Automatisch rijden- effecten op verkeer en leefomgeving

Bart van Arem

A first drive with fully automated vehicle…

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

DRIVE ME

Automated driving

Driver assistance/
Partial automation

Driver needs to be able to intervene at all times

Automated parking, autocruise

Conditional/ High automation

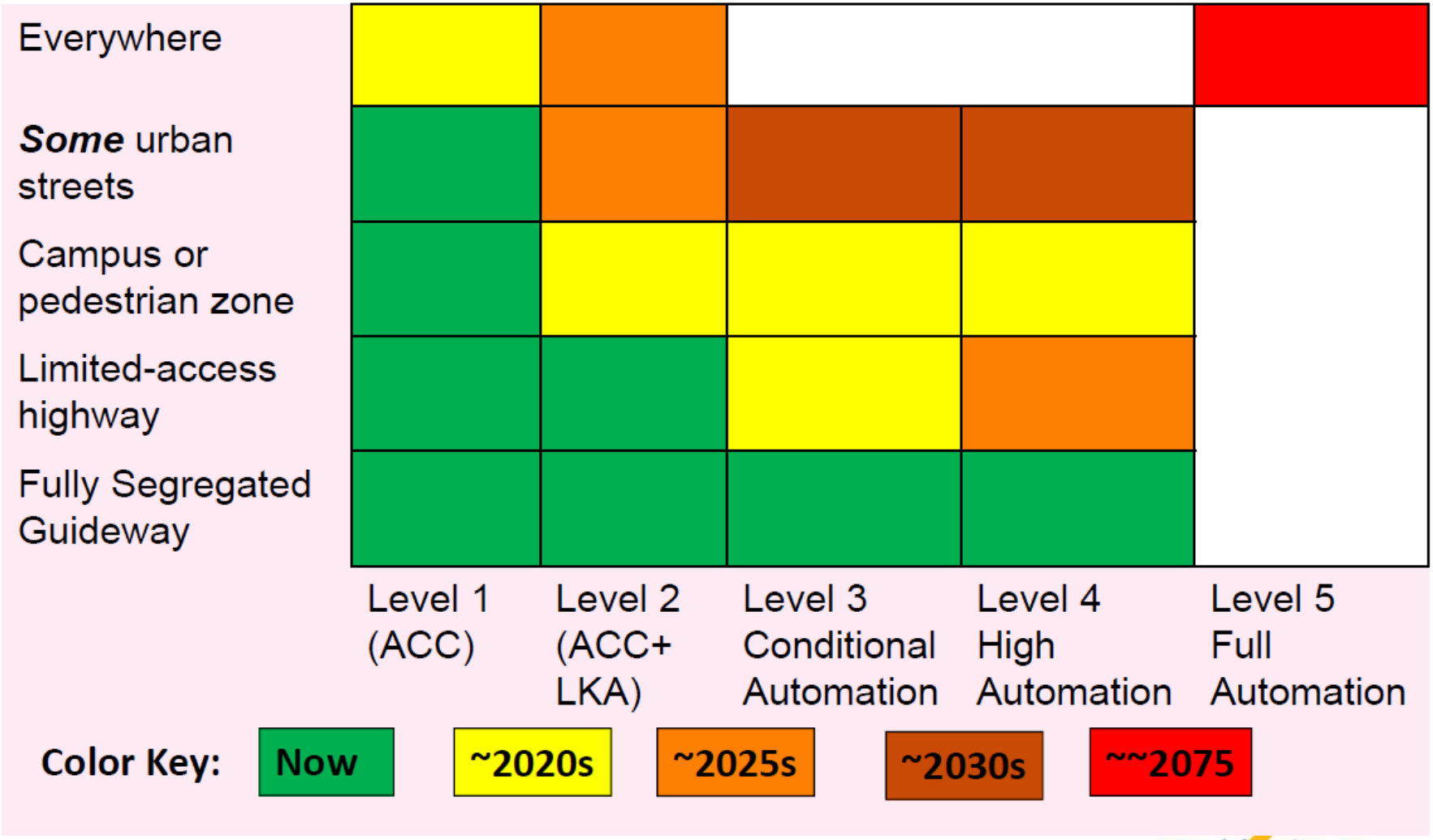
Vehicle in control in special conditions

Taxibots, platooning, automated highways

Comfort, efficiency, safety, costs

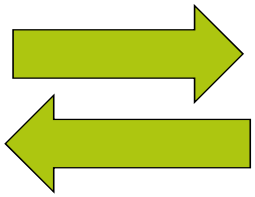
Mode choice, location choice, urban and transport planning

Personal Estimates of Market Introductions *(based on technological feasibility)*



Fundamental changes in driving behaviour

Driver in control



Vehicle in control
Driver supervision

Workload,
driving performance,
attention,
situation awareness
risk compensation,
Driver Vehicle Interface,
acceptance,
mode transition,
purchase and use

Potential impacts on traffic

Non connected
Large penetration

Solve traffic jams by increased outflow

Prevent traffic jams by better stability

Better distribution of traffic over network

Less congestion delay

Decreased throughput by larger headways

Decreased stability by lack of anticipation

Increased risk of congestion

General findings on motorway capacity

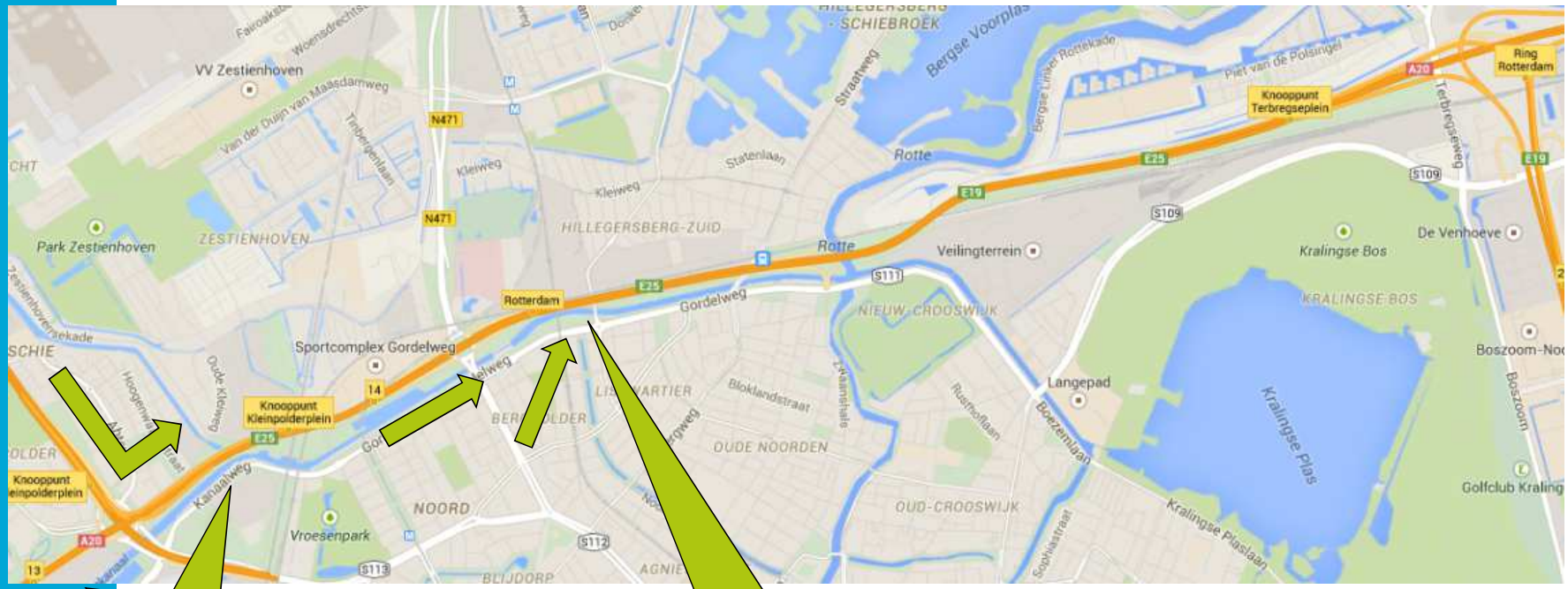
- Many micro simulation studies
- Difficult to compare
- Focus on ACC and CACC
- Hardly any bottlenecks

(Shladover, Su, & Lu, 2012)

		Percentage of CACC Vehicles										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Percentage of ACC vehicles	0%	2018	Niet vermeld in artikel (alleen grafisch)									97%
	10%	Niet vermeld in artikel	2%	4%	8%	12%	18%	22%	32%	47%	68%	
	20%		2%	5%	8%	12%	18%	22%	32%	48%		
	30%		3%	5%	8%	12%	18%	23%	34%			
	40%		3%	5%	9%	13%	15%	25%				
	50%		4%	6%	8%	11%	17%					
	60%		4%	6%	6%	11%						
	70%		5%	3%	7%							
	80%		3%	4%								
	90%		2%									
	100%											

- ACC can either have a small negative or a small positive effect on capacity (~ -5% to +10%)
- Bottlenecks: increase <10%
- Positive effect stability and capacity drop
- Lower level roads?

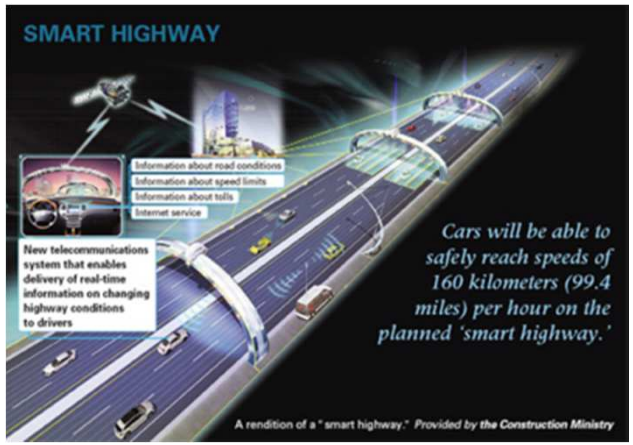
A20: bottleneck motorway, no more space to expand



How can AVs relieve congestion here?

Automated roads?

- Implication of changes in traffic load? Platoons, bridges, rutting?
- Automated driving under adverse roadway and weather conditions?
- Implications for traffic management? Opportunity or thread?
- eHorizon: automated driving cloud for real-time positioning, manoevering and safety?
- Level 4 certified roads?
- Geometric design, transition zones?



Acceptance

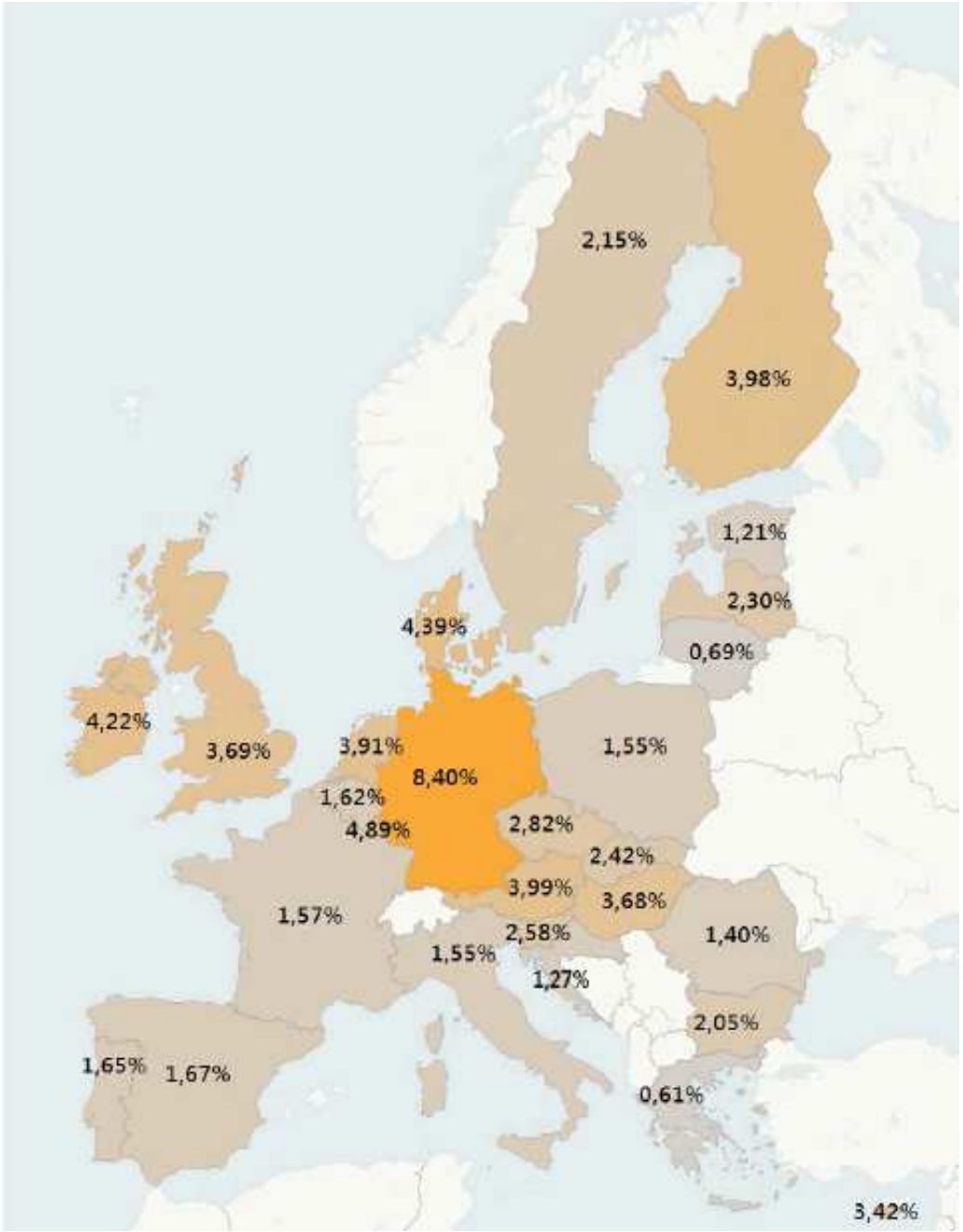
- Drivers state that they prefer warnings over control
- Control could be acceptable in special conditions such as congestion driving
- Acceptance of (different levels of) automation increases after (positive) experience
- Scepticism is declining

DEPLOYMENT RATES - EU27
BY MEMBER STATE

PS3
OBSTACLE & COLLISION WARNING

2012

PASSENGER CARS NEW REG. IN 2012



Car driving more attractive!

Partial automation

Better comfort,
Less accidents
Less congestion

High automation

Travel time can partially be used for other purpose

Full automation

Travel time can fully be used for other purposes

Spatial implications

Functional

- Geometric redesign of roads and junctions
- Increasing sprawl residential and employment locations
- Concentration activities by better accessibility

Spatial

- Redesign of urban, commercial, touristic areas
- No on street parking
- Combinations with car sharing, electric driving

Policy relevance

- Congestion and accessibility
- Safety
- Travel patterns
- Freight transport
- Public transport
- Socio-economic development
- Urban design
- Spatial structure
- Investment policies

National, regional, city authorities, public transport operators, Multimodal hubs (ports, airports)

Automated cars can improve traffic efficiency and safety

Netherlands to facilitate large scale testing of automated cars

Exploration using LMS

Automated Autonomous

5% capacity decrease on primary road network

	Index km travelled
Train	100.3
Car driver	99.8
Car passenger	99.7
Bus, tram, metro	100.2
Cycling	100.1
Walking	100.1
Total	99.98

Index congestion 115.7

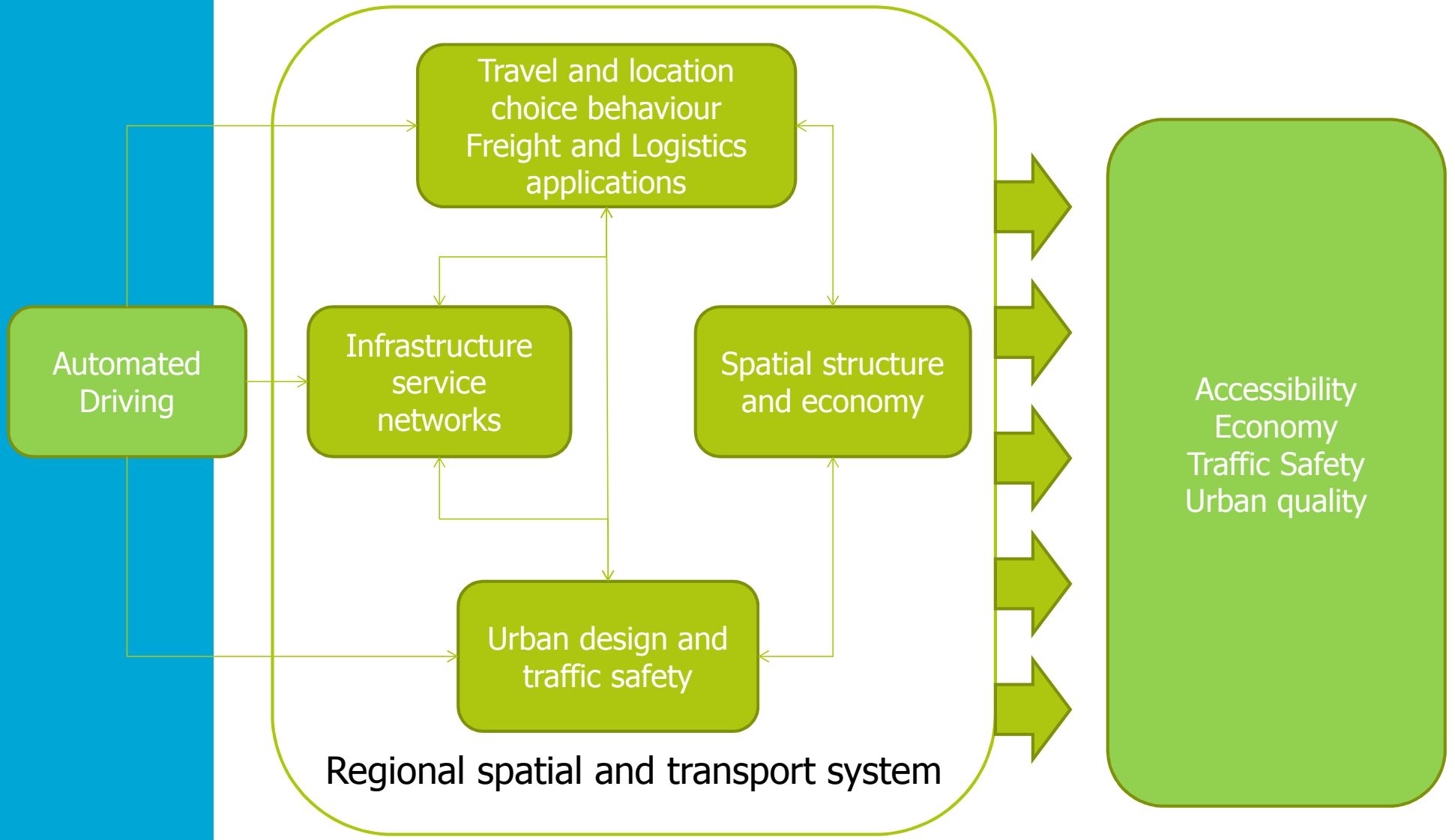
Automated Cooperative

15% capacity increase primary road network
10% capacity increase secondary road network
10% decrease value of time commuting and business car trips

	Index km travelled
Train	98.8
Car driver	100.8
Car passenger	101.4
Bus, tram, metro	99.2
Cycling	99.3
Walking	99.4
Total	100.10

Index congestion 69.1

Scientific challenges: understanding the spatial and transport changes



STAD: Spatial and Transport Impacts of Automated Driving

TU Delft

METROPOOLREGIO ROTTERDAM DEN HAAG

provincie ZUID HOLLAND

DAVI ONTHEROAD

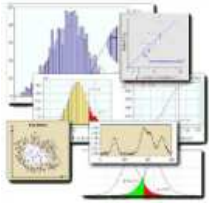
TrafficQuest

DAVI ONTHEROAD

The road to automated driving…

Develope efficient and reliable technology

Collect, analyse and publish large scale real-world experience



Study spatial, transport and societal impacts

Regulations, type approval

Awareness, ambitions, expectations, reality checks