Rijkswaterstaat
Ministry of Infrastructure and the Environment

Smart Mobility, Dutch Reality CAD in the NL

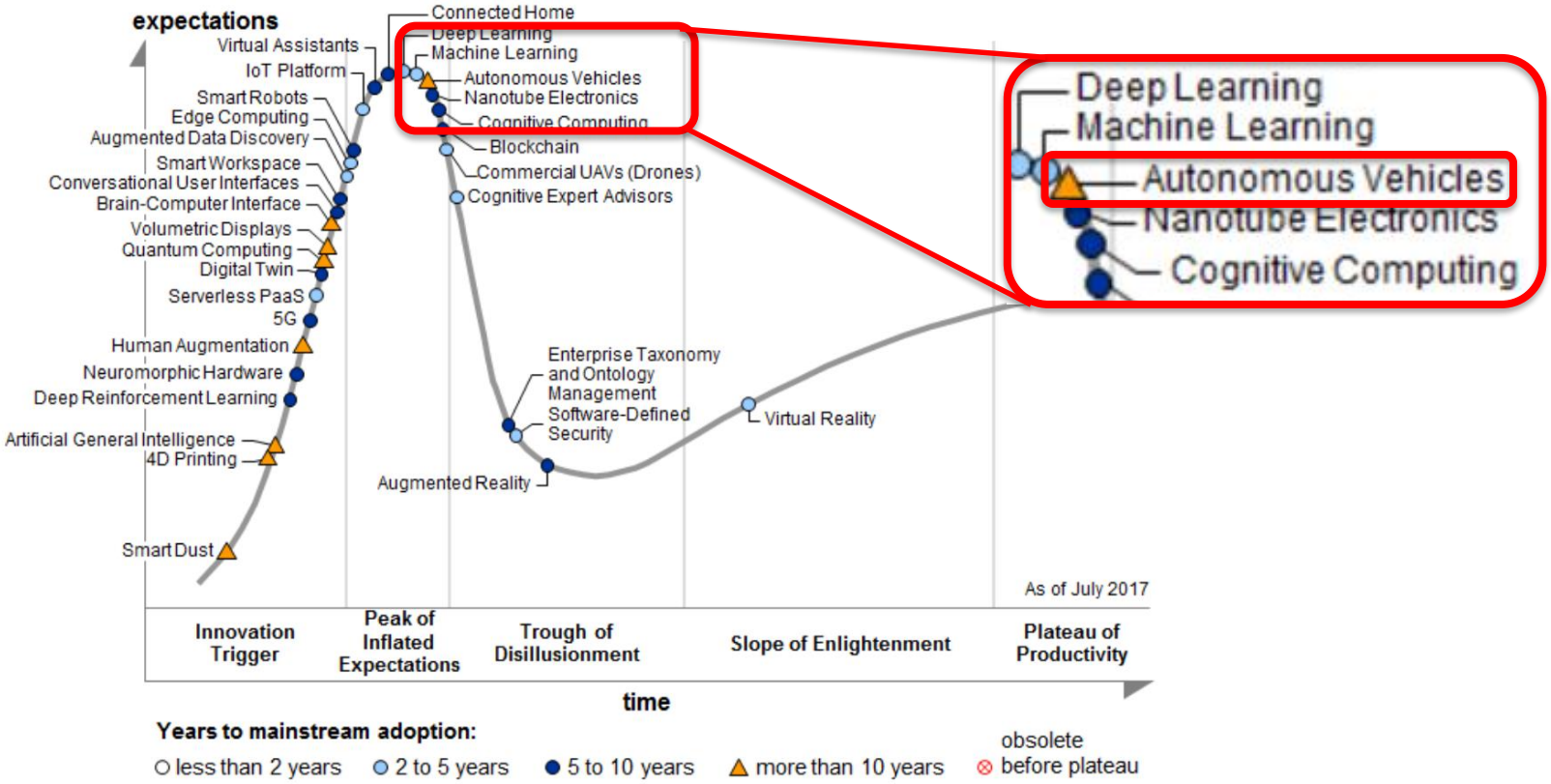
SIP-adus 2018, Tokyo

Tom Alkim
Senior Advisor
Connected & Automated Driving

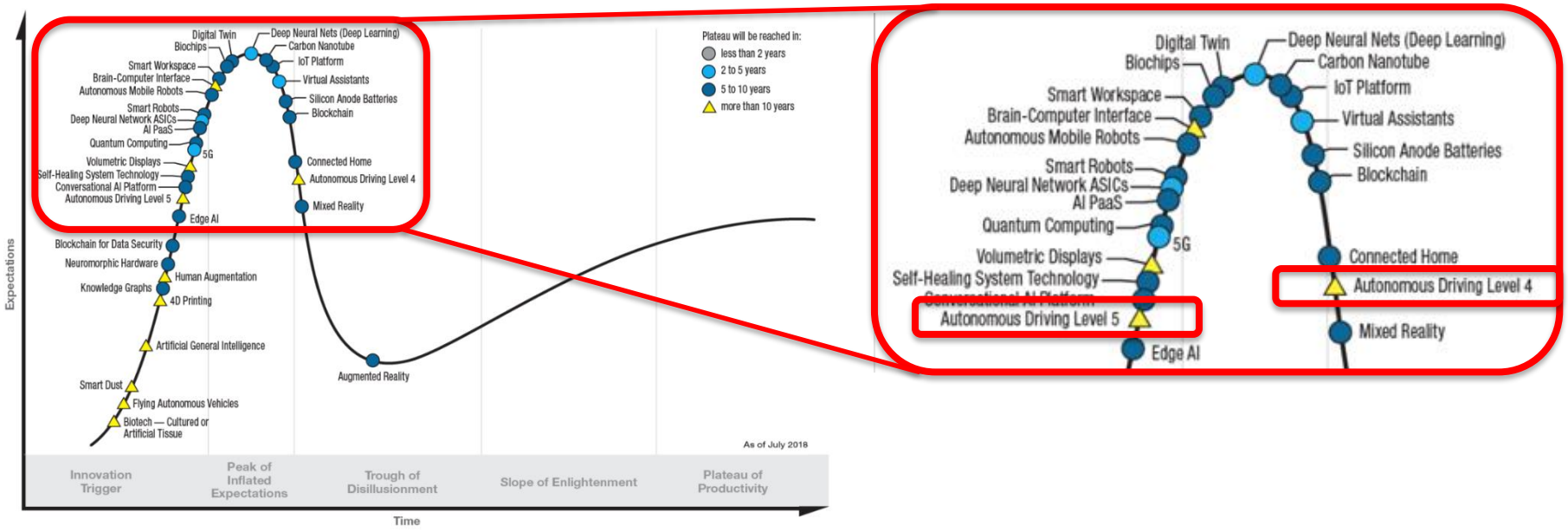
Rijkswaterstaat

13 November 2018

Past the hype? 2017



Past the hype. 2018



gartner.com/SmarterWithGartner

Gartner

Past the hype. 2018

AARIAN MARSHALL TRANSPORTATION 07.13.18 07:00 AM

HOME FROM THE HONEYMOON, THE SELF-DRIVING CAR INDUSTRY FACES REALITY

Last year's Automated Vehicles Symposium was all about big announcements and a gleaming future. This year, attendants focused on trickier questions of how to tell the public that its wonder drug of a transportation solution will have its limitations.

JEFF SWENSEN/GETTY IMAGES

AUTOMATED VEHICLES SYMPOSIUM 2018

Driven by AUVSI

AT THE BLOCKBUSTER plenary sessions, the chairs stretched so far back that even the most youthful Silicon Valley college dropouts-turned VC hoovers had to squint to see the action up in front. A handful of large projection screens hung between the ballroom's chandeliers, displaying loop-de-looping flow charts on vehicle safety systems, sensor alignments, liability law.

But despite the best efforts of the downtown San Francisco Hilton's air conditioners, the air shared by the attendees of this year's Automated Vehicles Symposium was thick with secrets and doubt. Eight years after Google first showed its self-driving car to *The New York Times*, the autonomous vehicle industry is still trying to figure out how to talk about itself.

Over the three-day conference, engineers, business buffs, urban planners, government officials, and transportation researchers grappled with how to tell the public that its wonder drug of a transportation solution will have its limitations. For at least a few decades to come.

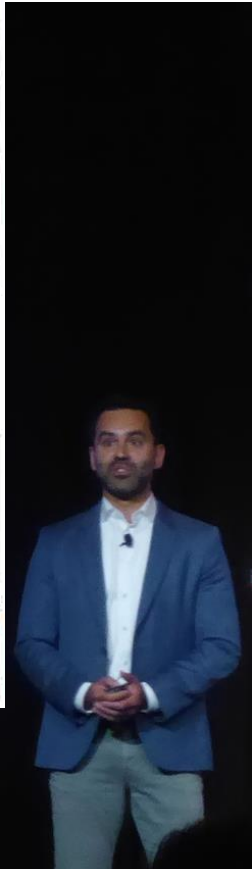
https://www.wired.com/story/self-driving-car-faces-reality/

1 Where to drive: know the best routes

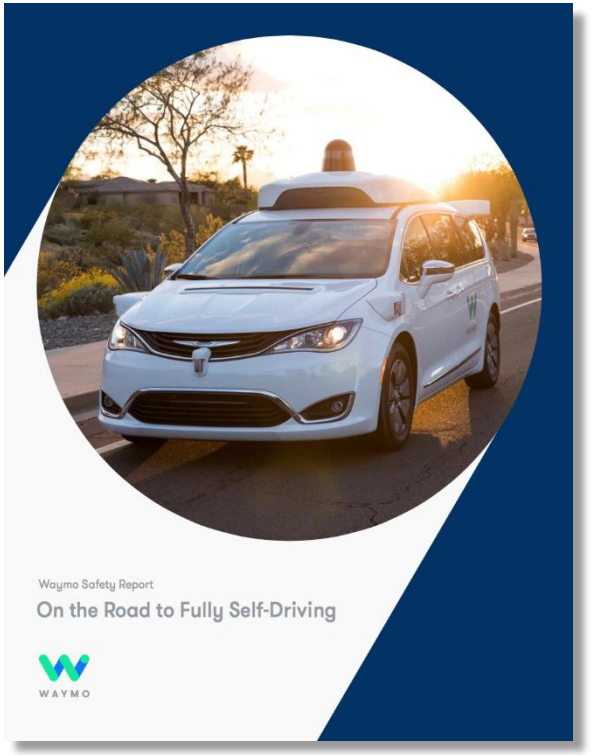
Lower speeds, limit complex situations & traffic restrictions

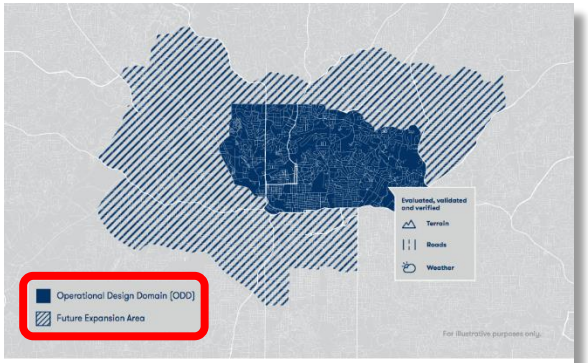
- Speeds <= 35 MPH
- Avoid difficult intersections
- No bike lanes
- Well-marked roads
- Easy pick-up and drop-off

AV eligible, limited ODD



Waymo safety report





***Operational Design Domain:* Ensuring Our Vehicles Operate Safely Under Specific Conditions**

The operational design domain refers to the conditions under which a self-driving system can safely operate. Waymo's domain includes geographies, roadway types, speed range, weather, time of day, and state and local traffic laws and regulations.

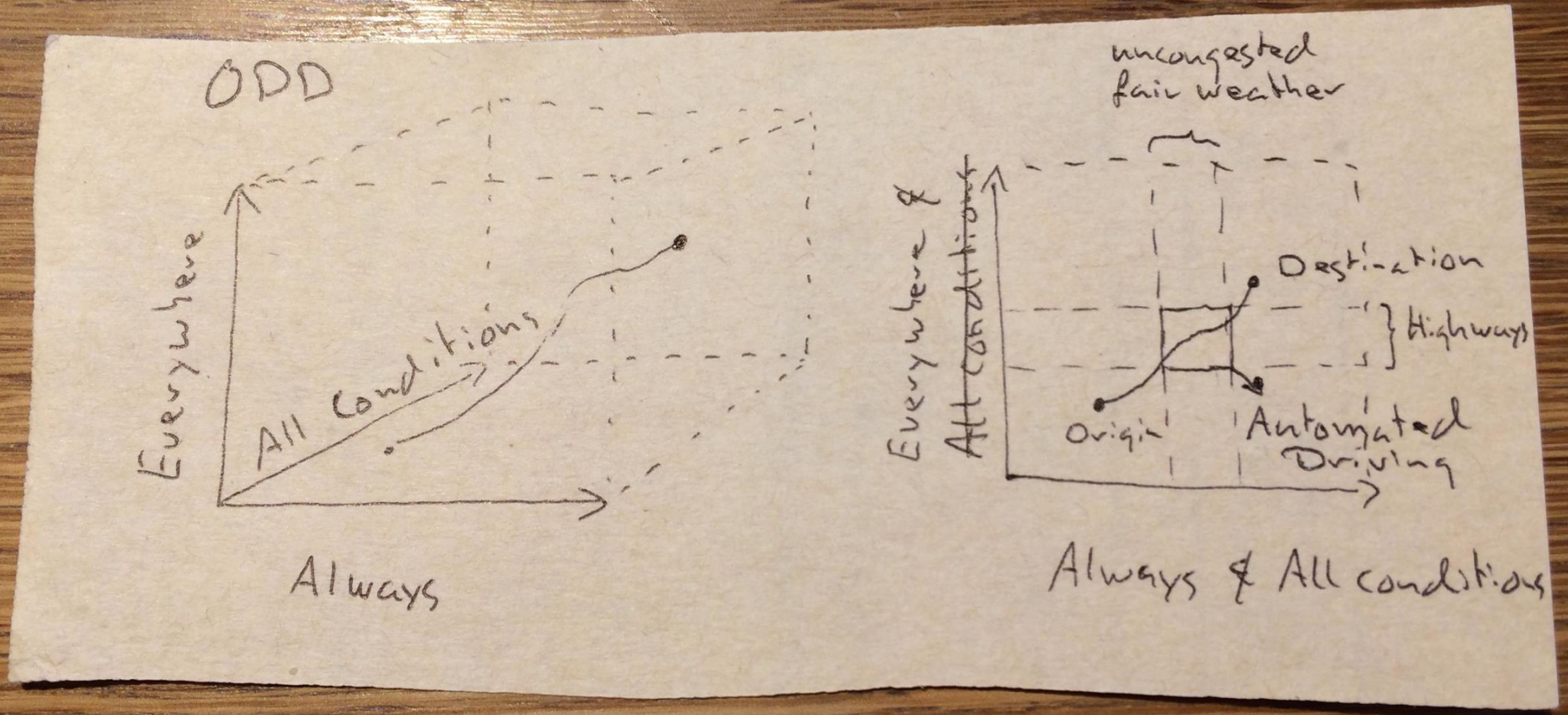
An operational design domain can be very limited: for instance, a single fixed route on low-speed public streets or private grounds (such as business parks) in temperate weather conditions during daylight hours. However, Waymo aims to have a broad operational design domain to cover everyday driving. We're developing self-driving technology that can navigate city streets in a variety of conditions within broad geographic areas. Our vehicles are designed with the capability to drive in inclement weather, such as light to moderate rain, and can operate in daytime and at night.

Waymo's system is also designed so each vehicle does not operate outside of its approved operational design domain. For example, passengers cannot select a destination outside of our approved geography, and our software will not create a route that travels outside of a "geo-fenced" area, which has been mapped in detail (see "How We Build a Map for a Self-Driving Vehicle"). Similarly, our vehicles are designed to automatically detect sudden changes (such as a snowstorm) that would affect safe driving within their operational design domain and come to a safe stop (i.e. achieve a "minimal risk condition") until conditions improve.

We design our vehicles to be capable of complying with federal, state, and local laws within their geographic area of operations. [14] Legal requirements, and any changes in those requirements, are identified and built into our system as safety requirements, including relevant speed limits, traffic signs, and signals. Before our vehicles drive in a new location, our team works to understand any unique road rules or driving customs, and we update our software so our vehicles are capable of responding safely. For example, California and Texas (home to two of Waymo's test cities) have differing rules for how to make right turns in the presence of a bike lane.

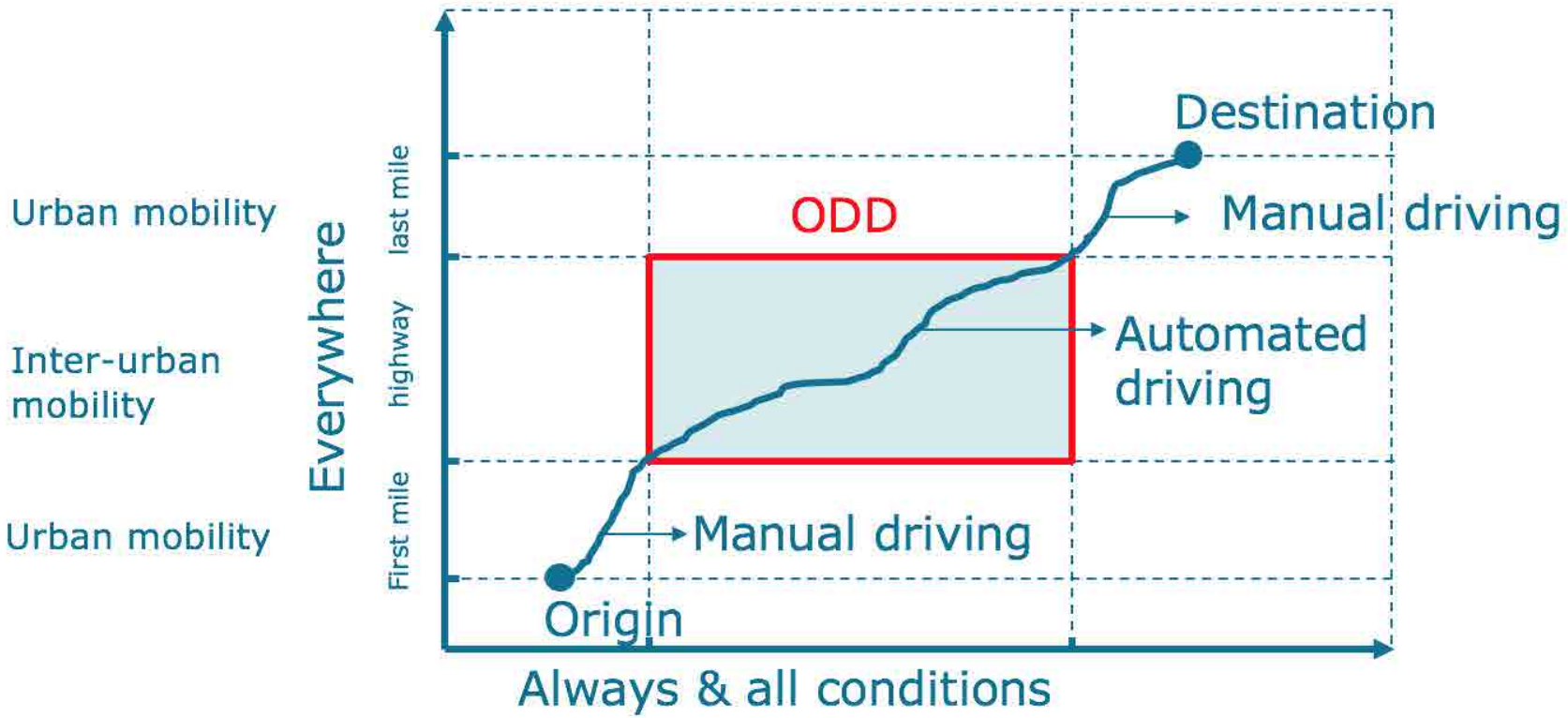
Waymo's operational design domain continues to evolve. Our ultimate goal is to develop fully self-driving technology that can take someone from A to B, anytime, anywhere, and in all conditions. As our system's capabilities grow and are validated, we will expand our operational design domain to bring our technology to more people.

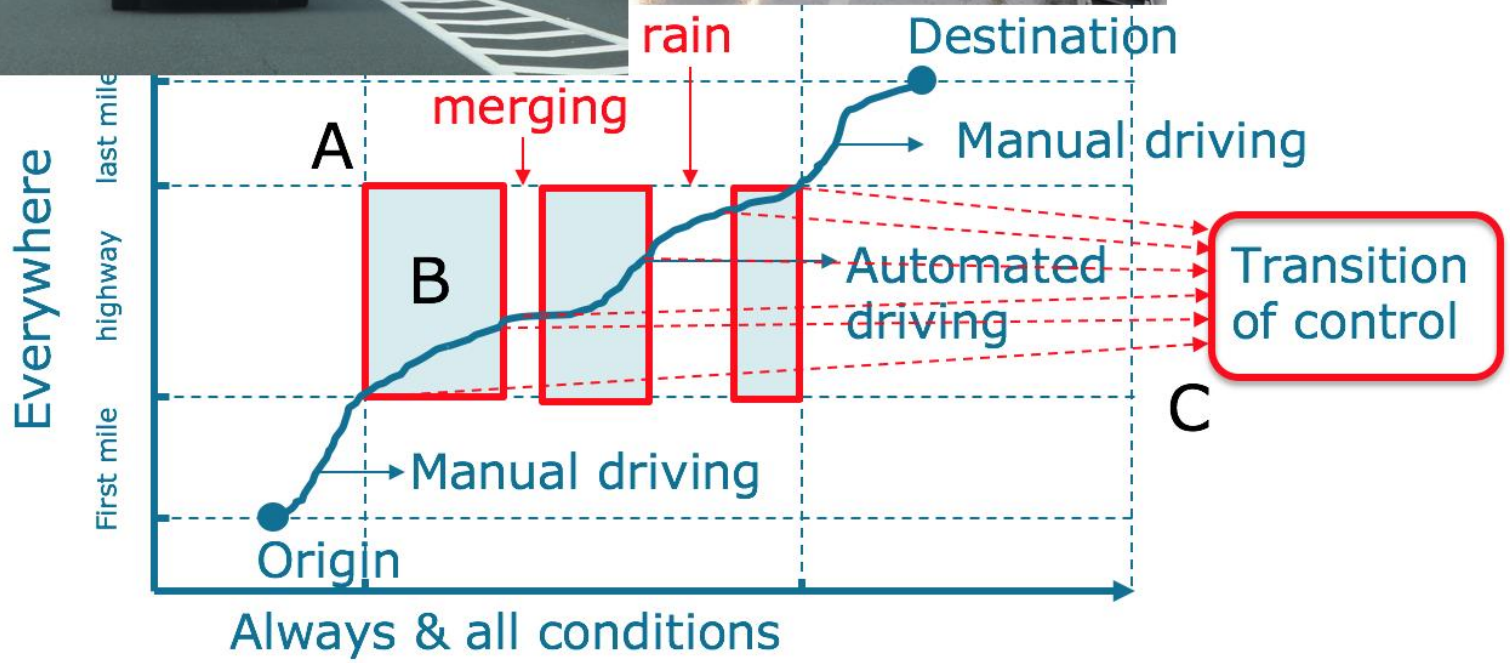
https://storage.googleapis.com/sdc-prod/v1/safety-report/waymo-safety-report-2017.pdf



Tokyo, 11 November 2017

ODD framework




rain
Destination
merging
A
Manual driving
B
Automated driving
Transition of control
C
Everywhere
last mile
highway
First mile
Manual driving
Origin
Always & all conditions

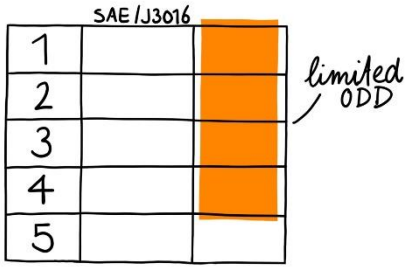
Updated ODD framework

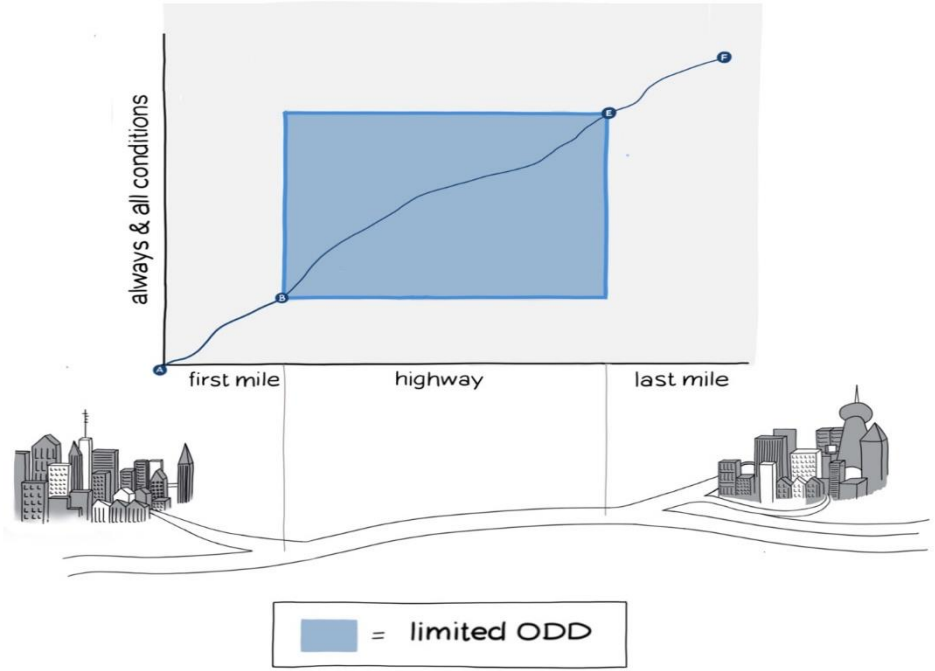
STORYLINE ODD FRAMEWORK

A
Driver leaves home to drive to work. First mile is driven manually.

B
... gives control to vehicle (ToC) and continues the trip in automated mode. Does something else with the freed up time, like reading email, posting on instagram or drinking coffee.

E
Vehicle approaches the exit and driver prepares to take back control (ToC) and drives last mile manually to destination.





Updated ODD framework

Infrastructure

STORYLINE ODD FRAMEWORK

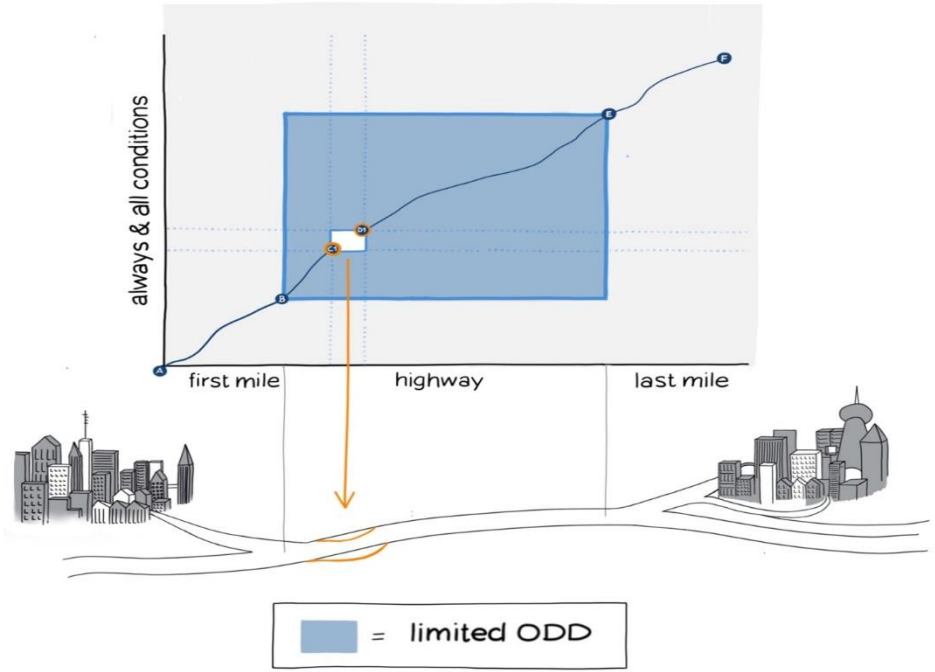
A
Driver leaves home to drive to work. First mile is driven manually.

B
... gives control to vehicle (ToC) and continues the trip in automated mode. Does something else with the freed up time, like reading email, posting on instagram or drinking coffee.

C1
During the trip vehicle encounters temporary lane markings, vehicle is confused and ODD ends. Driver needs to take over control (ToC).

D1
Conditions back to normal, ODD is available again, driver gives back control (ToC).

E
Vehicle approaches the exit and driver prepares to take back control (ToC) and drives last mile manually to destination.



Updated ODD framework

Traffic

STORYLINE ODD FRAMEWORK

A
Driver leaves home to drive to work. First mile is driven manually.

B
... gives control to vehicle (ToC) and continues the trip in automated mode. Does something else with the freed up time, like reading email, posting on instagram or drinking coffee.

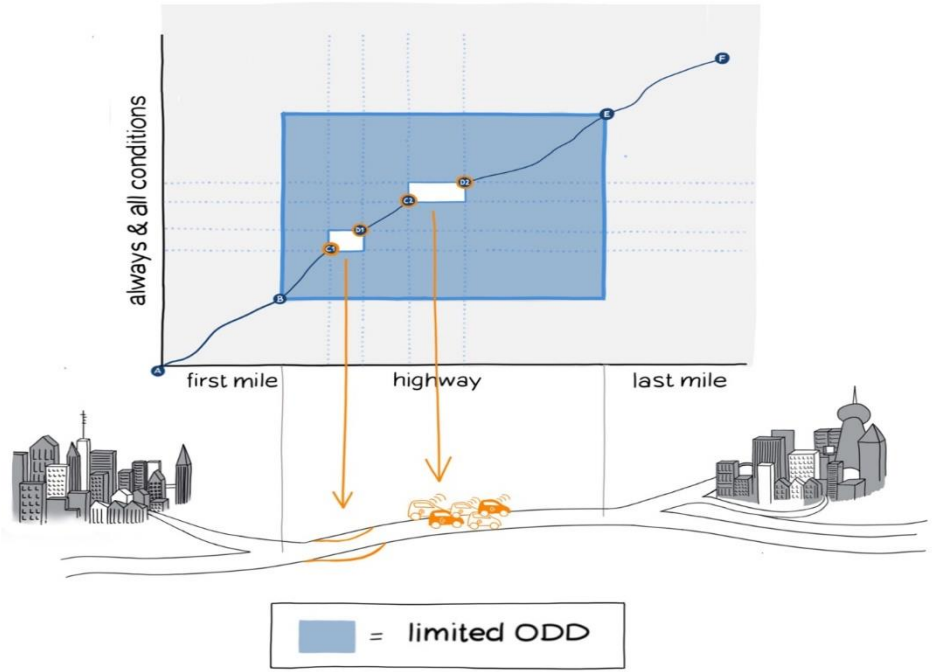
C1
During the trip vehicle encounters temporary lane markings, vehicle is confused and ODD ends. Driver needs to take over control (ToC).

D1
Conditions back to normal, ODD is available again, driver gives back control (ToC).

C2
During the trip vehicle has to merge in heavy mixed traffic, vehicle can't handle the situation and ODD ends. Driver needs to take over control (ToC).

D2
Conditions back to normal, ODD is available again, driver gives back control (ToC).

E
Vehicle approaches the exit and driver prepares to take back control (ToC) and drives last mile manually to destination.



Updated ODD framework

Weather

STORYLINE ODD FRAMEWORK

A
Driver leaves home to drive to work. First mile is driven manually.

B
... gives control to vehicle (ToC) and continues the trip in automated mode. Does something else with the freed up time, like reading email, posting on instagram or drinking coffee.

C1
During the trip vehicle encounters temporary lane markings, vehicle is confused and ODD ends. Driver needs to take over control (ToC).

D1
Conditions back to normal, ODD is available again, driver gives back control (ToC).

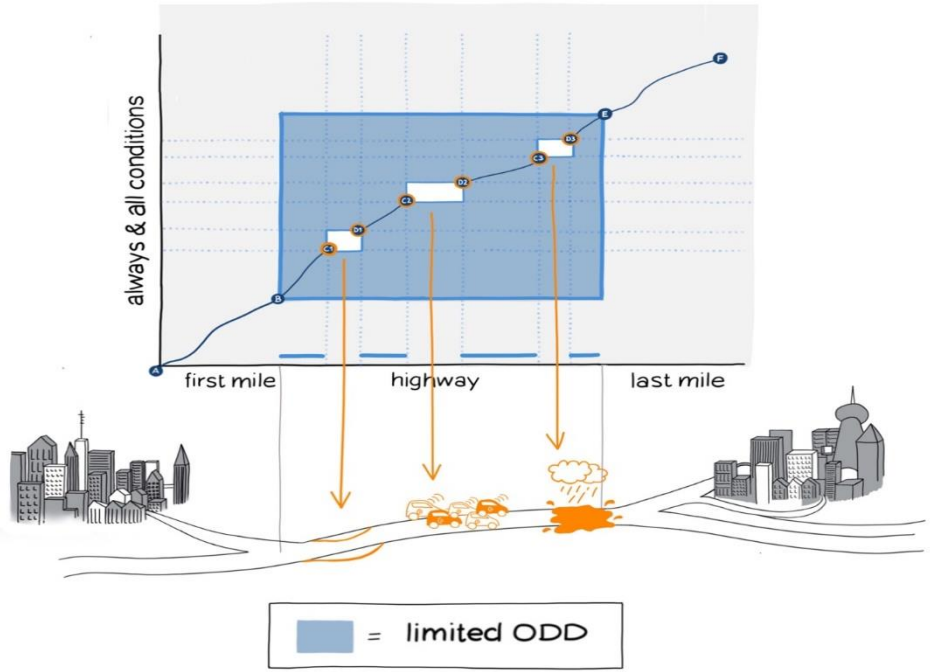
C2
During the trip vehicle has to merge in heavy mixed traffic, vehicle can't handle the situation and ODD ends. Driver needs to take over control (ToC).

D2
Conditions back to normal, ODD is available again, driver gives back control (ToC).

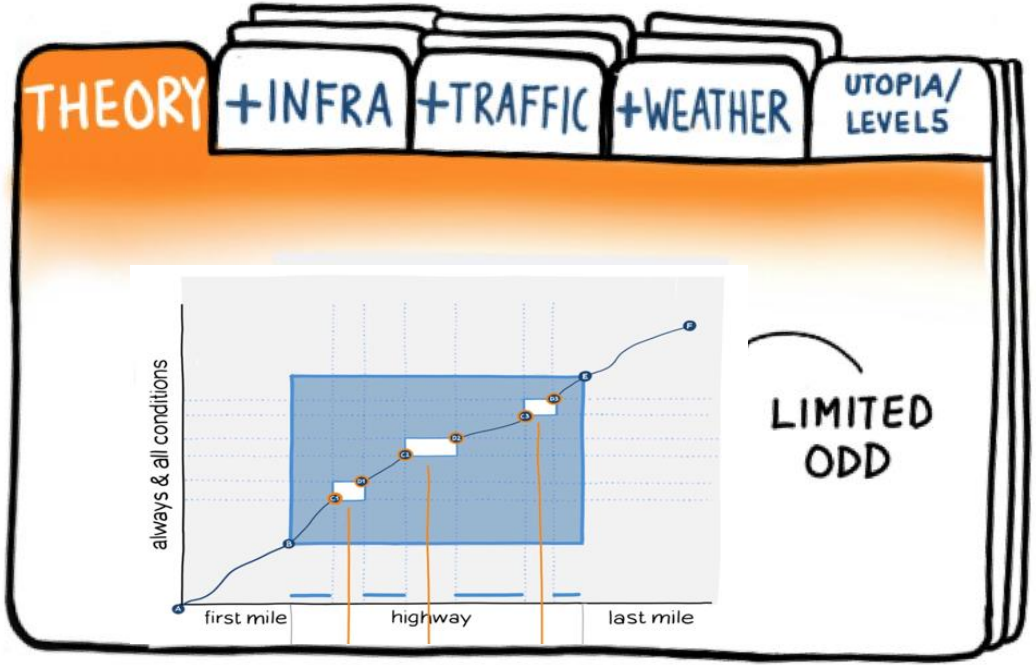
C3
During the trip a heavy rain shower occurs, vehicle can't handle the situation and ODD ends. Driver needs to take over control (ToC).

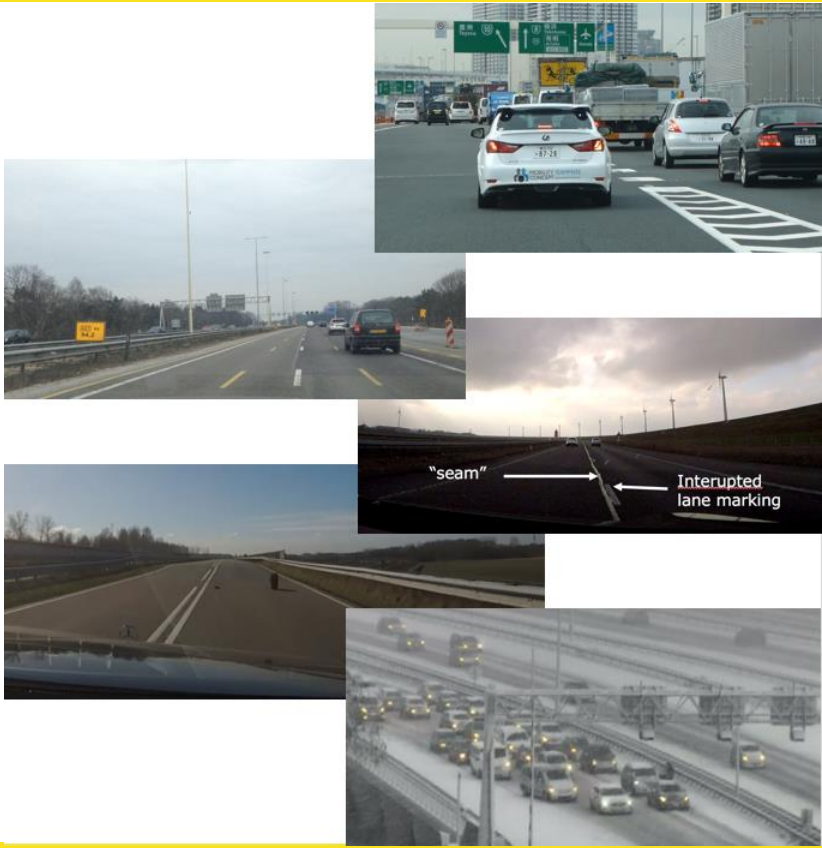
D3
Conditions back to normal, ODD is available again, driver gives back control (ToC).

E
Vehicle approaches the exit and driver prepares to take back control (ToC) and drives last mile manually to destination.

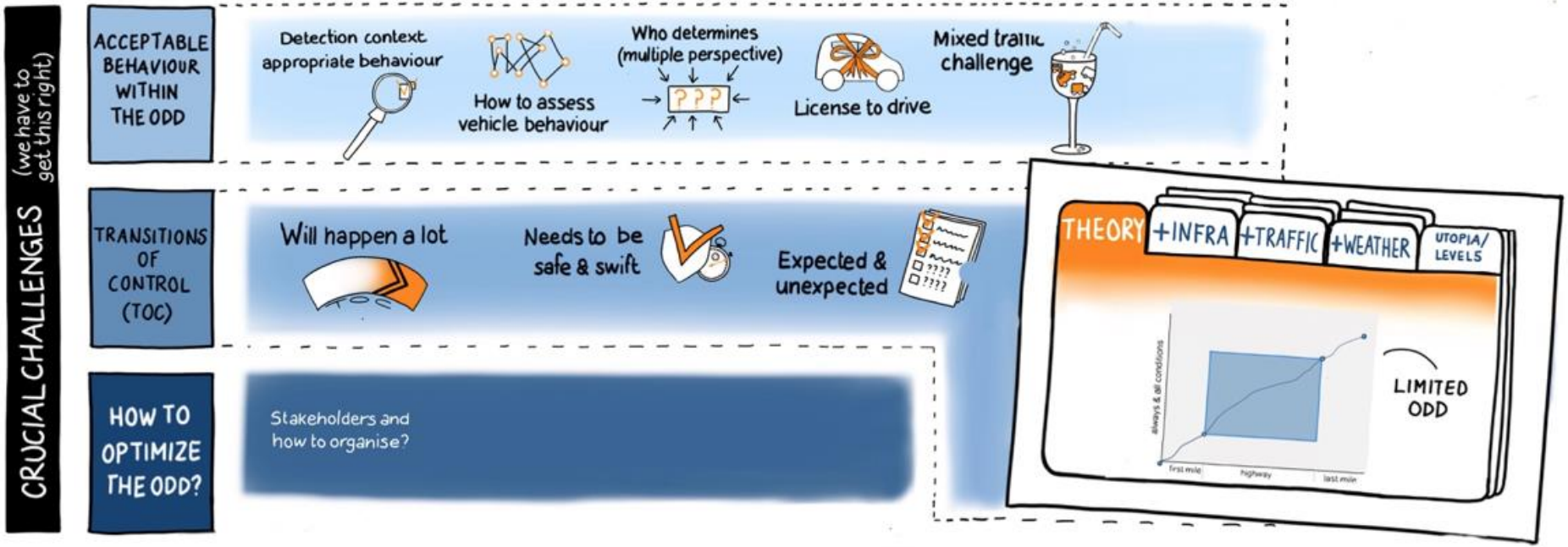


Concrete examples

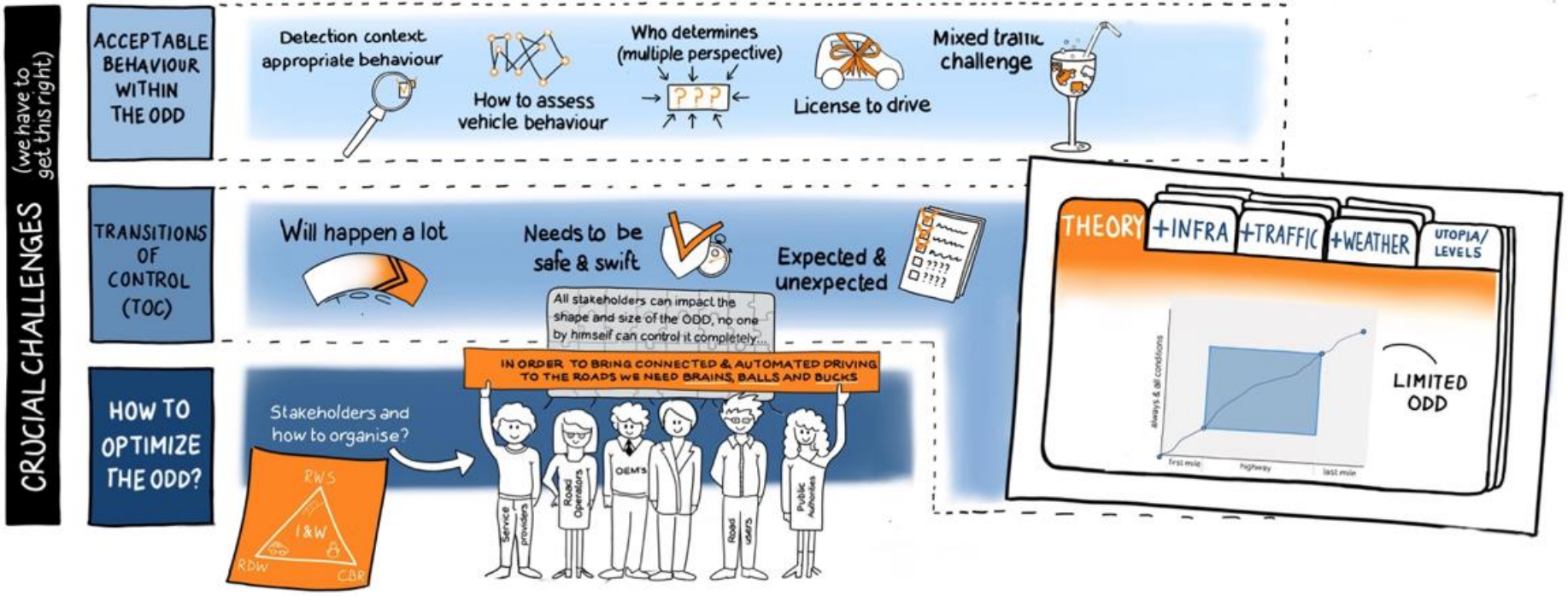


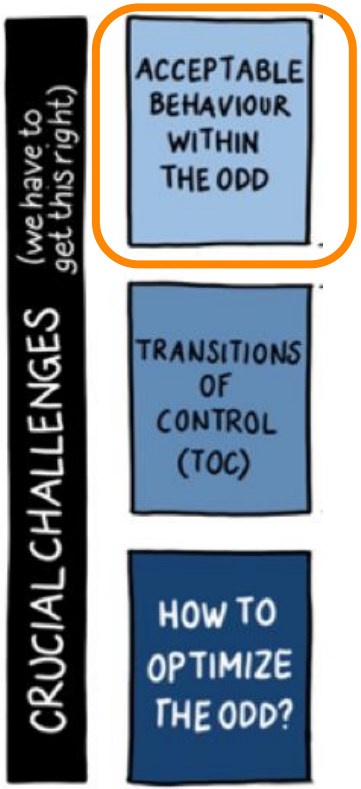


Crucial challenges



Crucial challenges





Acceptable behaviour

What is acceptable behaviour?

- Detection / context -> acceptable behaviour
- Who determines this? Multiple stakeholders

How do you know CAVs are capable of this bahaviour?

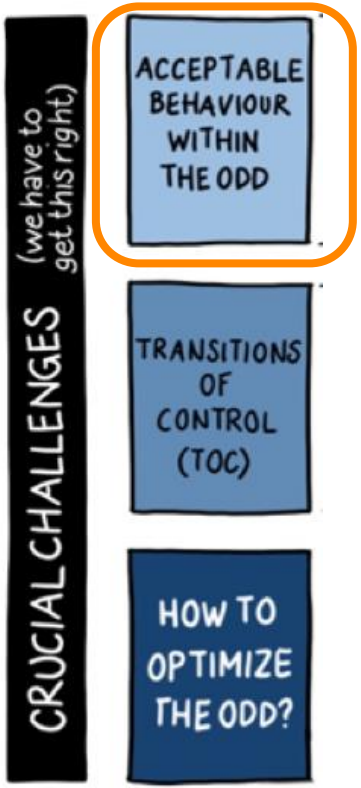
- How to assess this behaviour?
- License to drive

"I want to **enable the next generation of vehicles to actually take the road**. So I'm creating a legal framework for automated driving. Laying down requirements for reliability and safety that cars must meet before they can hit the road. **A driving licence for self-driving cars**, if you like. Not for the driver – but for the car itself!"

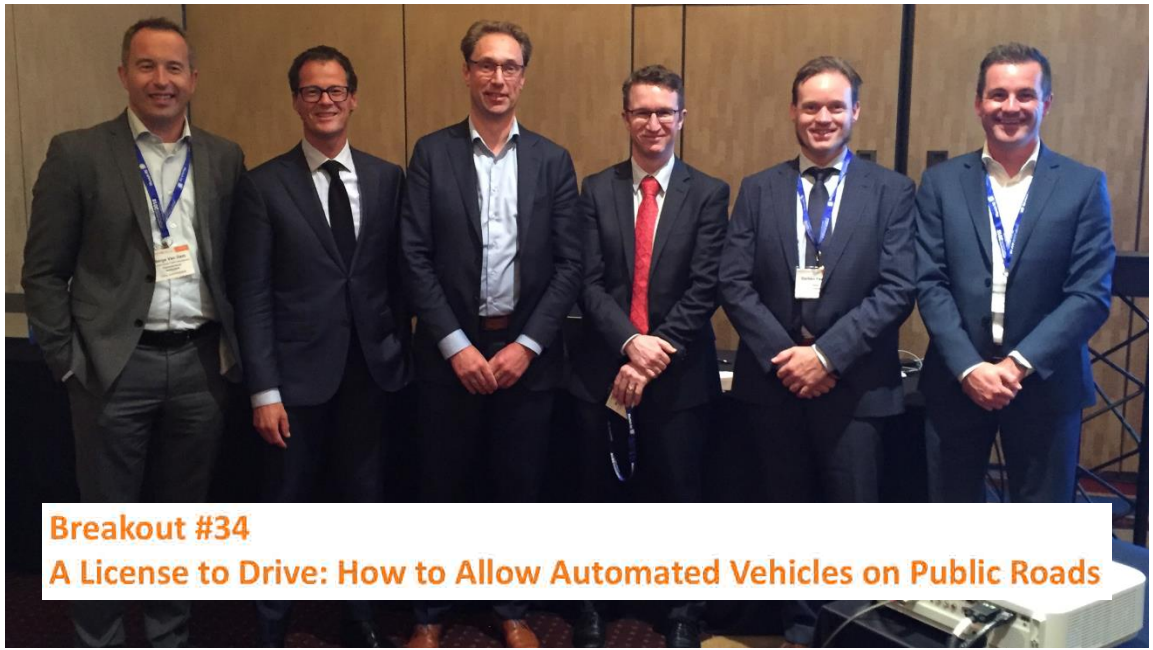
https://www.government.nl/documents/speeches/2018/03/26/speech-by-cora-van-nieuwenhuizen-minister-of-infrastructure-and-water-management-at-the-opening-of-intertraffic-amsterdam-20-march-2018

CRUCIAL CHALLENGES (we have to get this right)

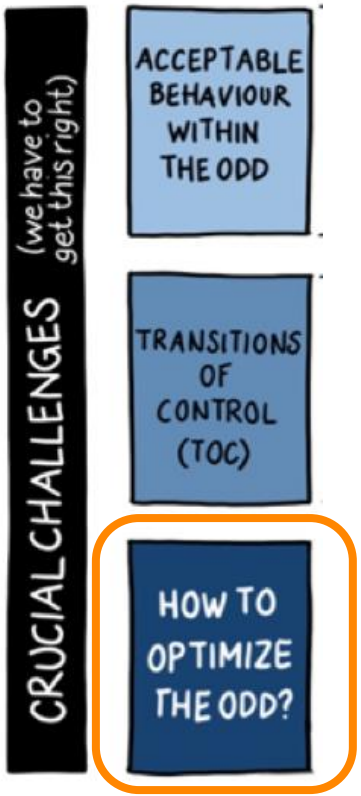
- ACCEPTABLE BEHAVIOUR WITHIN THE ODD
- TRANSITIONS OF CONTROL (TOC)
- HOW TO OPTIMIZE THE ODD?



Breakout session AVS 2018



http://www.automatedvehiclessymposium.org/avs2018/program/2018breakouts/2018breakout34

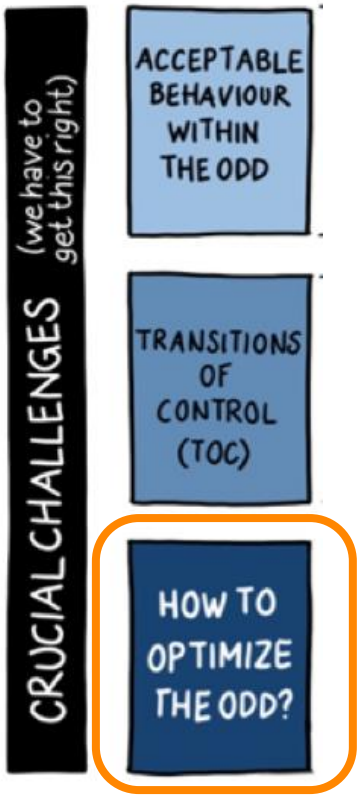


Physical and digital infrastructure

- Requirements
- Need to have vs nice to have
- Perspective
- How to optimize?

"I want to ensure our **infrastructure is ready for connected and automated driving**. I want to sit down with other road operators and the automotive and telecom sector. To discuss what infrastructure we'll need in order for the new generation of vehicles to deliver the greatest gains to society."

https://www.government.nl/documents/speeches/2018/03/26/speech-by-cora-van-nieuwenhuizen-minister-of-infrastructure-and-water-management-at-the-opening-of-intertraffic-amsterdam-20-march-2018



Joint workshop L3pilot / EU EIP 4.2

EU EIP
European ITS Platform

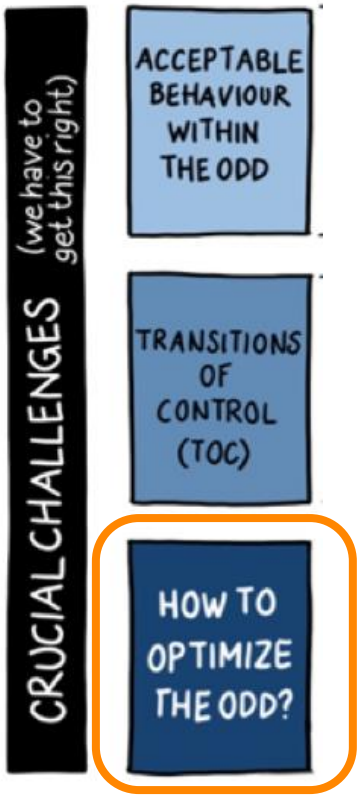
L3Pilot
Driving Automation

Joint (EU EIP 4.2 / L3Pilot) stakeholder workshop on

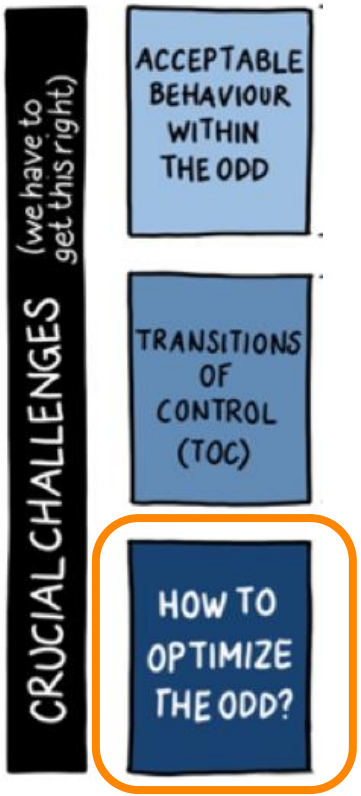
The impacts of automated driving, how to maximize the benefits

President Hotel, Athens, 25 October 2018 14.00 – 18.00

Crucial challenges

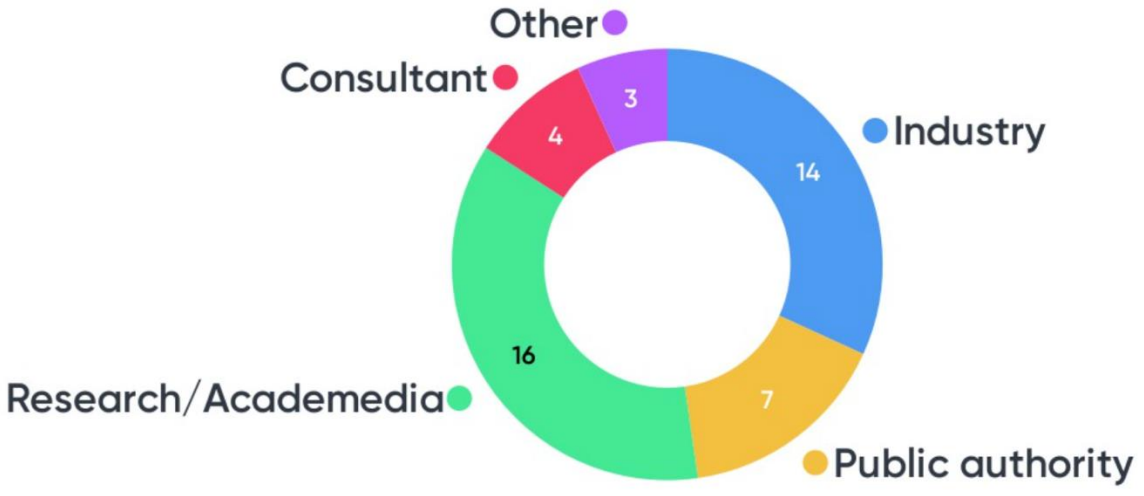


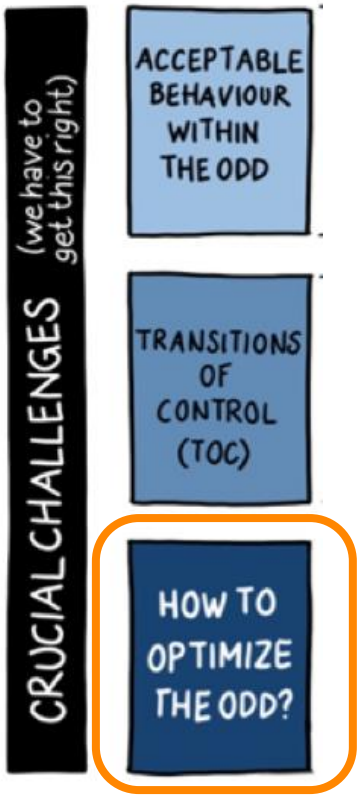
Joint workshop L3pilot / EU EIP 4.2



Joint workshop L3pilot / EU EIP 4.2

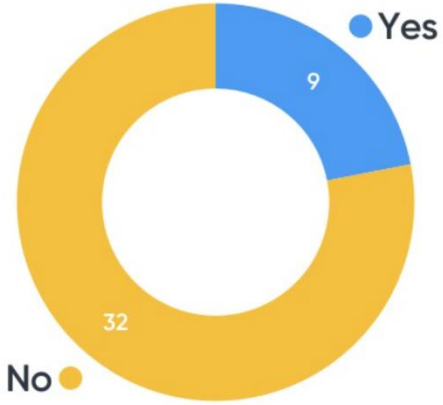
What kind of organisation do you represent?

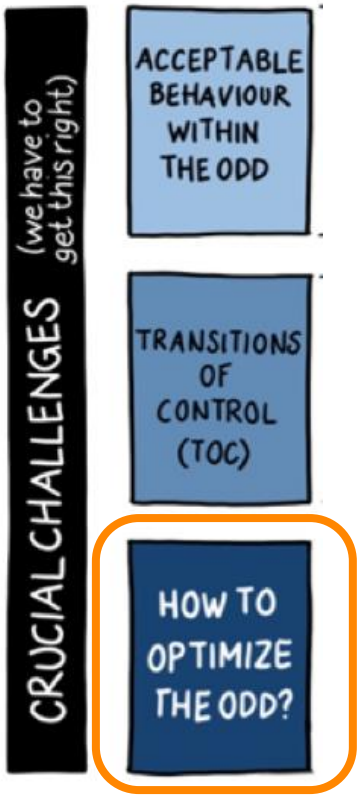




Joint workshop L3pilot / EU EIP 4.2

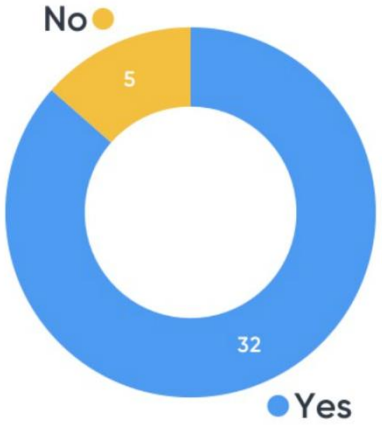
Can we reach a high level of automation without significant investments in infrastructure (physical and/or digital)?

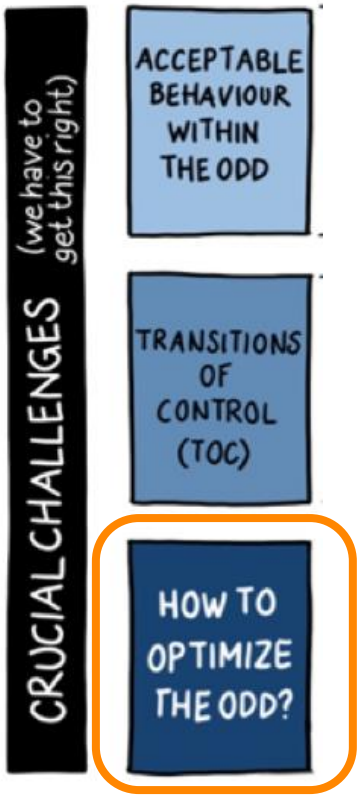




Joint workshop L3pilot / EU EIP 4.2

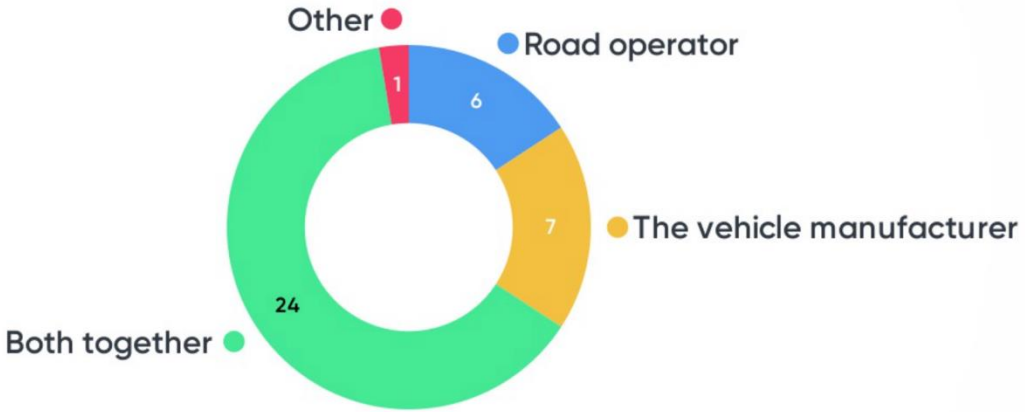
Connectivity is needed to improve the quality of automated driving?





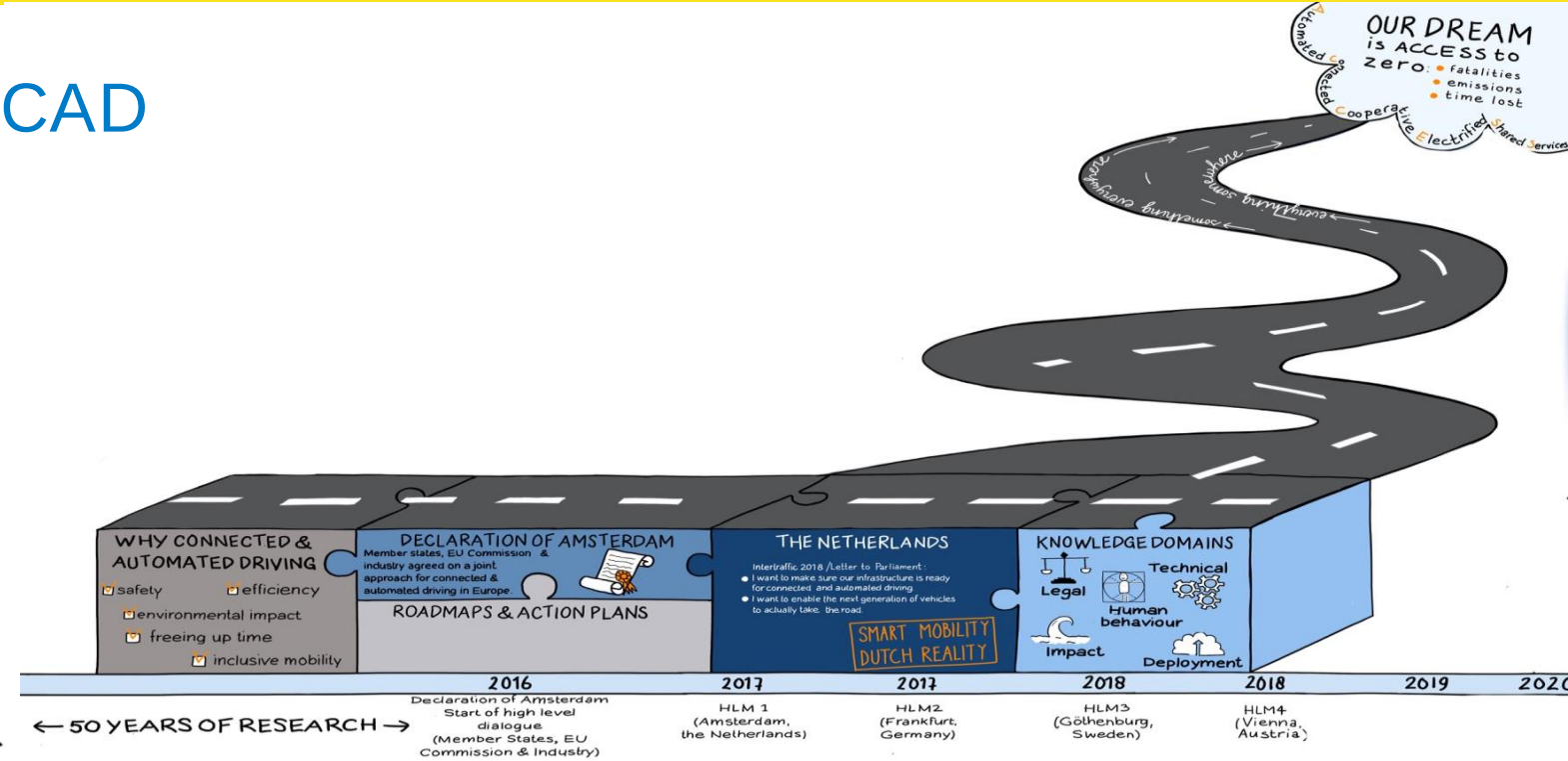
Joint workshop L3pilot / EU EIP 4.2

Who should decide whether a specific road section can be within the ODD for a specific AD use case?



Road to CAD


"Your car may be smart but Newton still applies"


OUR DREAM is ACCESS to zero: fatalities emissions time lost
Automated Connected Cooperative Electrified Shared Services
something everywhere
everything somewhere
WHY CONNECTED & AUTOMATED DRIVING
safety
efficiency
environmental impact
freeing up time
inclusive mobility
DECLARATION OF AMSTERDAM
Member states, EU Commission & industry agreed on a joint approach for connected & automated driving in Europe.
ROADMAPS & ACTION PLANS
THE NETHERLANDS
Interiraffic 2018 /Letter to Parliament:
I want to make sure our infrastructure is ready for connected and automated driving
I want to enable the next generation of vehicles to actually take the road.
SMART MOBILITY DUTCH REALITY
KNOWLEDGE DOMAINS
Legal
Technical
Human behaviour
Impact
Deployment
2016
Declaration of Amsterdam Start of high level dialogue (Member States, EU Commission & Industry)
2017
HLM 1 (Amsterdam, the Netherlands)
2017
HLM2 (Frankfurt, Germany)
2018
HLM3 (Göthenburg, Sweden)
2018
HLM4 (Vienna, Austria)
2019
2020
← 50 YEARS OF RESEARCH →

Rijkswaterstaat
Ministry of Infrastructure and Water Management

CONCRETE EXAMPLES AS INPUT FOR CONSTRUCTIVE DIALOGUE

SAE J3016 — limited ODD

Edge cases | Detection errors / mistakes | learning by doing | Traffic management | Temporary external issues | anticipate - react safe - swift

Automated Connected Cooperative Electrified Shared Services

OUR DREAM is ACCESS to zero:
- fatalities
- emissions
- time lost

CRUCIAL CHALLENGES (we have to get this right)

ACCEPTABLE BEHAVIOUR WITHIN THE ODD

Detection context appropriate behaviour

How to assess vehicle behaviour

Who determines (multiple perspective) ? ? ?

License to drive

Mixed traffic challenge

somewhere anywhere everywhere somewhere

TRANSITIONS OF CONTROL (TOC)

Will happen a lot

Needs to be safe & swift

Expected & unexpected ? ? ? ?

All stakeholders can impact the shape and size of the ODD, no one by himself can control it completely...

IN ORDER TO BRING CONNECTED & AUTOMATED DRIVING TO THE ROADS WE NEED BRAINS, BALLS AND BUCKS

HOW TO OPTIMIZE THE ODD?

Stakeholders and how to organise?

RWS — I&W — RDW — CBR

Service providers | Road Operators | OEM's | Road users | Public Authorities

THEORY | +INFRA | +TRAFFIC | +WEATHER | UTOPIA/ LEVELS

always & all conditions — first mile — highway — last mile — LIMITED ODD

WHY CONNECTED & AUTOMATED DRIVING

- safety
- efficiency
- environmental impact
- freeing up time
- inclusive mobility

DECLARATION OF AMSTERDAM

Member states, EU Commission & industry agreed on a joint approach for connected & automated driving in Europe.

ROADMAPS & ACTION PLANS

THE NETHERLANDS

Interlraffic 2018 /Letter to Parliament:
- I want to make sure our infrastructure is ready for connected and automated driving.
- I want to enable the next generation of vehicles to actually take the road.

SMART MOBILITY DUTCH REALITY

KNOWLEDGE DOMAINS

Legal | Technical | Human behaviour | Impact | Deployment

NOW

Peak of inflated expectations?
Trough of Disillusionment?

← 50 YEARS OF RESEARCH →

"Your car may be smart but Newton still applies"

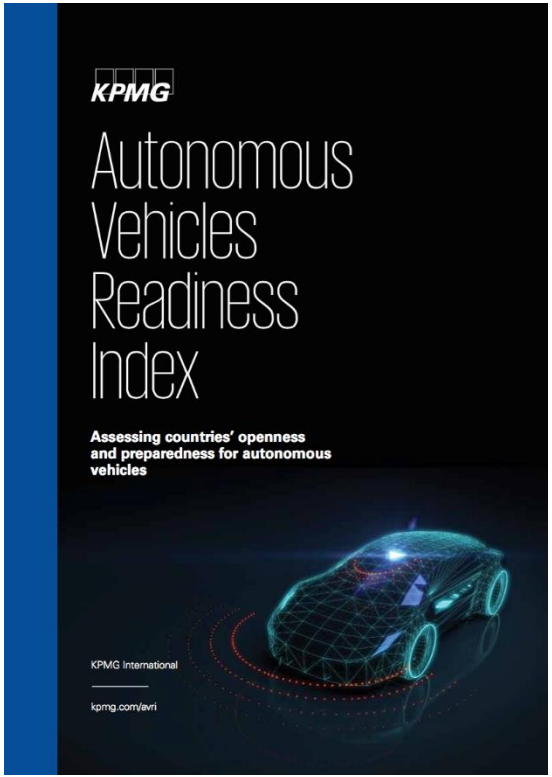
2016	2017	2017	2018	2018	2019	2020
Declaration of Amsterdam Start of high level dialogue (Member States, EU Commission & Industry)	HLM 1 (Amsterdam, the Netherlands)	HLM2 (Frankfurt, Germany)	HLM3 (Göthenburg, Sweden)	HLM4 (Vienna, Austria)		

DEPLOYMENT — city centre — rural road — highway — business park, campus, parking lot

SAFE, SWIFT & SUSTAINABLE TOWARDS CONNECTED & AUTOMATED DRIVING

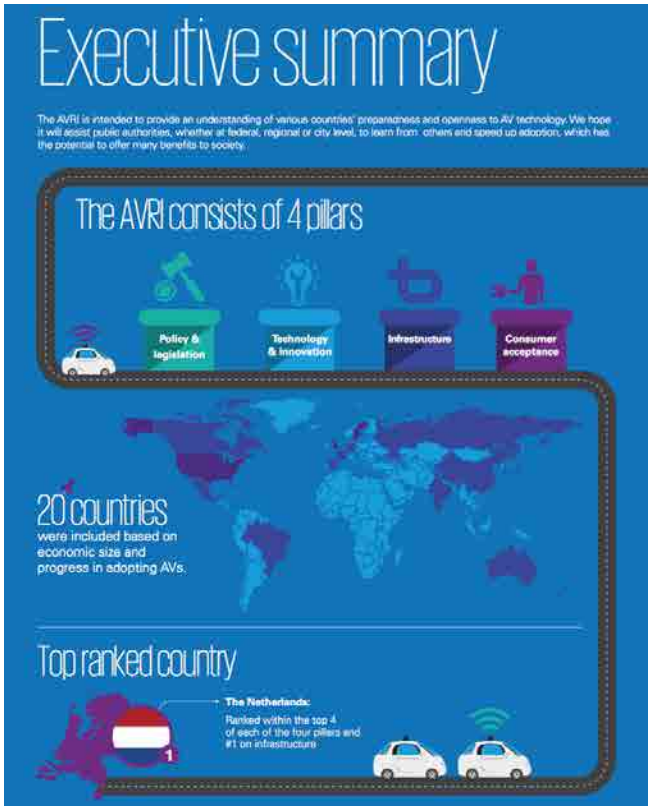
Tom Alkim 2018

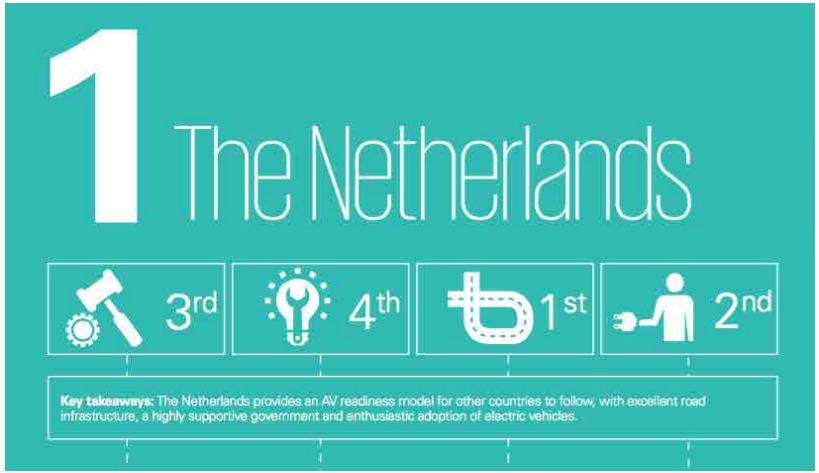
mindmatterz.nl



Overall rank	Country	Total score	Policy and legislation		Technology & innovation		Infrastructure		Consumer acceptance	
			Rank	Score	Rank	Score	Rank	Score	Rank	Score
1	The Netherlands	27.73	3	7.89	4	5.46	1	7.89	2	6.49
2	Singapore	26.08	1	8.49	8	4.26	2	6.72	1	6.63
3	United States	24.75	10	6.38	1	6.97	7	5.84	4	5.56
4	Sweden	24.73	8	6.83	2	6.44	6	6.04	6	5.41
5	United Kingdom	23.99	4	7.55	5	5.28	10	5.31	3	5.84
6	Germany	22.74	5	7.33	3	6.15	12	5.17	12	4.09
7	Canada	22.61	7	7.12	6	4.97	11	5.22	7	5.30
8	United Arab Emirates	20.89	6	7.26	14	2.71	5	6.12	8	4.79
9	New Zealand	20.75	2	7.92	12	3.26	16	4.14	5	5.43
10	South Korea	20.71	14	5.78	9	4.24	4	6.32	11	4.38
11	Japan	20.28	12	5.93	7	4.79	3	6.55	16	3.01
12	Austria	20.00	9	6.73	11	3.69	8	5.66	13	3.91
13	France	19.44	13	5.92	10	4.03	13	4.94	10	4.55
14	Australia	19.40	11	6.01	13	3.18	9	5.43	9	4.78
15	Spain	14.58	15	4.95	16	2.21	14	4.69	17	2.72
16	China	13.94	16	4.38	15	2.25	15	4.18	15	3.13
17	Brazil	7.17	20	0.93	18	0.86	19	1.89	14	3.49
18	Russia	7.09	17	2.58	20	0.52	20	1.64	18	2.35
19	Mexico	6.51	19	1.16	17	1.01	17	2.34	19	2.00
20	India	6.14	18	1.41	19	0.54	18	2.28	20	1.91

https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2018/01/avri.pdf





"The Dutch ecosystem for AVs is ready. The intensively-used Dutch roads are very well developed and maintained and other indicators like telecoms infrastructure are also very strong. In addition, the Dutch government Ministry of Infrastructure has opened the public roads to large-scale tests with self-driving passenger cars and lorries."

— Stijn de Groen,
Manager, Digital Advisory
KPMG in the Netherlands

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ITS Europe in the Netherlands
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