Regulation issue

Many building blocks need to be put in place to enable autonomous cars to take to the roads safely with the public’s blessing.

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A
tonomous vehicles hold the
promise of eliminating crashes
caused by human error, but
they are still a long way from
full deployment. There are currently no
vehicle regulations specifically aimed at
autonomous systems. Homologation
bodies are now working with OEMs
and governments on the first umbrella
legislation covering both autonomous
and non-autonomous vehicles.

"There are two stages to achieving
a common framework," says Alain
Piperno, an autonomous vehicle expert
and testing and homologation project
manager at French test lab Utac Ceram.
"By the end of 2017 we are likely to see
regulations for the first autonomous
vehicles, but only for highway use. Six
or seven tests are at an advanced stage
of development for this first draft of
regulation. They include minimum risk
maneuvers for when a vehicle gets into
difficulty because of an internal fault
or problems with the road surface."
Utac Ceram plans to open new
testing tracks for autonomous vehicles
in 2017, and to propose 30-40 tests for
critical autonomous driving scenarios.

Virtual assistance
At higher levels of automation, where
complicated driving situations will be
handled by a machine, testing will have
to take into account a huge range of
environmental conditions, driving
abilities and emergency situations – a
workload unlikely to be managed by
testing alone. "Virtual testing will
be key to the infinite number of
possible driving scenarios," says Arno
Eichberger, associate professor for
autonomous systems engineering at Graz
University of Technology in Austria.
"Stochastic scenario generation and
intelligent algorithms will create new
scenarios based on failed test cases.
However, verification on human-in
the-loop and vehicle-in-the-loop test
benches, as well as on-road testing,
will still be necessary."

Sensors and V2X
Arno Eichberger of
Graz University of
Technology in Austria
argues that a combination
of sensors will be needed to build
a robust 360° picture of the
environment around the car,
while V2X will be needed to
anticipate dangers further
ahead. "Each type of sensor has
its own strengths, and so we
need to combine data from them
all," he says. "Long-range
information, provided by V2X,
can enable the car to reduce its
speed ahead of danger areas,
for example.
Is standardization needed for
sensor hardware? "I would not
recommend prescribing certain
standards for sensors, but
rather focus on standardization
of the data that autonomous
vehicles will share with
infrastructure," says Eichberger.
"Sensors have to be good
enough to enable autonomous
driving, but OEMs should be
free to specify their performance
with component suppliers."
Gunwant Dhadyalla, principal
engineer at the University of
Warwick’s manufacturing group,
WMG, foresees delays for the
integration of V2X. "Companies
looking for low-speed
applications in autonomous
vehicles are quite happy not to
have connectivity yet," he says.

"The industry is still risk-averse – it’s looking for an independent
autonomous car that doesn’t have the added issue of
cybersecurity. But in the long term I don’t see how it can be
avoided. We will want vehicles to be able to talk to each other
and be aware of different situations, to enhance their capabilities.
This is critical when you’re dealing with a whole fleet of
autonomous vehicles."
Gerben Feddes, senior advisor for intelligent mobility at the Netherlands’ vehicle authority, RDW, wants to take testing even further. “In the future, a piece of software might legally be the driver of a production car, making the human driver a passenger in their own 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”.

**“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*

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75% of US drivers would be afraid to travel in autonomous cars

61% want AEB, ACC, parking assist or lane-keeping assist in their next car – 84% citing safety as their main reason; 64% citing convenience; 46% wanting to reduce stress; and 30% wanting the latest technology

84% of those who 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

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

An academic department of the University of Warwick, WMG sees itself as a bridge between research and industry. More than 500 people work on the WMG campus, as well as at collaborative centers located in seven countries.

The department has developed the 3xD (drive-in, driver-in-the-loop, driving) simulator to allow repeatable, scientific study of connected and autonomous vehicles. It is housed in a shielded room, enabling control over all wireless signals that communicate with the vehicle. Features include vehicle-agnostic adaptive systems, infotainment and communications simulation, eye-tracking technology and remote-sensing technologies. Vehicles can be ‘driven’ on a 30-mile route, based on data captured through lidar scanning.

It remains to be seen who will be liable at higher levels of automation, with machines making most or all critical decisions. Volvo is looking into accepting full liability for collisions involving its autonomous vehicles.

“Discussions are underway in Europe and at the ISO on an aviation-style black box data recorder that could help determine who was in control during an accident – the driver or the vehicle,” says Utac Ceram’s Piperno.

Will there also need to be standards relating to HMI? What would be an acceptable driving mode handover period? In a 2015 simulator study by Mok et al at Stanford University, Emergency, automation off: Unstructured transition timing for distracted drivers of automated vehicles, most drivers tested were able to navigate through a road hazard when they were warned five seconds before entering it. However, a 2014 study, Transition to manual: Driver behavior when resuming control from a highly automated vehicle by Merat et al, indicated that it might take up to 40 seconds for participants to stabilize the vehicle after an alert.

Moral compass

In developing software for autonomous vehicles, there are also ethical questions to be addressed. Filippo Santoni de Sio is a taskforce member for ethics and robotics at the 3TU Centre for Ethics and Technology, run by the universities of Delft, Eindhoven and Twente in the Netherlands. He references a thought experiment by Patrick Lin, asking if the autonomous vehicle is faced with the stark choice of having to hit one of two pedestrians, a pensioner or a child, which should the vehicle select?

Santoni de Sio says there are four possible approaches to the problem. He rejects the first two, of leaving the decision to the programmers or the driver. “A third option would be a public debate, involving all stakeholders – from politicians to car makers and consumers – to arrive at a solution that might be right or wrong but shares the responsibility,” he says. “Option four is to program the car to choose randomly, as if flipping a coin, effectively meaning nobody is responsible.”

Santoni de Sio urges the industry to consider ethics before it is forced to. “If you look at the history of technology and legislation, the most realistic scenario is that an accident will happen before we have reached a consensus and society will decide afterward how to cope,” he says. “I would prefer a public debate in advance, and to reach a shared decision with consumers, developers and policy makers.”

Gunwant Dhadyalla, Arno Eichberger, Gerben Feddes and Alain Piperno are confirmed speakers at the Autonomous Vehicle Test & Development Symposium 2016, to be held in Stuttgart, Germany, from May 31 to June 2. Two sister events are also being launched this year: The Autonomous Vehicle Safety Regulation World Congress 2016 and the Autonomous Vehicle Interior Design & Technology Symposium 2016 will be held in Novi, Michigan, USA, on October 25-26.