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White Paper

Making driving as safe as flying in an autonomous world

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Introduction

We are on the cusp of a truly revolutionary transformation in transportation. If the UK government's vision becomes a reality, we will see the introduction of autonomous vehicles on UK roads within the next three years, changing the ways in which people, goods and services move from A to B for good.

The public, however, is uneasy about this prospect of driverless cars on UK roads in 2021. Our recent research reveals that just 16% of the UK public would feel safe riding in a self-driving car. In comparison, 65% say they feel safe when flying on-board an aeroplane. So it begs us to ask the question, can we ever make driving feel as safe as flying in an autonomous world?

Addressing concerns over safety are a must if the government is to achieve its vision and reap the socio and economic benefits autonomous vehicles offer. The Society of Motor Manufacturers and Traders, for example, indicates that connected and autonomous vehicles (CAVs) could boost the UK economy by around £51 billion per year by 2030 and the market could create an additional 320,000 UK jobs in the next 11 years [1]. Furthermore, it's been reported that the introduction of CAVs will cut traffic congestion and reduce the number of road accidents, ultimately saving more lives.

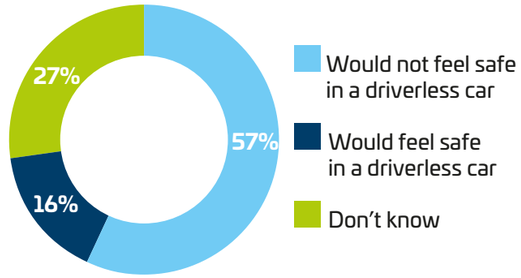
With this at front of mind, the UK government is making significant investments in developing the technology, enthusiastically pushing forward with its vision of being "at the forefront" of self-driving cars. However, the technology will only take off if consumers back it and trust that it is indisputably safe.

In this report, we evaluate attitudes of the UK public towards CAVs and assess how industry and government can address consumer concerns, by ensuring these innovative systems 100% safe. We take a look at how we can draw inspiration from other industries such as aerospace, using simulation technology to put AVs through rigorous testing to certify they are safe for the public to use. We also discuss how to address security concerns, looking into how industry can secure the systems and protect the vast amounts of data they produce – a concern for a significant percentage of population in this ever-more connected world. Lastly, we consider the reality of a world with autonomous planes and trains – where safety, once again, becomes a critical consideration in the transport revolution.

1 https://www.smmt.co.uk/wp-content/uploads/sites/2/CRT036586F-Connected-and-Autonomous-Vehicles-%E2%80%93-The-UK-Economic-Opportunity.pdf

A question of confidence

We recently conducted consumer research which revealed the attitudes of the UK public towards driverless cars. Fear, uncertainty and doubt were common feelings, with the majority of the UK public (57%) admitting they would not feel safe riding in a self-driving car. Nearly a quarter of respondents in our research (23%) said they feel apprehensive about the prospect of autonomous vehicles being on UK roads in the next three years. In addition, one in five (20%) said they are fearful or nervous.



In fact, just 12% of the UK public expressed feelings of excitement or optimism about the prospect of self-driving cars being on the roads in 2021 – a feeling most likely to be shared by the younger generation compared to older respondents.

When asked about their biggest fears towards self-driving vehicles, the UK public was, interestingly, most concerned about the safety of pedestrians (56%). This was closely followed by a fear over the safety of passengers within the car (51%) and a rise in, potentially fatal, accidents (49%).

The issue around pedestrian safety is, arguably, one of the biggest challenges for self-driving cars. As we know, pedestrians can be unpredictable and erratic. They do not necessarily always follow the rules of the road; moving in any direction, at any time, usually with very little warning.

Encoding unpredictable human behaviour into autonomous systems, to ensure a self-driving car will perform the correct and safest action, can, therefore, be tricky – but not impossible. Smart, innovative companies are currently looking into how cities can adopt smart traffic signals to manage the flow of traffic while AV developers are considering the implementation of 'distinctive sounds' – much like the sound large vehicles make – to alert humans to the whereabouts of AVs [2]. Other experts argue that perhaps better training and greater restrictions for pedestrians may be in order to ensure safety in an autonomous world.

While the UK public is worried about the safety of driverless cars at present, we can say with certainty that no government would certify autonomous vehicles for everyday road use without a mountain of evidence to show that they are unquestionably predictable and safe, even during a highly improbable sequence of adverse events. This is where the testing comes in.

Tried and tested

Since Phillip Hammond's Budget speech in 2017, whereby he formally announced the UK government's objective to have "fully driverless cars" in use by 2021, several trials have been taking place – with companies such as Waymo, Mercedes-Benz, Uber and many others, conducting on-road autonomous vehicle (AV) testing.

The issues with on-road testing, however, have been publically voiced – namely concerns over the volume and repeatability of the tests being applied to AVs. In a well-cited report [3], researchers at the RAND Corporation have argued that even though companies and manufacturers do publicise the millions of miles driven in 'autonomous mode', the number of vehicle miles travelled during testing is still insufficient to provide the evidence required that demonstrates self-driving cars are unquestionably safe.

The problem is that carrying out such large-scale testing on controlled tracks or on roads presents significant cost and safety challenges, as well as the requirement to drive huge amounts of mileage. In fact, RAND calculates that five billion miles of 'testing' will be required to gather the aforementioned mountain of evidence needed before driverless vehicles can be certified for public use on roads.

This is where we can look to simulation technology for the solution. Drawing on synthetic environment technologies that Thales already uses – for example, for full flight simulators in aerospace and vehicle simulators – we can subject autonomous driving systems to a huge number of scenarios, to gain confidence in their safety. We can test every function and response of self-driving vehicles under all kinds of conditions and circumstances – whether that's in cities or country lanes.

We can, essentially, subject AVs to a much more rigorous "driving test" than we do with human drivers. If we consider the current laws and regulations around driving, the government certifies that a human being is able to drive a car after passing a driving test from the age of 17 years old. That driver is never tested again. However, with simulation technology, we can continually test an AV throughout its life span making sure it is continually safe, even in the most unusual of circumstances.

And we are doing this right now. Through our work with XPI Simulation, Latent Logic and Warwick University WMG, we are now creating highly accurate virtual reality simulator environments – including artificial intelligence (AI) trained models of pedestrians and road users – to test CAVs. Through such measures, we can ensure they behave as if they are in the real world, knowing that the self-driving car is making smart, fast and safe decisions.

2 https://medium.com/waymo/sounds-of-the-self-driving-car-c26f30fcf76c
3 https://www.rand.org/pubs/research_reports/RR1478.html

Learning from other industries

The key challenge with simulation technology is ensuring that the scenarios we subject AVs to actually represent the real world, with a suitable level of accuracy.

For example, how can users be sure that the synthetic environment represents an environment whereby a pedestrian suddenly steps out into the road or extreme weather conditions cause blind spots? How can users be sure that the vehicle under test is going to behave in a similar way as if it were in the real world? To address this "reality gap", we can turn to lessons learned from our work in the civil aviation space.

Civil flight simulators, today, are certified before they can be used for formal pilot training. The devices are certified by aviation authorities against a set of objective and subjective criteria, which enables users to be comfortable conducting pilot training in simulation. As such, pilots are exposed to highly accurate scenarios, allowing them to be properly trained to make the right decisions in all kinds of conditions.

Aviation, today, has certainly set a very high bar when it comes to safety. Despite a slight increase in the number of aviation fatalities around the world in 2018, deaths from air crashes are still very rare. According to data from Aviation Safety Network, aviation deaths around the world have been falling over the last two decades. The number of fatalities on roads is much higher; the World Health Organisation states that "1.25 million people die each year on the world's roads [4]."

Reports have indicated that driverless cars have the potential to prevent 25,000 road accidents [5] but in order for this to be realised, the public has to perceive that the technology is safe to use in the first place – something our research has shown not to be the case at present.

Therefore, making the simulations as realistic as possible and demonstrating to the public that AVs have been subjected to scenarios that reflect the real world will be crucial to their success. It will give the public an independent validation of safety, robustness and reliability in driverless cars. The simulations we use will be fed by highly detailed scans of real roads, traffic camera data, accident data, and near-miss analyses. These inputs will be used to create a high-fidelity model of real-world roads, which will be populated with realistic artificial intelligence (AI) based road users.

If successful, this work could lay the foundations for the development and certification of all types of unmanned vehicles – including planes and trains as well as automobiles.

Planes, trains and automobiles

We have reached a point in time where the concept of flying cars and pilotless planes simply no longer resides in the pages of science fiction. Inner city tests of autonomous air taxis in places such as Singapore and Germany [6] are under way and we know, from experience, the rail industry has been taking incremental steps in its adoption of autonomy.

Our research, however, reveals that the UK public is quite sceptical as to whether autonomous aircraft used to carry people and goods will be a reality in the UK in the new future. In fact, just under a third (28%) believes autonomous air vehicles will transport goods and people within the next 10 years. Feelings of fear (26%) and apprehension (20%) were, again, shared by respondents when thinking about the new mode of transport.

We feel, more realistically, we are moving to single pilot operations (SPO), which we will see in the next 10 to15 years. Technologically speaking, SPO can be delivered to aircraft – it is no more complex a revolution than fly-by-wire – or shift from three pilots to two.

It is likely that AI would have a significant role to play in single pilot operations. It would entail changes to certain piloting procedures, new cockpits with a more intuitive design to simplify pilot training. Furthermore, digital technologies can help us to ensure a pilot is assisted by a pilot on the ground and by AI systems underpinning all operations.

However the journey to full autonomy will be a gradual one and it is also important that the industry fully understands the problems that could arise – namely, the interaction between humans and machines that could impact the public's perception of safety.

For example, once the on-board flight control and communications systems become powered by AI, the role of the pilot becomes a lot more challenging. The job description extends beyond the traditional roles and responsibilities to include the skills of an 'autonomous systems operator', making the job more complex than ever before.

Also, in the case whereby the 'pilot' is actually on the ground – linked to an airplane's flight management systems via the cloud where the aircraft and air traffic control are in permanent contact – how we can ensure the communications between man and machine are clear enough so that smart and accurate decisions are made?

Getting this right will be crucial to the future of transport and consumer adoption of the technology. It will require the knowledge and experience of companies that bear their aviation battle scars to assist and advise the innovative start-ups if this journey to fully autonomous vehicles is to be a success.

4 https://www.who.int/gho/road_safety/mortality/en/
5 https://www.smmt.co.uk/wp-content/uploads/sites/2/CRT036586F-Connected-and-Autonomous-Vehicles-%E2%80%93-The-UK-Economic-Opportu...1.pdf
6 https://www.engadget.com/2018/10/24/volocopter-air-taxi-test-singapore-autonomous-drone-helicopter/-

More than physical safety required

In our final chapter, we address public concern over cyber security in autonomous vehicles. In addition to the physical safety of individuals, our research reveals a significant proportion of the UK public fear the safety of their data, with nearly one in three (28%) voicing concerns over potential cyber-attacks and hacks on personal data in self-driving cars.

Of course, the connectivity offered by connected and autonomous vehicles brings huge benefits to the consumer, but it also creates a challenge: how do you safeguard the functioning of our car from malevolent hacking that could hijack your car's functions? In order to encourage the adoption of autonomous vehicles, we, as an industry, need to make sure that the hyper-connected self-driving car is totally fail-safe in terms of data protection.

At the end of 2019, the British Standards Institute published a new cyber security standard to "to set a marker for those developing self-driving car technology" and "improve the resilience and readiness of the automotive industry" [7]. This is certainly a step in the right direction; a commitment to data security is necessary for consumer confidence in the connected car.

The simple truth is that with more technology, there are more entry points that are opened up to malicious hackers looking to gain access to systems and steal valuable data. We need to show sceptical consumers that their data is protected, and that the critical information systems of their cars are secured. As with any connected device, it starts with building security in the connected car 'by design' and we need to ensure the entire AI system is secured and that the data it produces and holds is properly protected.

An onward journey

For the government's 2021 vision to become a reality, autonomous cars must not only 'be' demonstrably safe, but they must also be perceived as safe by the public. Our research has highlighted consumer concerns over the safety of passengers and pedestrians, and over data protection – concerns that need to be addressed if the UK is to reap the reward an autonomous world promises to offer.

We argue there are ways in which the industry and government can assure and demonstrate the safety of autonomous vehicles – namely through the use of simulation for AV testing which is faster, safer, cheaper, more versatile and more repeatable than any other method. With the mountain of evidence that we can generate, we fully believe consumers can feel as safe in a driverless car as they currently do when flying. And it is our hope that such measures will make truly autonomous driverless cars – and other vehicles in the future – an achievable reality sooner, rather than later.

7 https://www.gov.uk/government/news/new-cyber-security-standard-for-self-driving-vehicles

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