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What if technology takes over all driving tasks?

Software Driving License

Gerben Feddes **RDW** & Jorrit Kuipers **robot**TUNER

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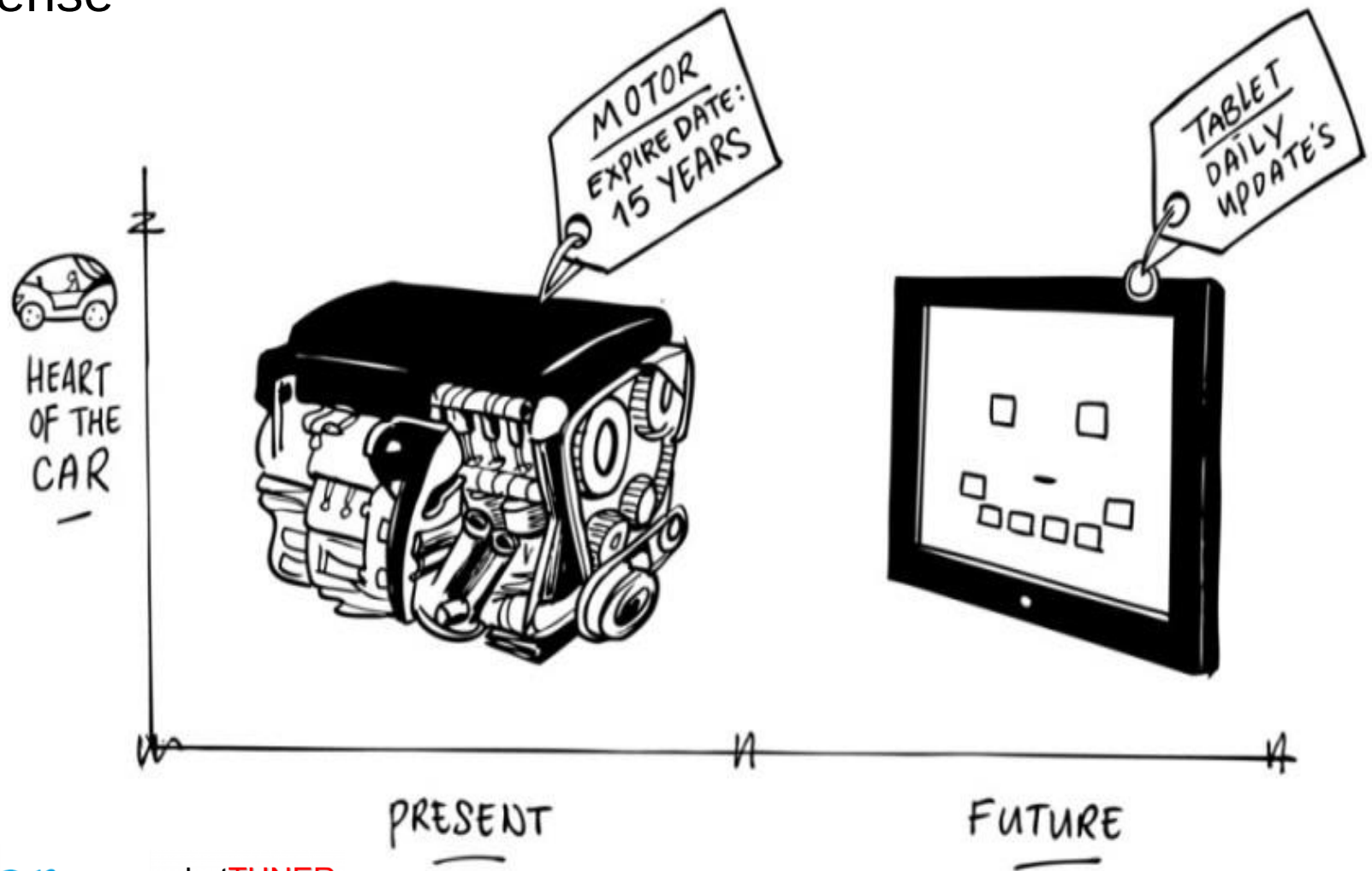
Agenda

1. Software Driving License
2. ISO proposal
3. Next steps



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1. Software Driving License

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Software Driving License

Cora van Nieuwenhuizen, minister of Infrastructure and Water Management at the **Intertraffic 2018 Amsterdam**:

“I’m going to create legal framework for automated driving. Laying down requirements for reliability and safety that cars must meet before they can hit the road. A driving license for self-driving cars, if you like. Not for the driver – but for the car itself!”

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Software Driving License

The Dutch Vehicle Authority **RDW** and the Dutch Driver Exam Authority **CBR** are challenged to develop a driving license for Artificial Intelligent drivers = software.

RDW and CBR invited **robot**TUNER to support them with expertise related to automated assessment of driving behaviour and AI.

RDW, CBR and robotTUNER initiated the ‘Digital Driving License Project’. A collaboration of stakeholders who want to attribute to an international standard for licensing of intelligent vehicle operating systems.

Digital Driving License Project → Software Driving License

Goal of this presentation is to share our ideas and motivate you to join the Digital Driving License Project.

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car. But where would the knowledge come from to drive that car safely? We believe it should come from the same people who devise and administer driving tests for humans. We're suggesting that maybe there should be a driver's license for cars."

Constant change

Feddes also says the evolving nature of software will necessitate radical reform of homologation procedures. "With software being constantly updated, a car is an ever-changing vehicle and there is no point in one-off admittance – you need to apply performance-based requirements," he says. "A car has to perform in a certain way and it's up to the manufacturer to produce acceptable means of compliance. We've learned from aviation and drone legislation – we're moving away from the how and beginning to focus on the what."

Another issue to settle is who is liable if an accident does happen. Where decisions leading to a crash are made by a machine, can some of the blame be laid at the manufacturer's door? With regard to its current, partially automated systems, Mercedes-Benz says "no". The company issued a statement in April 2016, as part of the Daimler Sustainability Report, which puts the onus on the consumer: "The legal situation in Germany and many other countries is clear: with regard to current, partially automated systems, the driver remains responsible. Although systems such as Lane Keeping Assist in the new E-Class provide support, the driver must still control the vehicle." However, the report did concede that "manufacturers are responsible for damages from product defects".

proving ground in Michigan, USA

[Left] Ford has also started testing its technology in snowy conditions

"WITH SOFTWARE BEING CONSTANTLY UPDATED, A CAR IS AN EVER-CHANGING VEHICLE AND THERE IS NO POINT IN ONE-OFF ADMITTANCE"

Gerben Feddes, *senior advisor for intelligent mobility at the Netherlands' vehicle authority, RDW*

reject semi-autonomous features think the technology won't live up to their driving skills; **60%** think the technology is too new; **57%** don't want to pay for it; **50%** know too little about it; and **45%** find it annoying

23% of female drivers and **12%** of male drivers rejected the technology, at least partly for being too complicated to use

*Data from an American Automobile Association survey of 1,800 US drivers, published in March 2016

Vehicle

Software

Software

Hardware

NEW ADDITION IN THE TYPE APPROVAL PROCESS

SOFTWARE AUTOMATED VEHICLES

Admittance

Virtual testing

Testtrack exam

Surveillance

Safe and predictable traffic behavior of automated systems

PROCESSES ARE SIDE BY SIDE

CURRENT SITUATION

Admittance

European Type Approval

Surveillance

- Manufacturer
- Vehicle
- Driver

Software Driving License

Assumptions

- For SAE level 4 and 5.
- Human drivers will be on the road for the coming years, so the autonomous vehicle has to act like a human.
- It’s about showing safe and predictable driving behavior related to human performance.
- Automated systems will have a stepped admission to public roads (SAE: Operational Design Domains).
- Driving simulators can speed up the assessment process.
- The safety assessment of automated driving skills should be a relative measurement. The human peer group sets the base-line.

Show Report Options

Explanation
Your Strength/Weekness Score is 6.5. **You are learning less fast than the average student.**
If you have not mastered the drivingtask (score les than 5.5) you should repeat the lesson. The score of the average student is 7.5.

Explanation of the used colors.	
	You did not perform this drivingtask yet.
	You are learning less fast than the average student. You should do the lesson again.
	You are learning just as fast as the average student.
	You are learning faster than the average student.

Strength/Weakness Report

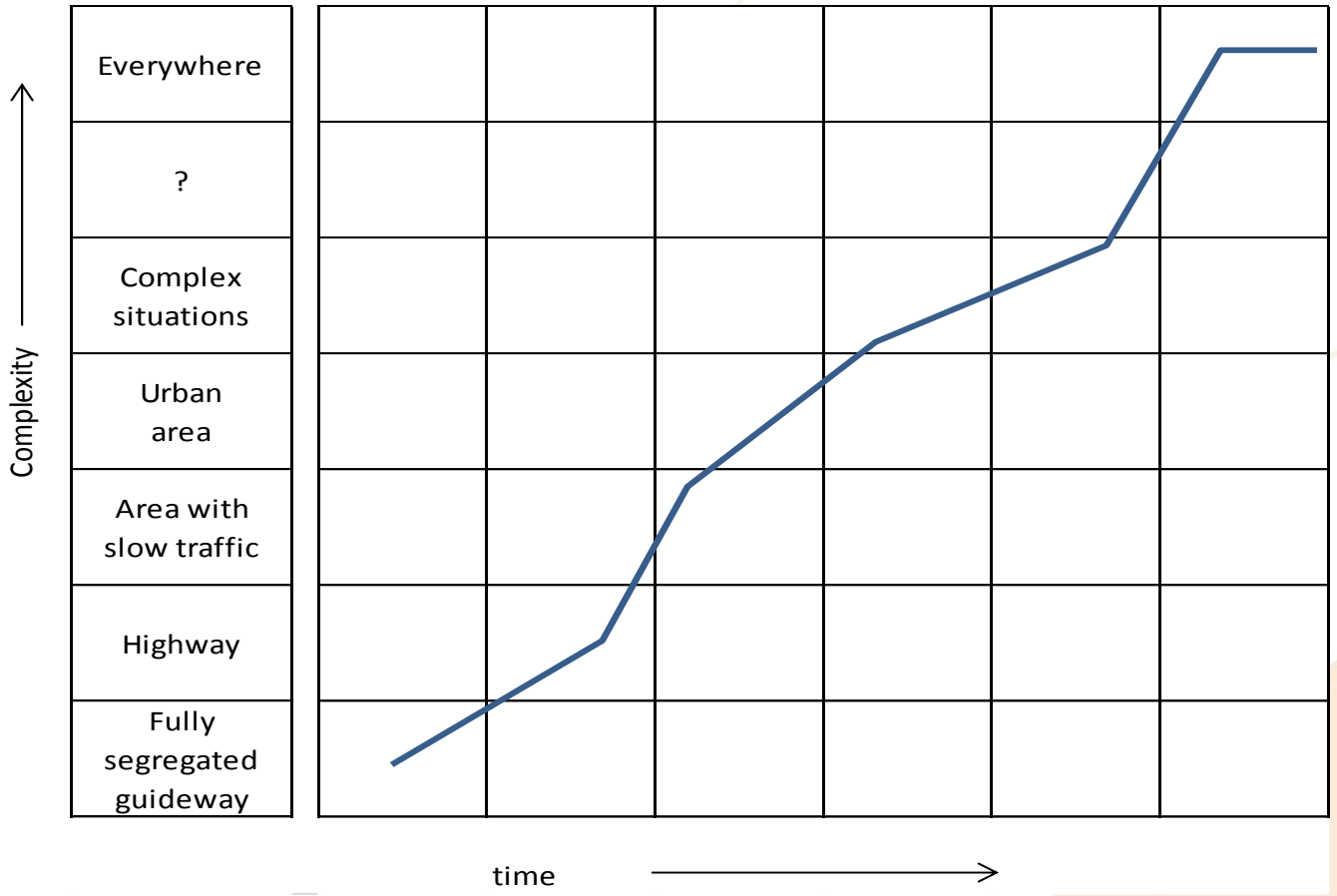
Click on the lesson date or score to view the lesson results.

Pauline van E		6.5	1 21 Jul 6.1	2 21 Jul 7.3	3 21 Jul 10.0	4 25 Jul 5.0	5 25 Jul 8.1	6 25 Jul 8.1	7 29 Jul 7.6	8 29 Jul 9.1	9 01 Aug 7.6	10 01 Aug 7.8	11 01 Aug 7.7	12 05 Aug 7.1	05
Vehicle control															
Taking a gentle bend *Too much steer*	21 / 23	7.8 3		2 / 3 4.0 1	3 / 3 10.0 2			2 / 2 10.0 3	6 / 7 5.4 3	6 / 7 7.4 3		1 / 1 10.0 3	1 / 1 10.0 3	1 / 1 10.0 3	1 / 1
Taking a normal bend *You approached the bend too fast*	35 / 37	7.0 3		2 / 2 10.0 1	1 / 1 10.0 1		2 / 2 10.0 2	6 / 7 1.6 3	11 / 11 10.0 3	13 / 14 6.1 3				1 / 1 10.0 3	1 / 1
Taking a right-angled bend *Too much steer*	64 / 79	7.1 3	0 / 2 1.0 1	7 / 8 8.9 3	7 / 7 10.0 3		15 / 22 3.9 3	13 / 16 10.0 3	13 / 17 4.3 3	13 / 14 10.0 3		1 / 1 10.0 3	1 / 1 10.0 3		1 / 1
Use of the accelerator															
Moving off *The engine has stalled or you did not anticipate in good time*	48 / 54	7.2 3	1 / 1 10.0 1	8 / 8 10.0 3		14 / 20 2.4 3	7 / 7 10.0 3	1 / 1 10.0 3	2 / 2 10.0 3	8 / 8 10.0 3	3 / 3 10.0 3	2 / 2 10.0 3	4 / 4 10.0 3	3 / 3 10.0 3	4 / 4
Change up a gear *You let the clutch come up too quickly*	14 / 19	2.5 1				14 / 19 2.5 1									
Change down a gear	3 / 3	10.0 1				3 / 3 10.0 1									
Use of the brake pedal	6 / 6	10.0 3					6 / 6 10.0 2								
Position within the lane *You drove too far right off centre*	454 / 475	8.9 3	6 / 6 10.0 2	42 / 47 5.6 3			87 / 99 6.4 3	50 / 55 9.1 3	88 / 90 10.0 3	124 / 125 10.0 3	14 / 14 10.0 3	29 / 29 10.0 3	29 / 29 10.0 3	14 / 15 3.4 3	19 / 19
Maintain safe distance from car in front	7 / 7	10.0 3							6 / 6 10.0 3	1 / 1 10.0 3					
Moving off after stopping away from traffic *The engine has stalled or you did not anticipate in good time*	3 / 10	1.0 1							3 / 10 1.0 1						
Park	4 / 4	10.0 2							4 / 4 10.0 2						
Keep to maximum speed *You drove too fast*	29 / 31	8.3 3		1 / 1 10.0 1						7 / 7 10.0 3	0 / 1 1.0 3	7 / 8 4.4 3	10 / 10 10.0 3		5 / 5
Crossings (basics)															
Go straight ahead an unmarked junction *No clear priority given to traffic coming from right*	33 / 35	8.1 3	6 / 6 10.0 3								14 / 14 10.0 3	9 / 9 10.0 3			10 / 12
Turn right at unmarked junction *You took the bend with the clutch depressed*	30 / 35	7.7 3	1 / 10 1.1 1								9 / 12 6.9 3	5 / 5 10.0 3		8 / 8 10.0 3	8 / 10
Turn left at unmarked junction *No clear priority given to oncoming traffic*	25 / 34	4.1 3	3 / 10 4.4 1								13 / 15 8.0 3	4 / 6 1.0 3			8 / 10
Turn left at junction with traffic lights	3 / 3	10.0 3		1 / 1 10.0 1								3 / 3 10.0 2			
Turn right at a junction with traffic lights *Wrong use of the indicator*	5 / 6	9.9 3		0 / 2 1.0 1								5 / 6 9.9 3			

Software Driving License

Stepped admission

Step by step related to traffic complexity.



2. ISO proposal

ISO proposal

RDW, CBR and robotTUNER initiated the ‘Software Driving License Project’. A collaboration of stakeholders who want to attribute to an international standard for licensing of intelligent vehicle operating systems.

An ISO standard will contribute to European regulation and speed up world wide commercial use of autonomous vehicles in public space.

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ISO proposal

Initial group

NVIDIA, AON Risk Solutions, Ricardo, HAN-Automotive Research, 2getthere, Roborace and initiators RDW, CBR and robotTUNER.

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ISO proposal

Draft proposal (ISO)

‘Safety of Intelligent Vehicle Operating Systems’ (SIVOS)

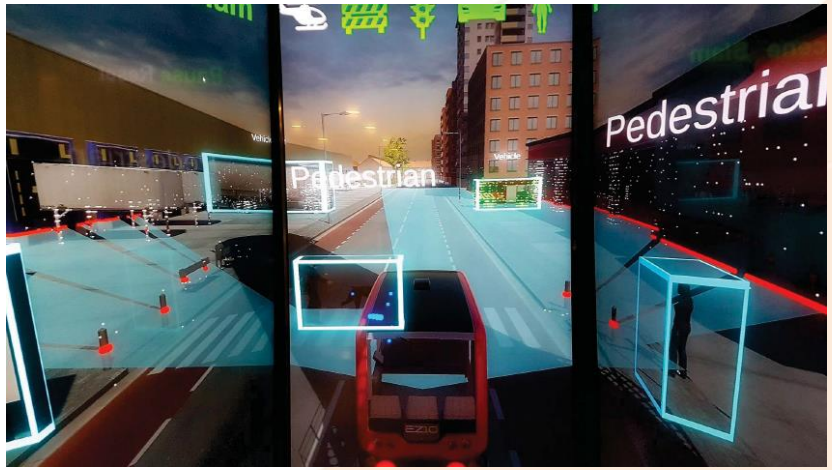
Proposed process of testing:

1 Virtual Environment	2 Scale Modelling	3 Proving Ground
4 Driving Exam	5 Driving License	6 In Use Compliance

ISO proposal

1Virtual environment

- From simulators used for training humans, we know the ‘average human driver’ performance in a broad set of ‘traffic situations’ (use cases, or Operational Design Domain).
- The AI-driver ‘competes’ in a virtual environment against this average human driver.
- Knowledge (theory) and skills are tested and related to human performances and risk profiles.
- The safety manager of a supplier can provide the evidence



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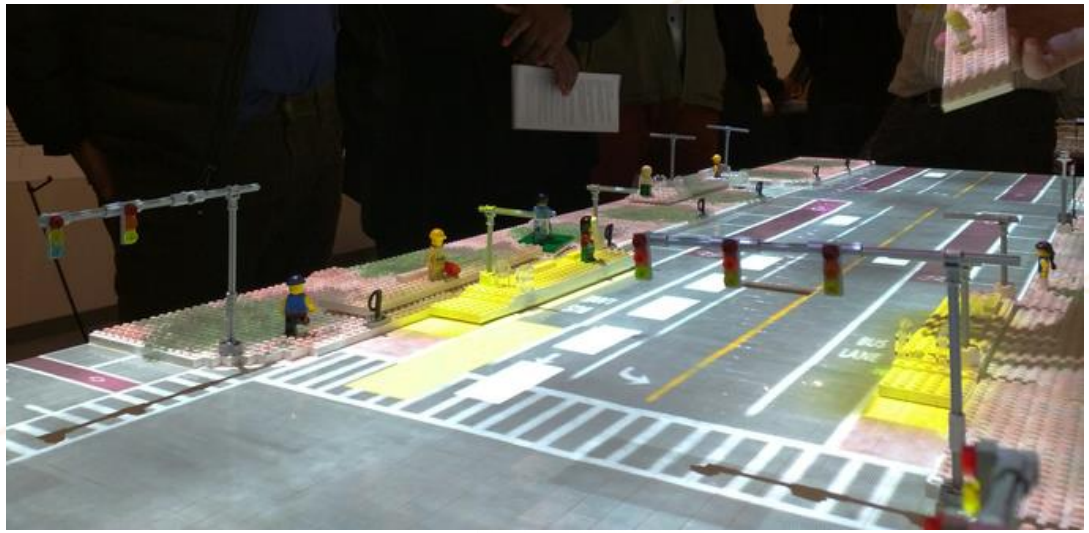
ISO proposal

2 Scale Modelling:

- The validity of simulation output is not proven yet. Scale modelling is a (traditional) cost effective method for live tests.
- The impact on the traffic system can be assessed using scale modelling and augmented reality. Stress testing (e.g. hacking) can show vulnerabilities.
- Standard hardware is used. Only the software is tested (sensor testing belongs to vehicle testing).
- Under supervision of RDW



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ISO proposal

3 Proving Ground

- To make sure the software and hardware are integrated well by the manufacturer, a real life test on a closed proving ground is performed for validation purposes.
- Happy flow tests and stress tests (aviation).
- Under supervision of RDW

ISO proposal

4 Driving Exam

- Just as for humans, the last step is a driving exam on public roads. In this exam (45 min- 1 hour) some situations from a predetermined list should be negotiated positively.
- Validation of safe interaction in complex traffic situations
- Under supervision of CBR

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ISO proposal

5 Driving License

- For the specific use cases / Operational Design Domain's, the AI-software obtains the driving license (ISO certificate) = stepped admission.
- The innovation strength / reliability of a manufacturer counts.
- RDW will give approval after licensing by CBR = compliance with the digital driving license methodology

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ISO proposal

6 In use compliance

- Given the ever-changing software, monitoring is needed when the vehicle is used on public roads. Unsafe software updates, hacking or malicious software would otherwise not be noticed.
- Traffic flow is monitored for detection of anomalies Abnormal behavior such as ignoring traffic rules or endangering other road users. Those vehicles that are detected as an anomaly need to be rechecked by auditors, or pulled of the roads if necessary.
- Software version shows the fitness of the software.
- Under supervision of RDW (software APK)

3. Next steps

Next steps

- ISO proposal ‘SIVOS’ now at NEN: Dutch National Standardization Organization.
- Approved by Technical Committee (NC 345042).
- Official proposal in preparation.
- Q2 2018: forming working groups.
- First stepped driving license in the Netherland in 2019.
- And hopefully: a new ISO standard in 2022!

NOTE: development of a new ISO standard is only possible with international support and resources!

Next steps

We start with pilot projects in the Netherlands. In these projects we develop and test the digital driving license methodology.

- 2018 Ommelander Hospital, NAVYA in cooperation with the Province of Groningen
- 2019 Rivium 2.0, 2getthere

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Gerben Feddes

RDW

RDW | Senior Advisor Intelligent Mobility | +31 (0)79 345 7826 | +31 (0)655 123 958
www.rdw.nl/ITS | gfeddes@rdw.nl | https://www.linkedin.com/in/gerbenfeddes/

Jorrit Kuipers

CEO **robot**TUNER
jorrit@robotTUNER.com
+31 (0) 653946943