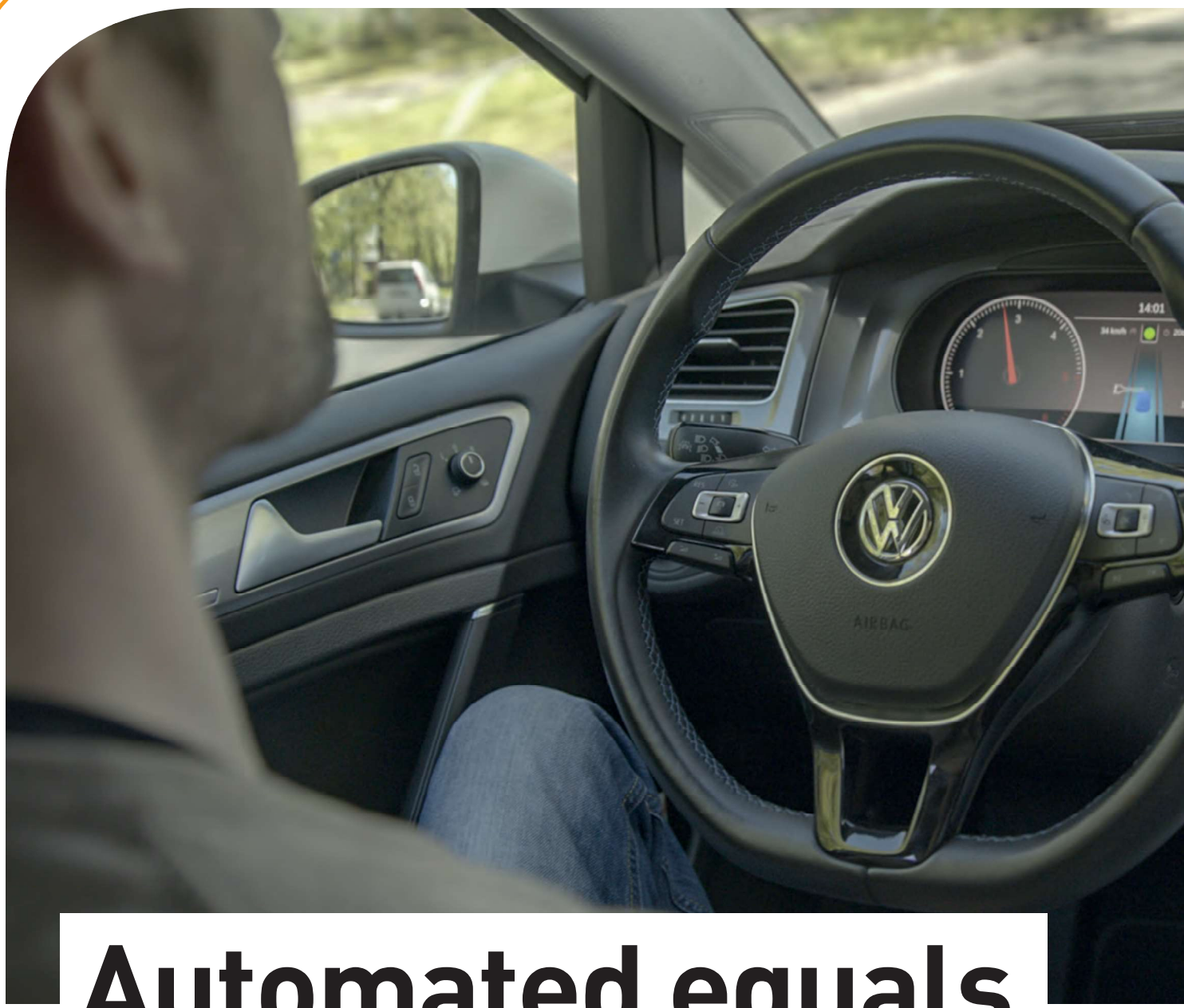

Automated equals good... doesn't it?

A comprehensive look at MAVEN, a 3.1 billion project that was launched in September 2016 under the Horizon 2020 Research and Innovation Framework Programme of the European Commission, and the challenges and perspectives of automation in an urban environment, by **Alessia Giorgiutti**, **Jaap Vreeswijk**, **Ondrej Pribyl** and **Klaas Rozema**

WHAT DOES LEVEL 4 MEAN?

In 2014 and with an update in 2018, SAE International (the automotive standardization body) developed a harmonized classification system known as J3016: Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems. Within this frame, SAE outlined six levels of driving automation from "no automation" to "full automation".

According to J3016, driverless automated cars are defined as Level 5 cars, which is the top level in the SAE automated scale. On all roadways and under all environmental conditions, the performance of these automated driving systems does not require human intervention whatsoever. As of Level 4 cars, no driver attention is required, and self-driving is supported in limited areas or under special circumstances.

A critical question is whether automated vehicles will increase or reduce total vehicle travel and associated external costs

Automated driving developments are experiencing a boom. They are driven by advances in technology, but also have a strong link with the Smart Cities agenda, where automated vehicles, the shared economy and electromobility will play an essential role. With this perspective, governments recognise the potential benefits of automated vehicle technologies but also see threats - researchers have recently become more skeptical and often refer back to them as "wishful thinking", while industry has scaled down its roadmaps to a perhaps more realistic proportion.

Governments are particularly attracted to the objectives of improving road safety while decreasing casualties, reducing congestion and supporting more affordable and efficient mobility services and infrastructures. However, these results would require new business models, different urban land uses and innovative regulations to be implemented and, furthermore, even after being reached, they would not be a guarantee of an overall positive impact of AVs.

In this frame, a critical question is whether automated vehicles will increase or reduce total vehicle travel and associated external costs. Depending on public policies, it could go either way: by increasing travel convenience and comfort, and allowing vehicle travel by non-drivers, they could increase total vehicle mileage, but they may also facilitate vehicle sharing, which will allow households to reduce vehicle ownership and therefore total driving.

TECHNICAL AND HUMAN CHALLENGES OF AUTOMATION

There are various challenging technological factors related to automation, such as the relative slow progress of the engineering, and the limited scale and high-cost production. These quantitative, tech-challenges, however, do also mirror qualitative ones: factors like the predictability of behavioural intent and the concept of trust towards automated vehicles exemplify the more human side of automation.

As of now, self-driving cars have still issues in determining the intentions of pedestrians and cyclists, especially on urban roads, where multiple functions (flow, parking, drop off/collection) and transport modes are accommodated. Therefore, it is very important for automated vehicles to refer to programmed models of behaviour and updated maps within their (driving) algorithms. On the other hand, the

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ABLE-ALLOW-ACCEPTED

So what can authorities do to facilitate, anticipate and/or regulate automated driving? The priority for authorities might be derived from three success criteria thart can characterise the introduction and deployment of automated driving: Able, Allow and Accepted.

Able refers to the capabilities of the vehicle given the road type, certain traffic and situational conditions, and includes the state of and functionalities provided by physical and digital infrastructure. Allow concerns regulation that prescribes where and what level of automated driving is allowed. Finally, Accepted is about adoption and usage of automated driving by citizens, vehicle drivers and other road users.

Although all three A's are relevant and necessary on their ow, they are also strongly related. For example, a system that is not or insufficiently Able or Allowed will not be Accepted. Moreover, a system that is Able but not Allowed or Allowed but not Able, will probably never go in production for usage on public roads.

technology must be accepted and trusted by society.

The matter of trust, which is a human concept, could be overcome through a process of trials and errors where vehicles with varying degrees of automation are tested physically, either in closed environments, on public roads, or virtually. The matter related to technologies of automation, instead, should be supported by, for example, a bold advance in the development of Invisible-to-Visible interaction (I2V) for automated driving.

I2V AND MAVEN

By combining information from sensors outside and inside the vehicle with data from the cloud, I2V would be an enabler to allow automated cars to "see where eyes can't see", around the corner and farther down the road. MAVEN (Managing Automated Vehicles Enhances Network), a 3.1 billion project that was launched in September 2016 under the Horizon 2020 Research and Innovation Framework Programme of the European Commission, is aiming to develop I2V interaction concepts for automated driving.

MAVEN specifically aims to provide solutions for managing automated vehicles in an urban environment, focusing on the transition stage where there is a mix of non-automated, automated and/or connected vehicles in the network. The core of the project is to manage automated vehicles at signalized urban intersections and corridors with a combination of technologies focused on Level 4 highly automated vehicles.

Dynamic vehicle platooning, infrastructure systems for adaptive traffic light optimisation and negotiation algorithms and scheduling programs would contribute to increasing traffic and energy efficiency, improving utilization of infrastructure capacity, and preventing or mitigating dangerous situations involving pedestrians and/or cyclists.

Hyundai automated car during a test

DO PEOPLE NEED AUTOMATED VEHICLES?

MAVEN, however, is not "just technology". It also tries to solve the above-mentioned citizens' "matter of trust" in relation to automated vehicles. Indeed, to gain a general understanding about citizen's perception and expectations with respect to the automation on roads, MAVEN surveyed 209 respondents from over 30 countries. The responses were reassuring, as they clearly indicated high expectations with respect to the benefits of automated vehicles.

Most respondents (about 75%) are shown to expect improved road safety, about half of them expect better prediction of traffic flows and one third travel time savings. It is then interesting to notice that respondents also affirmed they would spend their time in an automated vehicle working on tablet or smartphone, followed by reading a book or sleeping.

The most important obstacles on the road to automated vehicles have been identified as well: cybersecurity/privacy concerns and the lack of a regulatory framework are still a restraint to trust Connected Automated Vehicles (CAVs). Taking into account the actual state of technology or legislation, people responded also to the question when they believe that 10% of all traffic will be automated. The results can be seen in Figure 1.

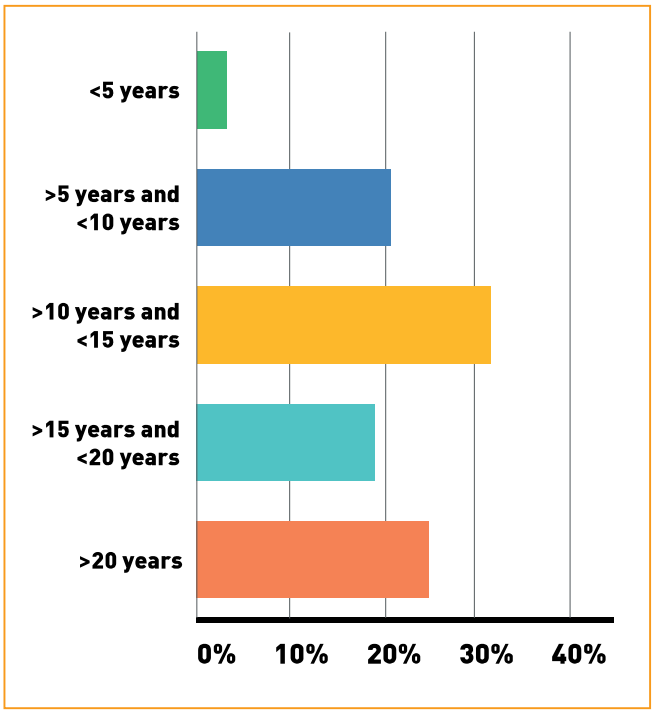


Figure 1: When do people think that 10% of all traffic in cities will be automated? **Only 3% of respondents expect that it will happen in the next five years, 32% respondents within 10 to 15 years. An interesting fact is that 25% of respondents expect it for more than 20 years. The survey also confirmed, that the actual benefits of automated driving depend on the overall city policies focusing not only on automated vehicles, but also, for example, shared economy and electromobility. More detailed analysis will be available in the public deliverables of the MAVEN project.**

ROADMAP FOR FUTURE TRAFFIC MANAGEMENT SYSTEMS

Not just from citizens' perspectives, but also from that of road authorities, the transition path to a cooperative, connected and automated world still looks uncertain. Inevitably, conventional, Cooperative Intelligent Transport Systems (C-ITS), automation equipped vehicles and roadside equipment will co-exist for some time. Vehicles will also co-exist with other types of non-motorised road users, such as manually driven vehicles, pedestrians and cyclists.

Within this frame, the MAVEN project developed a roadmap for the introduction of road transport automation to assist local road authorities in understanding potential future changes in their role and in the tasks of traffic management at various phases of the transition. Moreover, it identifies all the steps to be taken by policy makers, road-authorities, and stakeholders on the route to a high penetration of highly or fully infrastructure-supported automated vehicles.

The roadmap not only considers political, institutional and organisational aspects, but also focuses on priorities related to the safety and comfort of special category road users such as public transport vehicles, vulnerable road users, logistics vehicles, and emergency vehicles.

HOW TO MAKE IT WORK

In order to achieve positive effects from automated vehicles, municipalities must actively develop ways to make best and most sustainable use of available transport modes, discourage urban sprawl, and if possible limit the amount of individual car driving that people can do using some form of incentives. Given the diversity of cities across Europe, it is essential to also consider different approaches towards facilitating and regulating automated driving.

Not everything can immediately be solved with technology. For example, artificial intelligence is struggling to make sense of traffic management plans given their diversity and cultural specificity.

"In terms of infrastructure, many cities have not yet expressed support for investing in traffic management systems to facilitate automated driving"

Although it has been suggested that communication between the traffic management system and vehicle could help to bridge this gap, cities believe that the traffic manager will still be needed, even though automated vehicles may increasingly manage themselves as a system.

In terms of infrastructure, many cities have not yet expressed support for investing in traffic management systems to facilitate automated driving. Other cities, especially the ones implementing Smart City strategies, are putting into place new sensors, digital infrastructures and other technologies, which could provide some of the building blocks for automated vehicles in the future.

NEXT STEPS

MAVEN will host a demonstration on the roads alongside a workshop on urban traffic management and automation on 6 June 2019 at the Helmond Automotive Campus during the ITS European Congress in Brainport Eindhoven, the Netherlands.

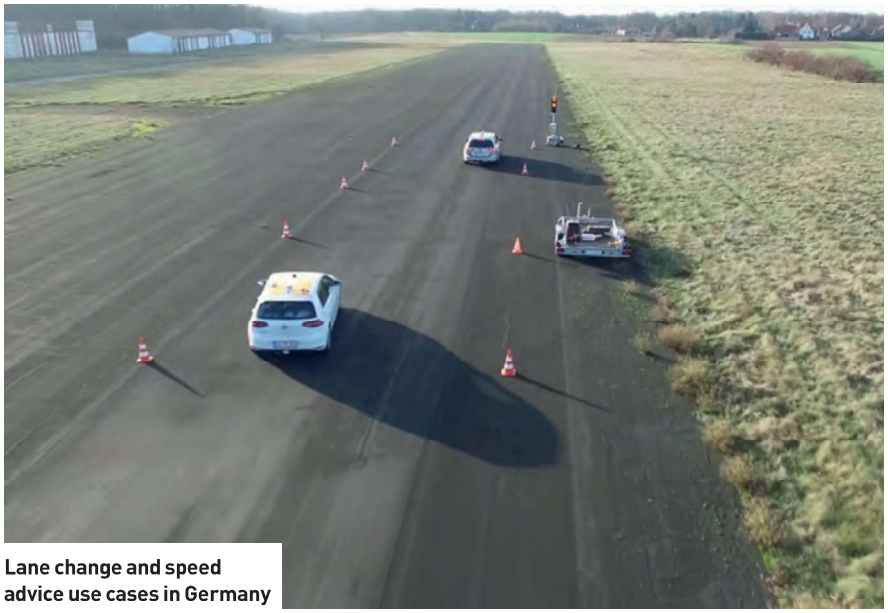
During the closed-circuit demonstration, delegates will be invited to take a tour in the automated vehicle to witness its responses to requests from the traffic light controller to change lane and/or speed. It will also be possible to see how the intersection controller will respond to information about the trajectory of the vehicle, causing it to change the traffic light sequence.

After the tour, delegates will be invited to the roadside display demo where the two aspects will be further highlighted: traffic controller's requests and responses to the vehicle will be visible on a dashboard and vehicle's responses will be observed through a live videostream of the traffic on the road.

The workshop will provide an opportunity to discuss the role of the urban traffic manager in a future with increasing levels and penetration of automated vehicles. This discussion has been conducted primarily within the three MAVEN stakeholder workshops that took place between 2016 and 2018. Moreover, two key project deliverables will be available at the event: 'Transition Roadmap' and 'White paper - Management of automated vehicles in a smart city environment'.

For more information on the event visit: www.polisnetwork.eu/publicevents/623/61/Urban-traffic-management-and-vehicle-automation

A simulation environment tested within MAVEN



Lane change and speed advice use cases in Germany

FYI

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