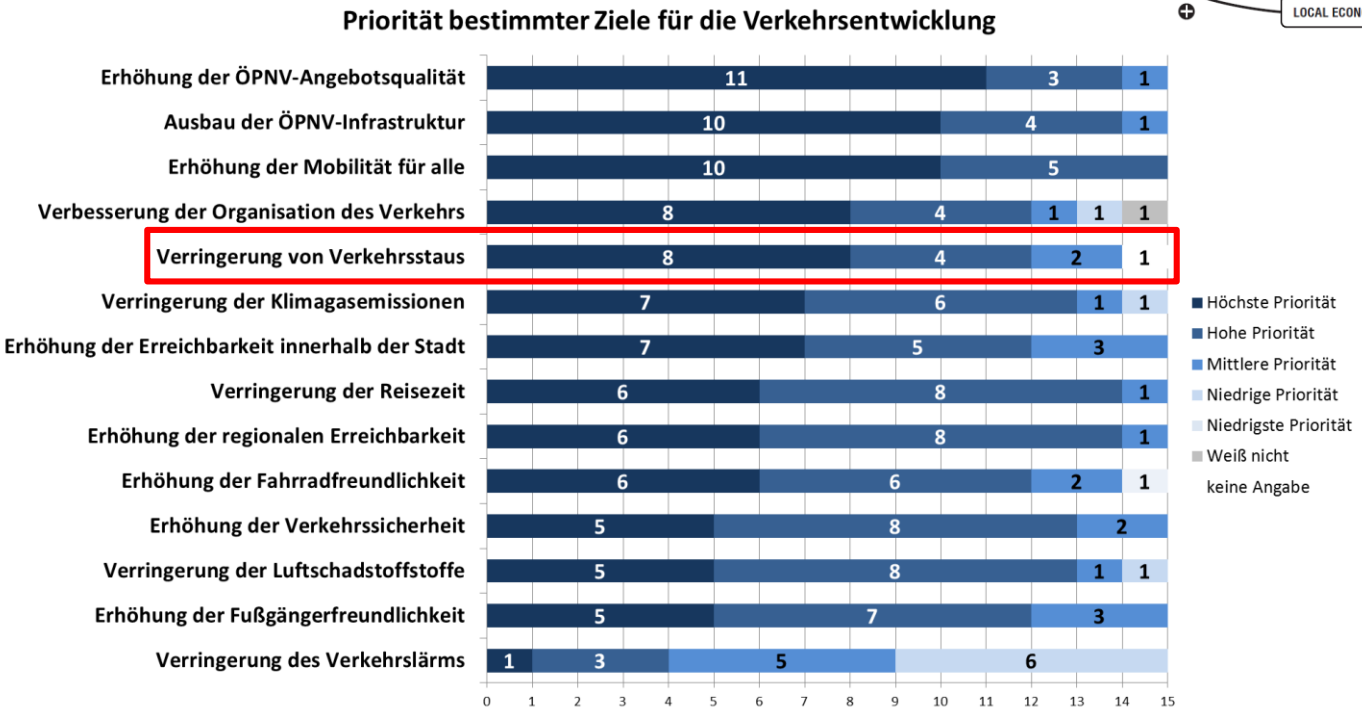




The economic development and urbanization control loop

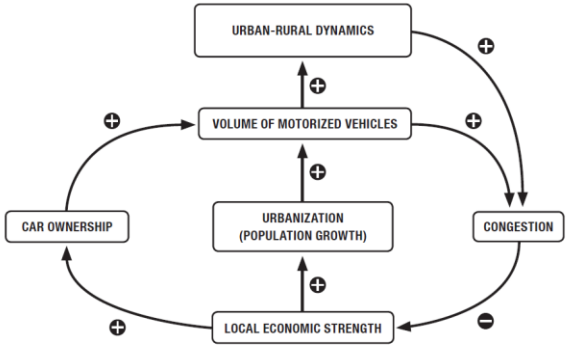
Stauvermeidung hat hohe Priorität
Strategien werden v.a. in der ÖPNV-Verbesserung gesehen

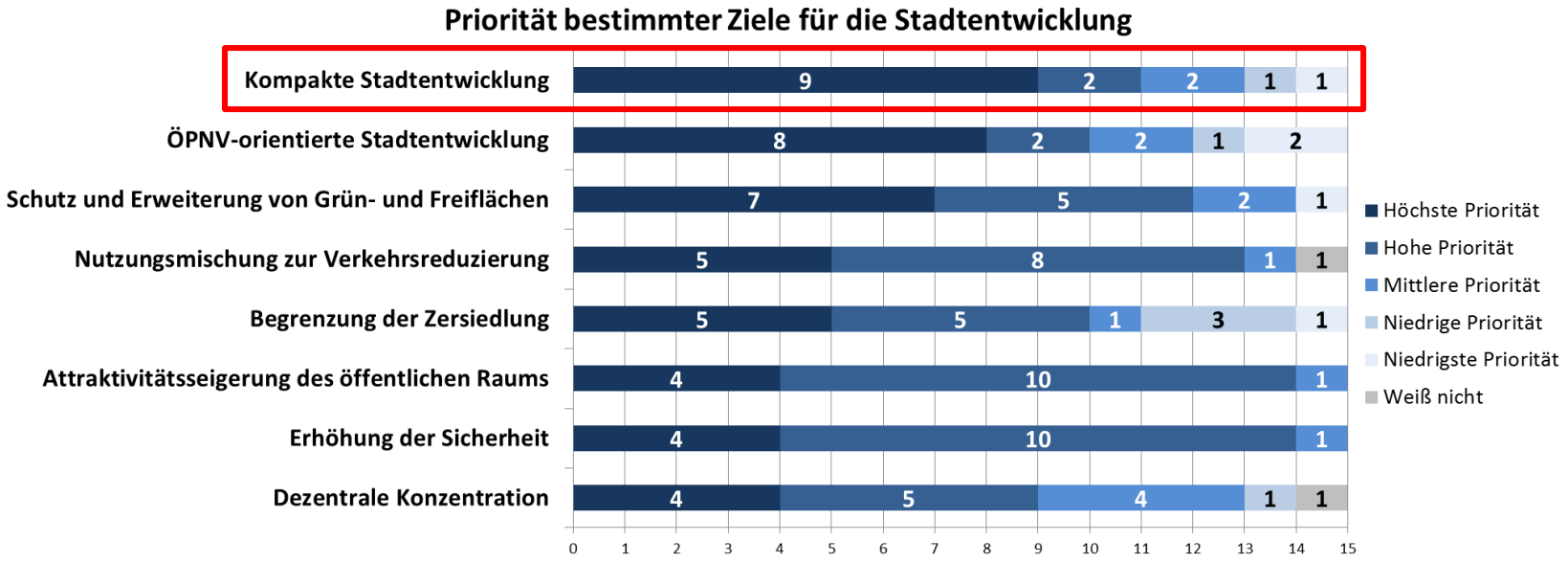




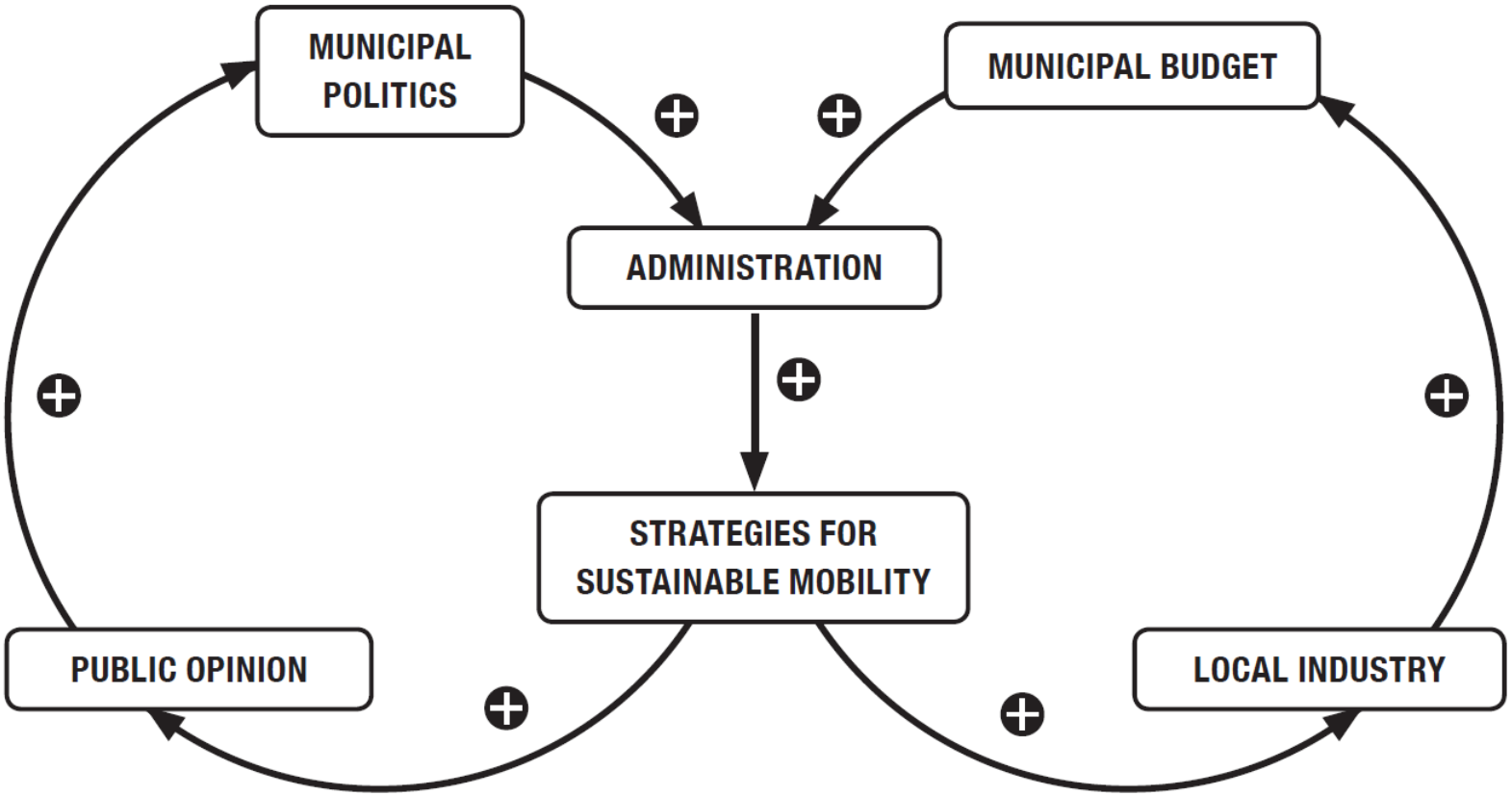
The economic development and urbanization control loop

Die Städte haben die Folgen der Suburbanisierung für den Verkehr erkannt und verfolgen kompakte Entwicklung



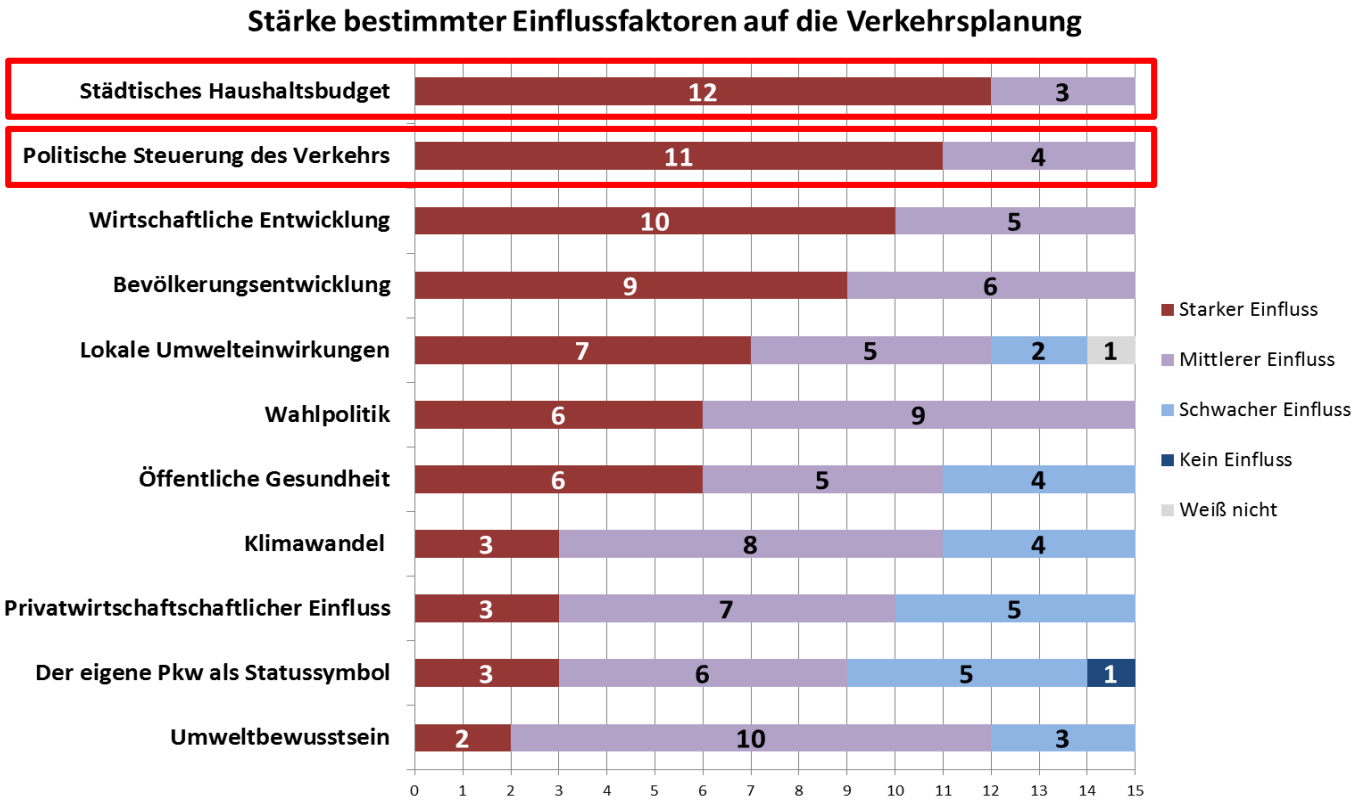


The implementation of strategy control loop

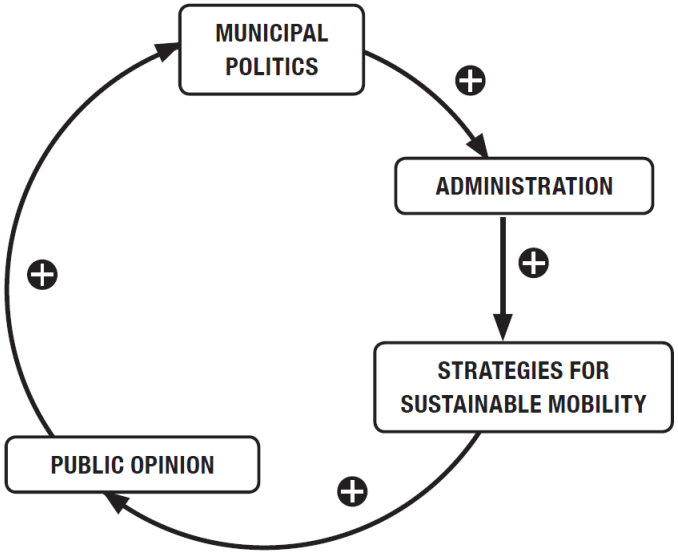


The implementation of strategy control loop

Finanzielle Situation und politische Steuerung setzen Rahmen für den Handlungsspielraum



The implementation of strategy control loop



Beispiel München:
Umfangreiche Bürgerbeteiligung bei der Erarbeitung des Verkehrsentwicklungsplans

Broschüre, Flyer, Internet
Diskussion vor Ort in allen Stadtbezirken
Öffentliche Expertendiskussionen mit Medienbeteiligung (SZ)
Bearbeitung von 1250 Anmerkungen der Bürger

- Hohe Akzeptanz der Maßnahmen
- Messbare Erfolges des Plans

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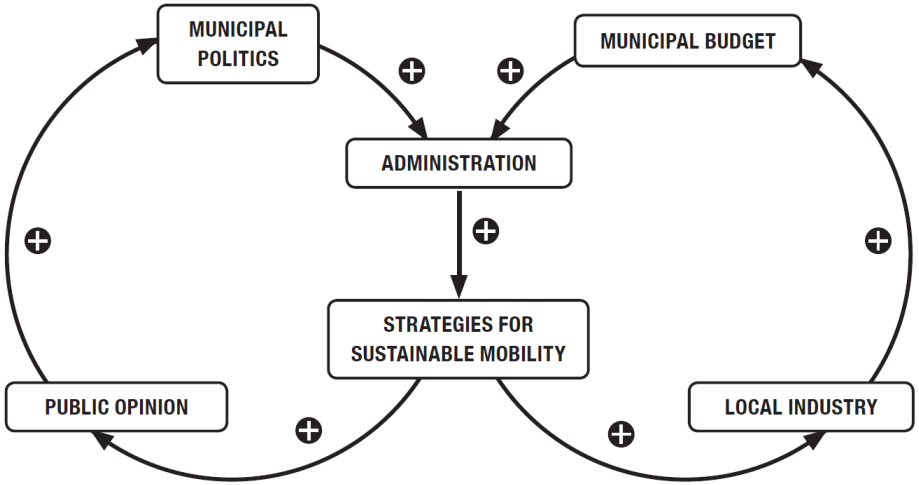
Example:
Los Angeles



$0.15/gallon countywide gas tax

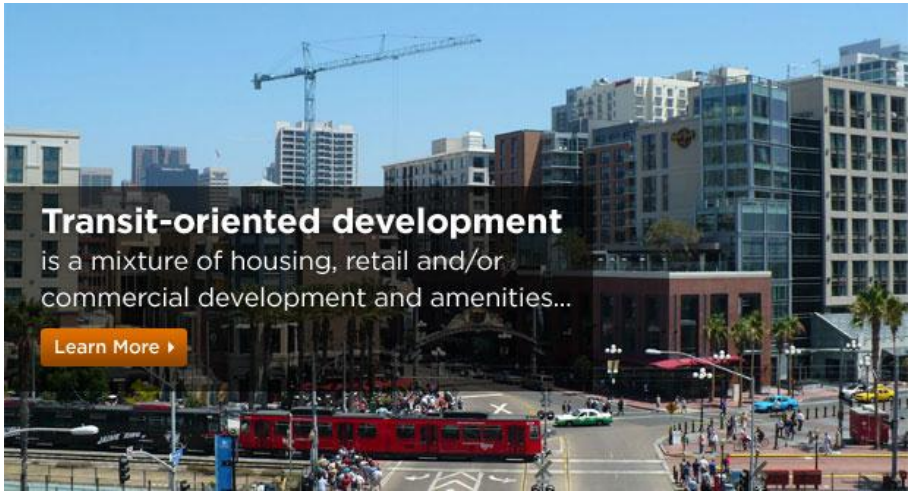
Support	38%
Oppose	**59%**

Double parking rates & fines

Support	42%
Oppose	**54%**

0.5% countywide sales tax

	2006	2007	2008
Support	**59%**	**65%**	**66%**
Oppose	36%	28%	24%



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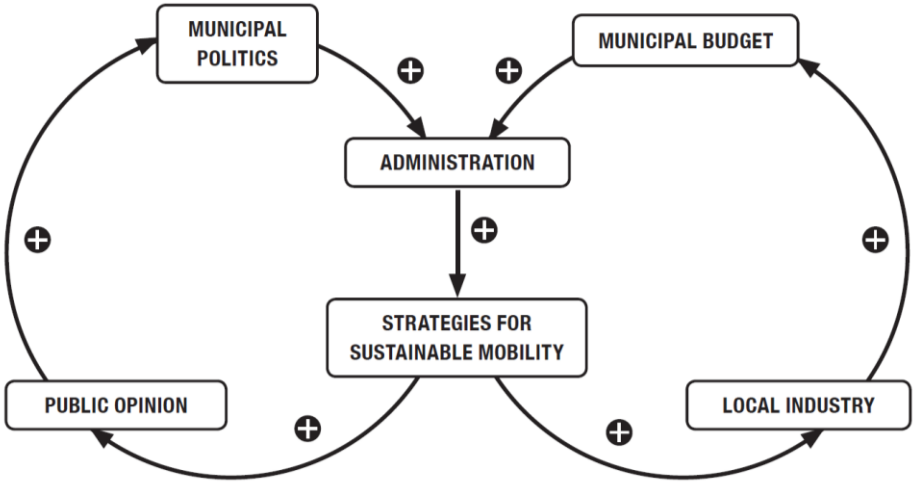
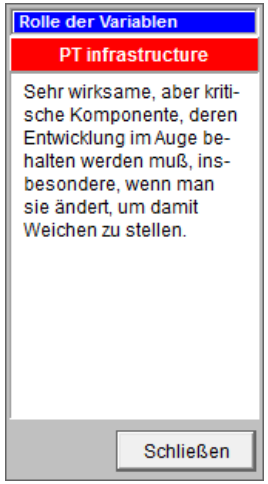
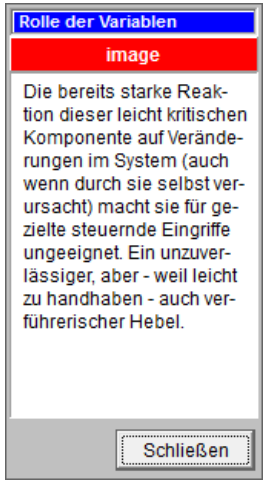
Beispiel Beirut:

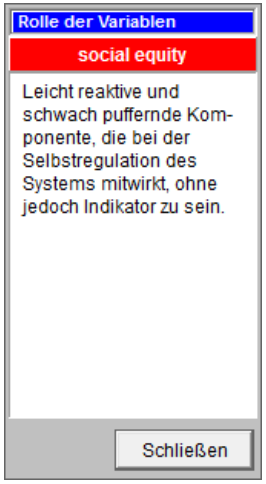


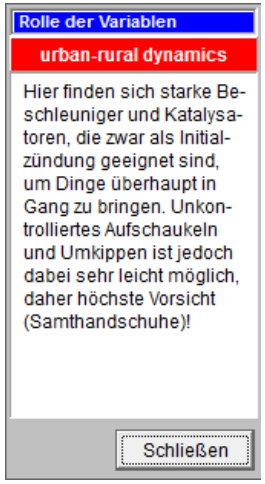
Umsetzungsprobleme aufgrund von zersplitterten Zuständigkeiten im Verkehrsbereich

- Stadt
- Verwaltungsbezirk,
- Innenministerium,
- Ministerium für öffentliche Arbeiten und Verkehr,
- Rat für Entwicklung und Wiederaufbau
- öffentlichen Verkehrsbehörde


Rolle der Variablen
PT infrastructure
Sehr wirksame, aber kritische Komponente, deren Entwicklung im Auge behalten werden muß, insbesondere, wenn man sie ändert, um damit Weichen zu stellen.
Schließen


Rolle der Variablen
image
Die bereits starke Reaktion dieser leicht kritischen Komponente auf Veränderungen im System (auch wenn durch sie selbst verursacht) macht sie für gezielte steuernde Eingriffe ungeeignet. Ein unzuverlässiger, aber - weil leicht zu handhaben - auch verführerischer Hebel.
Schließen


Rolle der Variablen
social equity
Leicht reaktive und schwach puffernde Komponente, die bei der Selbstregulation des Systems mitwirkt, ohne jedoch Indikator zu sein.
Schließen


Rolle der Variablen
urban-rural dynamics
Hier finden sich starke Beschleuniger und Katalysatoren, die zwar als Initialzündung geeignet sind, um Dinge überhaupt in Gang zu bringen. Unkontrolliertes Aufschaukeln und Umkippen ist jedoch dabei sehr leicht möglich, daher höchste Vorsicht (Samthandschuhe)!
Schließen