Do AVs really hold the key to future travel?

The development of driverless/autonomous vehicles is a veritable rocky road. **Christian Wolmar** dissects hype from reality by assessing the claimed benefits

ABOUT THE AUTHOR

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The driverless car revolution is upon us. That has been the opening of almost every article in the mainstream press about autonomous vehicles (AVs) for several years.

Yet there is no sign of driverless cars being widely available any time soon. Indeed, even Google, whose company Waymo is the most advanced technically, has been guilty of overconfidence.

In 2012, one of its founders, Sergey Brin said driverless cars "would be available for Google employees within a year and they will be on the market commercially by 2018".

Similarly, in 2006, the Royal Academy of Engineering suggested there could be driverless trucks on Britain's roads by 2019.

Neither of these things has happened. But still, the predictions continue to come thick and fast and, recently, there have been even more confident claims.

In 2018, Rethinkx, 'a team of technology, finance and market sector experts', made this jaw-dropping claim: "95% of US passenger miles travelled will be served by on-demand autonomous electric vehicles owned by companies providing Transport as a Service. As fewer cars travel more miles, the number of passenger vehicles on American roads will drop from 247 million in 2020 to 44 million in 2030."

Tesla boss Elon Musk has suggested that the ability to develop full driverless capabilities is imminent. In April, at a press conference, he said his Tesla cars would, next year, effectively be available as driverless taxis. Owners would be able to park outside their homes and the cars would then go into autonomous mode to be used as taxis in nearby cities.

He also claimed: "A year from now we'll have more than a million cars with full self-driving, software, everything" and that "probably two years from now we'll make a car with no steering wheels or pedals".

The predictions by Rethinkx and Musk are not borne out by any evidence that they can be realised in the timescales they are predicting.

Waymo, for example, is now far less confident than Brin was seven years ago. Waymo boss John Krafcik said at a conference last year: "It'll be decades before autonomous cars are widespread on the roads – and, even then, they won't be able to drive themselves in certain conditions."

This new realism has already had an impact on the financial markets. In late September, Morgan Stanley valued Waymo at $105 billion (£82bn), down from last year's valuation of $175bn (£136bn) because self-driving cars are developing slower than expected and because the bank had previously underestimated how long safety drivers would be needed to ride along in self-driving cars.

CONFUSED PICTURE

Unsurprisingly, the public is confused by the various predictions being made with the result that many think driverless vehicles are already available. According to Thatcham Research, a body funded by UK insurers, "71% of drivers around the world and 53% in the UK believe they can buy a self-driving car right now".

Thatcham director of research Matthew Avery is concerned this confusion is caused by carmakers who are "designing and marketing vehicles in such a way that drivers believe they can relinquish control".

Carmakers want to gain a competitive edge by referring to "self-driving" or "semi-autonomous" capability in their marketing, but it is fuelling consumer confusion, he says.

The concern for the insurers is that overconfidence in the ability of vehicles to control themselves will lead to an increase in accidents.

Late last year, I was on the test track at the old Upper Heyford airfield when Thatcham was assessing the ability of various vehicles to avoid a collision with a broken-down car on a motorway when using driver-assist functions. One car saw it well in advance, another swerved at the last minute and the third drove straight through what was, fortunately, a dummy vehicle made of foam, highlighting the danger of drivers making over-optimistic assumptions about the technology.

HYPE AND REALITY

The gulf between the hype and the reality is, therefore, quite possibly widening. That is important not just because of the amounts of money being spent on the development of this technology, but also because of the risks it poses to sensible policymaking.

This is hardly surprising given the size of the claimed benefits for AVs.

Take the mission statement from Oxbotica, one of the UK's leading companies developing this technology, which certainly does not lack ambition:

"The world will be transformed beyond recognition by autonomous vehicle technologies," it claims.

"The way we move people and goods will change forever. Software is the beating heart of this transformation. To survive and build compelling, competitive market positions, companies will need to adopt world-leading AV technologies.

However, Oxbotica admits that this is far in the future. Its boss Paul Newman told *The Times* after a test drive of one of the company's vehicles that unsupervised driverless cars were several years away.

He says: "In a major city, there are all sorts of unexpected things that can happen. At the moment, we still need a human to take over in these scenarios."

Indeed, *The Times* reported that during the trial the supervisor had to intervene when a pedestrian walked into the road.

Yet, despite the growing doubts about the ability of the technology to achieve full driverless capabilities soon, the massive investment levels continue.

Predicting the future is a fraught business. This is especially true given we are in the middle of a technological revolution that few would have predicted with any accuracy even two decades ago.

However, trying to separate the likely outcome from the hype is important to enable politicians and policymakers to be well informed.

There is a wave of interest from ▶▶

politicians tempted by the possibility that this technology may solve various fundamental problems caused by transport.

For example, at October's European Transport Conference in Dublin, Niels van Oort of the Delft University of Technology said: "Already in the Netherlands, I know of policymakers who are suggesting we should spend less on public transport because AVs will reduce demand."

The hype, therefore, may already be distorting decisions on transport investment. Indeed, in researching this article, another practitioner who is rather sceptical of the potential of the technology and therefore wishes to remain anonymous, says: "The surprising thing is just how much civil servants and local authority managers are keen on the idea and ready to embrace it, as well as, more predictably, the politicians."

The UK is no exception. In launching a London trial, George Freeman, number two at the Department for Transport, says: "Self-driving technology has the scope to revolutionise the way people travel, with potentially profound benefits for road safety, accessibility and convenience. We want to drive the roll-out of self-driving vehicles and continue to support innovators developing this ground-breaking technology."

HISTORY

The notion of driverless cars has been around for a surprisingly long time. There were even trials between the wars, with a famous experiment of sending a radio-controlled car up Fifth Avenue in New York using transmissions from a second vehicle.

After World War II, there were attempts to develop vehicles that were controlled by electronic devices in the roadway. The General Motors Autoline envisaged vehicles driving at speeds of 150mph bumper-to-bumper, contending, as many protagonists of the cars do today, that this would greatly increase the capacity of highways. But the practical difficulties killed off the project.

In the 1990s, the US Department of Transportation spent $90 million (£70m) sponsoring several manufacturers to develop automated vehicles and around 20 cars, trucks and buses were demonstrated on an Interstate highway near San Diego in southern California in 1997.

In 2004, the Defense Advanced Research Projects Agency (DARPA) of the US government offered a $1m (£777,635) prize to any team of robotic engineers which could build an autonomous car capable of finishing a 150-mile course in the Mojave Desert.

While there were no winners in the first contest, the following year several vehicles completed the course and two years later the challenge took place in an urban environment. These highly publicised tests attracted a lot of attention and laid the seeds for the massive investment that ensued.

THE INVESTMENT

The rush to invest in this technology started about a decade ago, stimulated by the DARPA tests and the high level of public interest. More important, though, the technological revolution created a number of highly profitable companies with money to spare for startups. Google, then operating under its own name rather than, as now, Waymo, began developing autonomous vehicles in 2009 without a public announcement of its intentions.

There are hundreds of startup companies concentrated in California's Silicon Valley but also in the old auto manufacturing belt in the Midwest. The Crunchbase website lists 259 startups focusing on autonomous vehicles across the US, by far the biggest player, and that does not include those which have subsequently been taken over.

Indeed, the acquisitions and mergers market on the Dow Jones has been kept alive by autonomous vehicle developers. In particular, it is mergers between tech developers and the auto manufacturers that are most common.

THE ROADMAP

The obstacles to the widespread introduction of this technology are, to say the least, challenging.

In September, Zenzic, a Government-sponsored company which has the mission of being "a leader in the move to a safer, more inclusive and productive mobile future" produced a roadmap (see page 42) which it hopes will help bring the various players together and set out a path to widespread autonomous vehicle use by 2030.

The roadmap lists 500 'milestones' required to achieve the goal of widespread autonomy under six main headings: legislation and regulation, safety, CAM services (in other words the technology), public acceptability, infrastructure and cyber resilience.

It suggests that the middle of the next decade will be the tipping point at which the trend towards autonomous vehicles will be unstoppable.

The problem, as the *FT* points out, is "the business case for autonomous vehicles is still unproven and consumers have yet to be won over" and that many of these milestones are interdependent. It is rather like building Crossrail – the delays to that project were caused by its very complexity and the number of interrelated systems that needed to be installed.

259

start-ups focusing on AVs are listed on the Crunchbase website

The development of AVs is several times more complex than that.

As John McCarthy of Arup put it at the European Transport Conference: "There is so much going on in terms of tests and trials on AVs that it is impossible to know what is going on."

This highlights another issue. The development of AVs is a competitive process driven by companies eager to be the first in the market to dominate, in the same way that Microsoft, Facebook and Google have.

The biggest prize, so enormous that it has attracted the billions of investment, is the super-profits that could be made by the winner.

However, while competition is undoubtedly a stimulus to technical development, there is a desperate need for co-operation among the players if their dream of an autonomous future is to be achieved.

This can be likened to the way cars were developed initially. At the beginning of the 20th century, there were 80 car manufacturers in the US and within a quarter of a century, three-quarters of vehicles were produced by just three. The huge number of mergers and acquisitions can be seen as a similar process.

But there is a big difference.

The various players are developing their own systems which may not be compatible with one another, and huge sums could be wasted in Betamax-type developments. There is enormous secrecy about both the hardware and, particularly, the software, as shown by the recently resolved legal battle between Waymo and Uber.

Waymo alleged that former engineer Anthony Levandowski stole confidential files containing trade secrets before leaving to form his own startup, Otto, in 2016.

Waymo claimed Levandowski used the information to help develop Uber's self-driving technology after Otto was acquired later that year by Uber and successfully sued, winning compensation of £190m from the car-sharing firm.

Eventually, the regulators will need to intervene and impose some type of order into the chaos especially where safety is concerned. Otherwise, if something goes wrong it will be very difficult for the regulators to uncover what happened.

THE BENEFITS – ARE THEY REAL?

The astonishing rate of investment reflects the fact that the protagonists believe the benefits are on the same scale.

There is much talk about the industry being worth tens of billions of pounds within a decade.

In the previous issue of *Smart Transport,* for example, Daniel Ruiz of Zenzic, wrote: "It has been estimated that CAVs will deliver £62bn in economic growth by 2030."

Broadly, supporters argue that AVs will greatly reduce the death toll on the roads, cut congestion by reducing the number of cars on the road and, by increasing road capacity, reduce the cost of motoring and improve employee productivity.

They will also remove the need for city/town centre car parks, freeing up valuable space for other purposes.

Some even suggest it will be possible to green over some roads as there will no longer be a need to own vehicles individually.

SAFETY

The biggest claim is over safety. It is argued that 94% of accidents are caused by drivers. Replace the human driver with a fault-free software system and most of the 1.25 million lives lost globally on the roads every year (1,800 in the UK) will be saved.

In fact, this is a rather simplistic view of road casualties.

While mistakes by drivers are indeed a major contributing factor to accidents, the bald statistic of putting all the blame on them in such a high proportion of accidents is misleading.

In particular, the design and layout of roads, especially at junctions, is often a major contributory cause as are other external factors.

Drivers are the last resort, preventing accidents all the time – they are navigating dangerous junctions, poor road surfaces, deficient road infrastructure and when, occasionally, they fail to do so that does not necessarily mean it is their fault.

Nevertheless, autonomous vehicles seek to prevent these incidents, and not just because they are autonomous; they will also be connected, communicating with each other and with the road infrastructure to warn and alert each other about risks that could never be seen or predicted by a driver.

Of course, that information could just as easily be relayed direct to a driver as it could an algorithm, arguably making the connectivity more vital than the autonomy.

And, we certainly aren't there yet, with ▶▶

> **I know of policymakers who are suggesting we should spend less on public transport because AVs will reduce demand**
>
> **Niels van Oort, Delft University of Technology**

Levels of autonomy

LEVEL 1: Minor assistance –the driver is in charge, but a vehicle may feature relatively basic systems such as adaptive cruise control.

LEVEL 2: Advanced driver assistance systems (ADAS) – new safety technology such as automatic emergency braking and lane-assist. The driver is fully engaged and ready to override any ADAS system.

LEVEL 3: Vehicle takes control – the first major step into self-driving, with vehicles capable of taking full control in some scenarios. However, the driver has to remain sufficiently alert to take back control.

LEVEL 4: Door-to-door automation – vehicles are capable of completing entire journeys using their own artificial intelligence, although the vehicle would still have the architecture of a familiar car, with a steering wheel and pedals for times where a human still needs to drive.

LEVEL 5: Complete automation – these driverless vehicles don't even need to have a steering wheel or pedals. They are the long-term goal of every manufacturer and tech firm.

the route to full AV lined with risks when trials take place, as shown by the Tesla fatalities two years ago.

There is an issue of disengagement statistics when considering the safety of autonomous trials. Disengagement rates are not counted in most places except California.

There the rates vary. The best was Waymo, which had a disengagement once every 11,000 miles, effectively a driver intervention around twice a year on an annual mileage of 20,000.

Arguably, that's pretty low but all the other companies had much higher rates which shows these cars are not yet driverless, even in conditions far easier than in the UK.

The number of miles per disengagement is, in any case, an unreliable metric for measuring progress and is not meaningful in terms of safety.

According to Michael DeKort, who worked in the industry and has turned whistle-blower: "Companies inflate their miles per disengagement to appear further along and use their own absurd definitions of what a disengagement is — effectively erasing thousands of safety-related disengages."

Moreover, driverless cars are not running in real-life situations. They do not operate in dust storms, heavy rain, snow or in situations where road markings are not visible.

Add in the fact that software faults – some estimates suggest there is one for every 100 lines of coding – are likely to emerge.

No one knows yet whether driverless vehicles may ultimately be safer, although experts with a vested interest claim that Level 4 autonomy (see panel on page 33) gives a 98% guarantee of zero fatalities and Level 5 is a 100% guarantee. These are impossible to corroborate until AVs are launched to the public.

£62 bn
estimate of what CAVs will deliver in economic growth by 2030

REDUCING CONGESTION

There are two claims which suggest it might be possible to reduce congestion through the use of autonomy.

First, autonomous cars could make more efficient use of road space as they would drive in a controlled manner that would prevent the wave effect common on crowded highways which results in a 'stop-start' concertina pattern.

It is not correct to put all the blame on drivers for accidents. Other considerations, such as poor road surfaces, play a part too

Secondly, it is suggested people would no longer need to own cars and, therefore, there would be fewer on the road and less need to provide parking spaces.

Neither stands up to scrutiny. While there may be some marginal benefits in terms of vehicles being able to drive closer together, the idea that this will represent a big advantage remains to be proven.

Moreover, this clearly only applies to highways – dual carriageways and motorways, where vehicles travel at some distance apart for safety reasons – rather than ordinary urban roads. Vehicles already travel pretty close together in city centres.

Furthermore, it is quite easy to argue the opposite. If driverless cars really do reduce the costs or lure people away from public transport, then there will actually be more cars on the road, or at least greater utilisation/usage of cars that today spend much of their lives parked up – not emitting or causing congestion.

In addition, empty driverless cars on the road would represent extra traffic. There is considerable evidence that driverless cars operate in a very conservative fashion, causing delay to conventional cars sharing the road space.

This shared road space in itself is a concern: no one knows how mixed use might affect the behaviour of both drivers and algorithms running AVs.

Finally, there is the issue of pedestrians who, realising cars are driverless and have to stop for them, will take advantage by walking out in front of them, again adding to congestion.

Here, though, CCTV could potentially identify culprits and issue fines – jaywalking, as in the USA, could become an offence.

A solution to many issues suggested by some is that autonomous vehicles are restricted to central control rapid transit systems, run by fleets rather than in private ownership for cars.

CHEAPER

Much has been made of the fact that driverless cars will be cheaper to operate because the cost of a driver is so high.

Taxi services, in particular, will be revolutionised, according to AV supporters, as well as logistics and distribution, which are facing well-documented driver shortages.

This ignores two huge considerations. First, the cost of additional equipment is currently enormous and is unlikely to reduce to insignificance.

One Lidar (light detection and ranging instrument) system currently costs about £58,000. Uber predicts this could be reduced to a tenth – £5,800 – but, even that represents a considerable extra expense given there will be a plethora of devices required to make vehicles autonomous.

There is currently nothing like a driverless car on the market, but estimates suggest those being tested by Waymo and the like will cost at least £155,000 and probably considerably more. Making a car driverless even for a mass market would add at least £77,800 to the vehicle's cost.

Second, a driverless taxi firm would need a huge back-up organisation – one ready to rescue blind people or children stuck in broken down cars or those stuck in congestion. It would need to monitor the cars constantly and, incidentally, would also need to buy or lease vehicles, rather than having them individually owned by drivers.

Given that a driver earns, say, £23,000 to £30,000 per year, being driverless is not the game-changer it is often presented to be.

There will also be a need for investment in infrastructure and accurate mapping, particularly if AVs are going to understand road structures and speed limits.

The widespread adoption of AVs implies the need for a triple revolution – electric, shared use and autonomous.

Let's look at these in turn:

ELECTRIC

Electric is obviously desirable, provided the power is obtained sustainably.

However, there are still issues around the availability of the raw materials, which have caused supply delays. These are now starting to ease: certainly Tesla is promising 14-week lead times, quicker than some combustion engine cars.

£58k
current cost of a Lidar instrument

Persuading people to buy electric cars has proved an uphill task, although ultimately they will have little choice as Government policy at a national and local level forces them down this route.

There are around 250,000 electric or plug-in hybrid cars in the UK's fleet of 30 million. Nevertheless, interest from business and consumers is rising, with many more models, promising range of 200-plus miles, coming to market next year.

If even 10% of the fleet were purely electric there would be huge problems in providing sufficient charging points and batteries. And these lithium batteries are highly toxic and not necessarily environmentally sustainable.

Solutions are being sought, with the Faraday battery challenge working on a University of Birmingham-led project to identify recycling and re-use opportunities on an industrial scale.

Some re-use is already a reality, with batteries being used to power part of the Amsterdam stadium in the Netherlands, for example.

The charging infrastructure is expanding, but the build-up of rapid charge points is lagging behind. According to Zip-map, there are 28,127 connectors at 10,205 locations of which 6,500 are rapid chargers at 1,800 locations. The growth rate is around 750 new charge connectors per month.

Take up may be further accelerated by technical developments.

BP, for example, has a major programme of developing fast chargers. In August, it announced the opening of what it plans as a network of rapid charging stations near Heathrow Airport.

BP Chargemaster chief operating officer David Newton said the charging points "will provide an expected dwell time of 10-12 minutes, not dissimilar from the average of around seven minutes spent by drivers of petrol and diesel cars on a forecourt today".

Of course, having a bigger fleet of all-electric vehicles powered by sustainable means is greatly desirable, but it is important not to conflate EVs with AVs. Nevertheless, it is generally accepted that AVs will be pure electric.

SHARED USE

There is no evidence that driverless cars will mean personal ownership would end. People want full-time access to their cars even if they only use them 10% of the time.

While a group of younger, urban-living people with access to good public transport may adopt such a lifestyle, the numerous advantages of owning a car – from keeping the baby seats or golf clubs in it to the instant availability of a personalised vehicle – will outweigh other factors.

AUTONOMOUS

With billions being invested, progress has been made with the technology, but the developers have come up with a major obstacle – the handover between automation and humans.

Level 3, where the car drives itself much of the time, but requires the human to stay alert and take over if something goes wrong, has proved problematic.

Ford began testing Level 3 vehicles and found the drivers dozed off as they had nothing to do and, therefore, were unable to react to dangerous situations.

Michael DeKort says: "Handover cannot be made safe no matter what monitoring and notification system is used. That is because enough time cannot be provided to regain proper awareness."

Could this be solved by AI (artificial intelligence)? DeKort suggests not because of the sheer amount of learning that would have to take place.

He says: "Thousands of accident scenarios will have to be run thousands of times over to train the AI on those scenarios."

Ironically, this is also a counter argument to those who question the need to invest in fully autonomous vehicles when autonomous systems can do the job just as well with a driver still in absolute control.

There is no doubt that autonomous systems being developed by manufacturers, such as lane-keeping and autonomous emergency braking, will prevent crashes; but they also risk a driver paying less attention, as the Level 3 AV studies show.

Such considerations have pushed the developers to go straight to Level 4, where, basically, the car is driverless all the time in geodefined areas.

This is also proving difficult with several manufacturers saying targets to reach that level have not been met.

Even Waymo, which is far ahead technically, has struggled with basic infrastructure comprehension and driving tasks, such as making an unprotected left turn or stopping at traffic signals designed to control the flow of traffic from a ramp onto a road.

Moreover, there is the huge issue of hacking and software safety. The large number of computers – eight is typical – and the code they use on board could be a vulnerability.

One AI expert told me there tends to be one error for every 100 lines of software code and while that can be reduced over time, issues of reliability could remain.

LAWS AND REGULATIONS

Assuming that all the technical and political detail can be sorted, there is the minefield of the legal, liability, regulatory and social issues.

Currently, cars only require insurance and to be roadworthy before going on to roads.

The Law Commission is engaged in a three-year programme to establish the framework for the law on AVs and has just published an interim report on the 178 responses to its consultation.

The main finding is widespread consensus on the need for a national safety assurance scheme for autonomous driving systems.

A key issue under discussion is the definition of a 'user in charge' rather than a 'driver', to make a clear delimitation between driver assistance and automated driving highlighted by the problem over Level 3.

There was broad consensus, too, that the insurer should be liable in the case of an accident, something likely to push up insurance costs.

▲ Insurers are concerned that an over-confidence in the ability of vehicles to control themselves will lead to an increase in crashes

10%

amount of time people actually use their cars

SOCIETAL ACCEPTANCE

One of the key themes of the Zenzic roadmap centres around social acceptance of the technology.

The deaths of Elaine Herzberg, killed by a driverless Uber in Arizona and Joshua Brown, who placed too much reliance on his Tesla Autopilot, along with numerous other incidents, have increased public concern.

There have been numerous surveys on the acceptability of driverless cars and all point to a reluctance to use them.

For example, Thatcham found that only 29% would be happy to be picked up by a driverless car, and, when it comes to trusting autonomous driving technology with the safety of a person's child, that number dives to 17%.

Overcoming this reluctance will require assurance that the technology is safe, which may be helped by the work of the Law Commission and the creation of a safety assurance body.

A further barrier to acceptance is the possible need to adapt the environment to the needs of autonomous cars.

In an article in the *Evening Standard* last year, Caroline Hutt, the mobility programme manager for London taxi firm Addison Lee, wrote: "London needs to embrace the arrival of driverless car. Street design needs consideration – autonomous vehicles need a de-cluttered environment, with clear delineation between pedestrian and vehicle space."

This however, runs precisely counter to the mayor's "Healthy Streets" agenda which emphasises shared space and pedestrian priority.

There has been similar talk of the need for pedestrian barriers at traffic lights to prevent jay-walking, a concept not recognised in UK law.

So, to adopt this technology, its supporters are suggesting current policies around making city centres into healthy streets and decluttering the environment will have to be replaced by the construction of fences and barriers.

TWO LITTLE PROBLEMS

Driverless cars will have to be programmed not to kill people.

If someone stands in front of them, they will have to stop. Their range can be altered – say 5ft or 10ft – but not the fact that they cannot be allowed to hit someone knowingly.

How will a driverless car cope with streets congested with people crossing or steeping out into the road?

This also creates a security issue. A driverless car can be stopped by anyone walking in front of it. That means they will not be used by anyone concerned about personal security as a would-be attacker simply has to step out in front of the car to confront their victim.

So, in this scenario, the 100% driverless world portrayed by some of the developers could never happen.

Then there is a simpler issue. Imagine two driverless cars meeting each other on a single lane highway in the wilds of Somerset. If they are Level 5, as Waymo seeks, the passengers will not be able to intervene. So how will the cars sort themselves out?

One answer returns to connectivity. The cars may have communicated to each other long before meeting, knowing each others' routes, so one would be able to stop at an appropriate passing point.

Solutions like these still need some working out – not least how comfortable passengers would be to know that other cars on the network know where they are going and the route they are taking – and they are among the problems being considered by the AV developers.

CONCLUSION

None of this is to imply that the whole exercise is doomed. Given the sums of money being spent, there will undoubtedly be useful innovations coming from the research.

Michael Hurwitz, director of innovation at Transport for London, says already the bus fleet is seeing the benefits.

He says: "Abellio has 700 buses in London with intelligent speed adoption, which means they can anticipate risks and predict danger through using AI."

To be successful, Hurwitz says three things need to happen: "The tech has got to be good enough. It already does some things, such as 360-degree vision, better than humans, but is lagging in others.

"Second, there has to be public acceptance and while we easily 'accept' 1,800 road deaths per year, there will be less tolerance of deaths involving 'robocars'."

And, third, he agrees with the Law Commission that there has to be the right regulatory environment, which will take time to develop. Most important, he adds, it will be up to politicians to create the right environment.

Hurwitz stresses: "I like it if it helps deliver safer transport, but not if it takes 60 people off a bus and into pods."

29%

of people would be happy to be picked up by a driverless car

However, even supporters like Hurwitz accept that the widespread introduction of AVs remains a far off prospect and may, indeed, never happen.

At the European Transport Conference, it was difficult to find anyone who, in private, believed that driverless cars would be commonplace by 2040, let alone 2030.

Many transport practitioners are not only sceptical of the hype, but angry about it.

As one said to me: "The expectations being built by the hype are not going to be met and then there may be a strong reaction against the whole concept."

This phenomenon of hyping new inventions has even been expressed on a graph, known as Gartner's hype cycle which goes up sharply before beginning to descend, which is precisely where we are now.

The supporters of this technology should rein in their most outlandish claims and focus on the achievable, which, ultimately, may be rather more modest but no less worthwhile in improving safety. ST

TURN OVER FOR THE PEER REVIEWS