Roads that Cars Can Read

Tackling the Transition to Automated Vehicles

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EuroRAP
EUROPEAN ROAD ASSESSMENT PROGRAMME

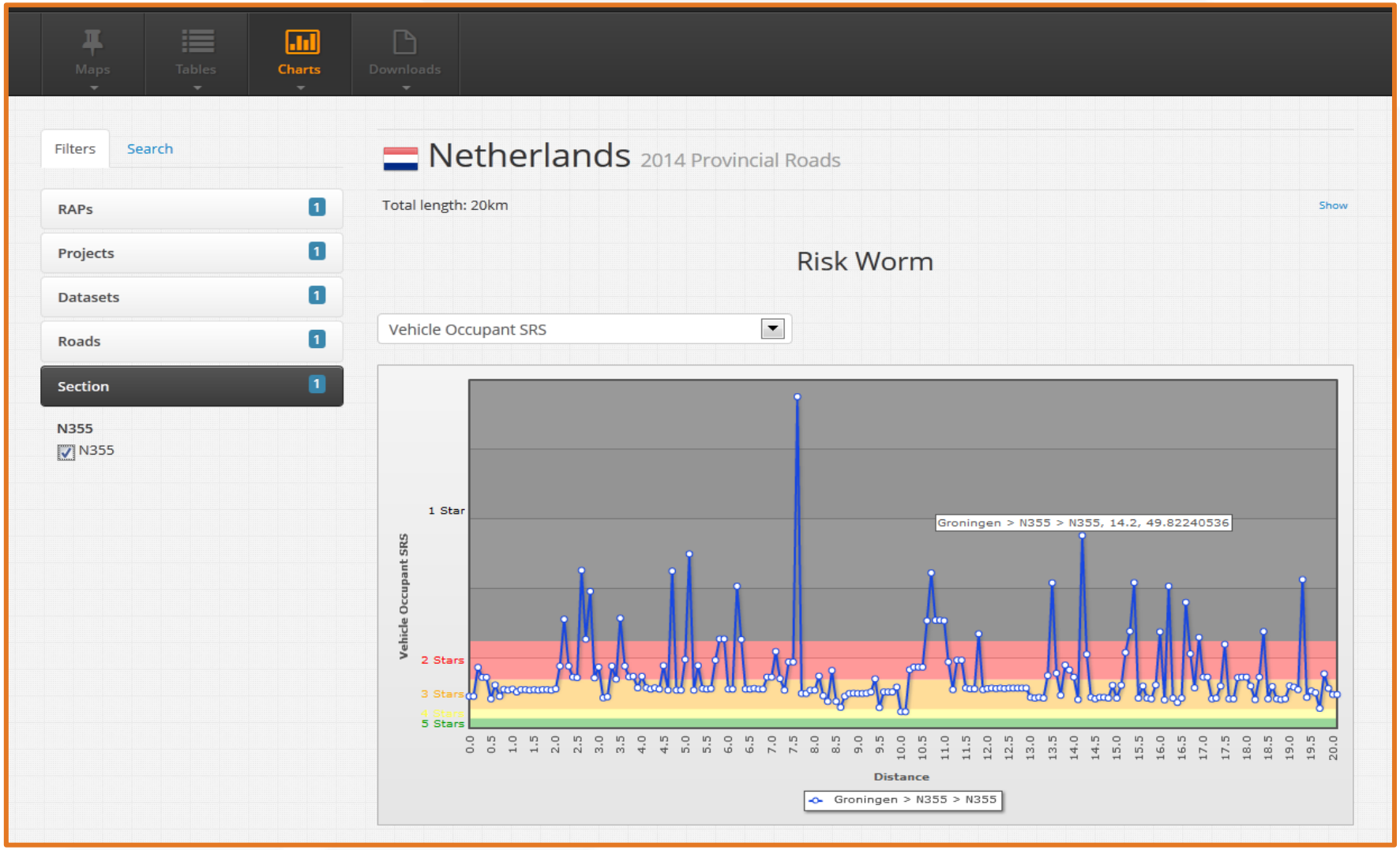
Improving Road Safety

- **Safe drivers**
- **Safe cars**
  - European New Car Assessment (EuroNCAP)
- **Safe roads**
  - European Road Assessment Programme (EuroRAP)

European Road Assessment Programme

EuroRAP
EUROPEAN ROAD ASSESSMENT PROGRAMME

ViDA Database



Automated driving

- **Role of human driver:**

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**

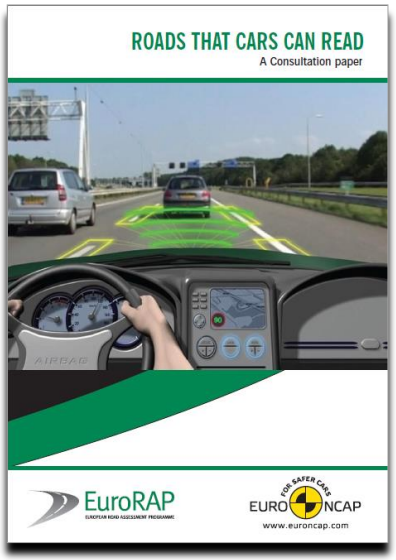
New risks likely to arise

- …when road maintenance is poor (e.g. poor line markings)
- …in autonomous perception of the traffic flow
- …when levels of total vehicle travel increase

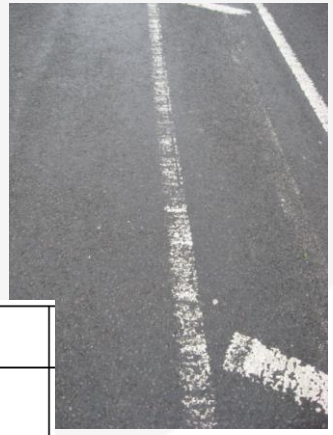
The transition to automated vehicles

- What do we **know now**?
- What **may change** in the transition?
- What are the **implications for infrastructure safety**?
- What are the **priorities**?

Roads that cars can read 2011,2013:



-- "signing and lining often poor and inconsistent"



ROAD SIGNS	Germany (D)	Great Britain (GB)	Greece (GR)	Netherlands (NL)	Poland (PL)	Serbia (SRB)
Slippery road						
Steep hill downwards (or upwards)						
Falling or fallen rocks	 Only for extraordinary situations			 In under plate description for danger type		

Road markings in SENSOR study (2013/14): **4,869** crossings, 14 countries in south-east Europe – **2,151 (44%)** described as **poor quality**

Pedestrian crossing is visible (just), but does “the system” know it is there?

Who said…?

"There are known knowns.

These are things we know that we know.

There are known unknowns.

That is to say, there are things that we know we don't know.

But there are also unknown unknowns.

There are things we don't know we don't know."

Donald Rumsfeld

“Collision partners” – today, **who hits whom, what and how**?

- Cars
- Roadside hazards
- Motorcycles
- Bicycles
- Pedestrians
- Other vehicles

“Known unknowns”: crash patterns

Collision partners	Conventional car	Autonomous car	Infrastructure (Roadside hazards)	Motorcycle	Bicycle	Pedestrian
Conventional car	✓	?	✓	✓	✓	✓
Autonomous car		?	?	?	?	?
Infrastructure (Roadside hazards)				✓	✓	✓
Motorcycle				✓	✓	✓
Bicycle					✓	✓
Pedestrian						✓

Which crashes will automated vehicles help to reduce?

- Shunts? Distance keeping, Autonomous Emergency Braking?
- Run-offs? Speed control, lane-keeping?
- Head-on? Speed control, lane-keeping?
- Vulnerable road-users? Pedestrian and bicycle detection?
- Intersections? Vehicle-vehicle detection?
- Other?

All of them?

Some more than others?

Simple crashes more than others?

How much may autonomous vehicles help to reduce crashes?

- Shunts?
- Run-offs?
- Head-on?
- Vulnerable road-users?
- Intersections?
- Other?

If reduction by around 60-80% ?

60-80% ?

40-60% ?

20-40% ?

20-40% ?

20-40% ?

A small amount?

A large amount?

Simple crashes more than others?

AV crashes – **very little evidence**

- **Virginia Tech Transportation Institute** (2016) – **11 autonomous vehicle crashes,** of which:

- **6 shunts**, vehicle held up and struck in rear,

plus

- 1 same direction changing lane
- 1 intersection
- 1 in intersection struck in rear
- 1 decelerating and same-direction side-swipe
- 1 changing lanes and struck in rear

The report – **many questions** and a **few answers**

- **Which crashes** will AVs reduce?
- **By how much**? – a first estimate

- **Will we still need** the infrastructure we have now?

- How might it affect **infrastructure investment**?

- **What else do we need to do** to help and understand the transition?

What is the **current picture** for major roads in Britain?

	Vulner-able Road Users	Inter-section	Run-off	Head-on	Shunt	Other	Total
Fatal and serious crashes 2013-15 on motorway and 'A' roads in Britain	5041	7008	4148	1703	1752	2488	22140

What might the future picture in Britain look like…?

Assuming **50% of travel** is by **autonomous or highly autonomous vehicle,** high-end range reductions apply + other assumptions

	Vulner-able Road Users	Inter-section	Run-off	Head-on	Shunt	Other	Total
Fatal and serious crashes 2013-15 on motorway and 'A' roads in Britain	5041	7008	4148	1703	1752	2488	22140
Fatal and serious crashes when there is 50% travel by autonomous vehicles	4033	5606	2489	1192	1051	1990	16362
Percentage reduction in overall crashes	20%	20%	40%	30%	40%	20%	26%

What's needed

Understanding of:

- Behavioural interactions of conventional and autonomous vehicles
- Conflicts and near-miss involving autonomous vehicles
- Effectiveness of crash countermeasures
- Assessment of changes in crash patterns

To do:

- Provide consistent signing and lining
- Keep existing crash countermeasures for conventional vehicles during the transition
- Continue to save lives with adding existing countermeasures

Recommendation

- “The transition to autonomous vehicles should be planned for now, but should not be a distraction from the life-saving work that can be done using conventional approaches to crash reduction”

Thank you

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2011-2020


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