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Commercialising the next mobility revolution

Industry views on the commercial potential of connected and autonomous vehicles

Artificial Intelligence

At a roundtable dinner at CMS's London headquarters in spring 2019, we brought together industry leaders from the automotive and technology (autotech) world and key members of the CMS Autotech Group to discuss the commercial potential of connected and automated vehicles (CAVs). We also discussed the impact of artificial intelligence (AI) on this growing sector. In this report, we capture expert views on the current status and future outlook for the industry, and on the key catalysts that are needed for CAVs to deliver their full potential.

Vehicle automation and connectivity are currently being driven forwards at an ever-quickening pace, spurred on by AI-powered technologies. Cars are increasingly becoming digital content platforms in their own right. The roll-out of new communications networks and technologies will play a major role in underpinning this mobile 'internet of things'. And after much hype, driverless vehicles may finally be on the verge of reaching the streets. All of these developments will have major implications for how mobility and related services are delivered and monetised, as well as for vehicle safety and reliability. But are the right building blocks in place? What should government and industry do to foster further investment? And how should the market adapt to these opportunities?

We explore these issues in this report – I hope you find it interesting. If you require further information on any of the topics that it covers, please feel free to contact me.

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A vision of a connected and autonomous future

A FTSE 100 chief executive wakes early on a Monday morning at her home in a remote part of the Yorkshire Dales. A car is waiting to whisk her to her company headquarters in the City of London. It has no steering wheel and is programmed to complete the journey with no human interaction, while continuously adapting to the variable speed limits along the route. The CEO uses the time to read emails, join a video call and then catch up on some TV.

During the journey, the car informs her that its rear off-side brake will need replacing in 212 miles and confirms that it has booked itself in for repair. It reminds the CEO that she has a dinner meeting scheduled with a client. The car analyses her calendar to identify her favourite places to eat and books a table at the one that's most conveniently located for her guest. Meanwhile the vehicle connects with travel reports and identifies a build-up of traffic on its current route into central London. It quickly diverts along an alternative route and the CEO arrives at work on time.

This story is of course just one view of a connected, autonomous and AI-driven future, but it is consistent with the visions that are increasingly being promoted by vocal advocates for CAVs. Elon Musk, chief executive of Tesla, has famously predicted that a fleet of more than a million driverless Tesla vehicles will be on US roads by mid-2020, as the company introduces an on-demand robot taxi service. Meanwhile manufacturers and tech disruptors are capturing more and more attention as they unveil their latest connected vehicle prototypes at set-piece events like the Consumer Electronics Show, Mobile World Congress and the Geneva Motor Show.

But how close are we to seeing truly connected and autonomous vehicles on our streets? The prevailing view is that we shouldn't be bracing ourselves for the rise of the robots just yet. Despite the fanfare around the advent of driverless vehicles and the connected services that accompany them, it seems that these grand visions of full automation and connectivity remain some way off.

Elon Musk, chief executive of Tesla, has famously predicted that a fleet of more than a million driverless Tesla vehicles will be on US roads by mid-2020.

Reality check – where are we with connected and autonomous vehicles?

In November 2017, Philip Hammond, the UK's Chancellor of the Exchequer, predicted that fully autonomous cars would be on British roads by 2021 as he sought to position the country at the forefront of the "next industrial revolution" and as a leader in AI. In the autumn Budget that year, he announced regulatory changes to promote the testing of driverless cars. Yet looking at UK roads today you will see little evidence that Mr Hammond's prediction will be realised.

At the CMS roundtable, David Wong, Senior Technology and Innovation Manager at the Society of Motor Manufacturers and Traders (SMMT), says there is nevertheless cause for optimism. Although levels 4 and 5 on the SAE International scale of driving automation – representing highly and fully automated vehicles – are still firmly in the future, individual driver assistance features have been making their way into our cars for some time. Around two-thirds of vehicles sold in the UK now have some form of driver assistance. Features like autonomous emergency braking, adaptive cruise control and lane-keeping assistance are becoming more prevalent. And David Wong observes that

"Higher level autonomy in tightly-confined spaces like city centres or other geo-fenced areas may become possible" in the short term.

It's also important to separate connectivity from automation, not least because the short-term picture is more favourable for connected vehicle systems. Again, the advent of connected car technologies is proving to be incremental rather than immediately revolutionary. eCall, a system that automatically dials emergency services after a serious road accident, became mandatory in all new car and van models sold in Europe from 31 March 2018 – and so all new cars will, in a sense, be connected vehicles. Systems that link cars to drivers' mobile phone platforms, such as Apple's CarPlay and Google's Android Auto, are now well-established. And advanced systems based on voice and gesture control are making their way towards the market.

So we may not have entered a brave new world just yet, but we are inching towards a bolder horizon. What are the main forces that are going to take us to a more connected and autonomous future, and to enable us to realise the full benefits of these new technologies? The next few pages explore some of the key catalysts for change that were discussed at the CMS roundtable.

Key catalysts (1): Adapting to emerging regulation and standards

If the world of CAVs is still in its relative infancy, then the corresponding legislation and regulations that will help it to reach maturity currently remain in the slow lane. Some countries have, however, taken the first steps towards legislating specifically for CAV technologies.

In the UK, for example, the Automated and Electric Vehicles Act 2018 sets out the basic principles of liability by requiring insurers to take primary responsibility for accidents caused by automated vehicles. The Act also lays the groundwork for the UK government to introduce rules in relation to the roll-out of charging points for electric vehicles – but no regulations have yet been made under it. Meanwhile, in Germany, the Act on Road Traffic includes specific definitions of cars with highly or fully automated driving functions, and establishes key rights and duties of drivers who operate them. A further Act on Autonomous Driving is also being prepared.

The European Union has also started to pave the way for cooperative transport systems. It has made sustainable, safe and connected mobility a political and legislative priority through its *"Europe on the Move"* strategy and associated measures (see the box entitled 'Regulating for a connected and autonomous future?' below). But, across Europe and further afield, regulation of CAVs remains patchy and unharmonised, making it hard for market participants to strategise and invest accordingly.

Is a greater focus on legislation and regulation needed? David Abrahams, Managing Partner at Inline Policy, says that regulation shouldn't be feared by the sector, as it can ensure there is a more even playing field between established OEMs and disruptive innovators: *"Regulation is the friend of the industry. It can hold back 'big tech' from racing ahead with nominally attractive and cheap services, which bypass the safety or other critical regulation that is ingrained in the culture and work of the automotive sector."*

Beyond this, regulation can also play a role in determining the direction in which the market develops from a technological perspective. Uncertainties surrounding available infrastructure currently present a considerable challenge to market participants. In terms of connected vehicles, the European Commission has nailed its colours to the mast in favouring the ITS-G5 standard – which is based on existing Wi-Fi technology – for internet-enabled cars. This has sparked significant controversy, as many vehicle manufacturers and technology providers prefer the cellular vehicle-to-everything (C-V2X) standard. C-V2X will rely on new 5G mobile networks and many believe it will offer a better solution than ITS-G5, although it may take longer to develop. A final decision is currently awaited from the Council.

Regulating for a connected and autonomous future?

In March 2019, the European Parliament and the Council agreed on the text of a Regulation that the European Commission proposed in May 2018. This will require all new motor vehicles placed on the market to be equipped with advanced safety systems. These include:

Intelligent speed assistance
The vehicle automatically makes the driver aware that the speed limit is exceeded, based on speed limit information obtained through road signs and signals (although the driver may override the system to exceed the system's prompted vehicle speed).
Driver drowsiness and attention warning systems
The vehicle assesses the driver's alertness through vehicle systems analysis and warns the driver if necessary. The system must be designed so that it does not continuously record or retain data beyond what is needed.
Advanced driver distraction warnings
The system assists the driver in keeping his or her attention on the traffic situation and warns the driver when distracted. Again the system must be designed not to record or retain data excessively.
Reversing detection systems
The system makes the driver aware of people and objects at the rear of the vehicle with the primary aim of avoiding collisions upon reversing.
Event data recorders
Similar to an aircraft's black box, the recorder stores critical crash-related parameters and information shortly before, during and immediately after a collision so as to allow data to be analysed after an incident.

Additional advanced safety measures will be required for cars and vans, including:

Advanced emergency braking systems
The system can automatically detect a potential collision and activate the vehicle braking system to decelerate the vehicle. The system must detect obstacles and vehicles in the first instance, and it must also provide for extending detection to include pedestrians and cyclists.
Emergency lane-keeping systems
The vehicle assists the driver in keeping a safe position in relation to the lane or road boundary, at least when a lane departure occurs or is about to occur and a collision may be imminent.

This feels like a replay of the days when VHS competed with Betamax for dominance in the "format war" that marked the 1980s VCR market. But is it the right place for regulators to intervene? David Wong (SMMT) believes there is a place for regulation, but he has concerns about regulators picking winners and thinks it should be left to the market to identify its preferences. Other commentators have echoed these views, criticising the European Commission for essentially attempting to select the 'right' technology for vehicle connectivity and imposing unfair interoperability requirements on newer technologies.

If we need to watch out for excessive regulation, then perhaps there is a role for increased standardisation. Technology standards can promote consensus and allow the market to cluster around a set of attributes in terms of quality, safety and compatibility – while maintaining a level playing field. Santino Pietrosanti is a Senior Manager in the Corporate Strategy team at Jaguar Land Rover and focuses on strategic projects across mobility, electrification and CAVs. He feels that standards can relieve some of the uncertainty that is hindering progress in the automotive industry: *"Standardisation is the big thing for technology in the automotive industry over the next five years. This is what will move the needle. The technology will come, but right now the horses are at a gate waiting to be directed"*.

Key catalysts (2): Aligning with societal values and consumer demand

Regulation and standardisation are one part of the picture, but they tend to imply a 'top down' approach. Looking at things from the 'bottom up' is also vital, and CAVs will clearly succeed only if they gain acceptance both among society at large and among individual consumers. Indeed Anthony Waller, a partner in CMS's London Corporate team, suggests that there is often too much focus on whether regulation hinders innovation and industry advancement: *"What stands in the way of progress is ourselves and society. In many ways this represents a greater challenge than issues of regulation"*.

One of the participants at the CMS roundtable, who is a senior lawyer at a leading OEM, points to the recent strength of feeling around Uber, particularly amongst London's traditional black taxis, as an indicator of the power of public opinion. The ride hailing company lost its licence to operate in London in September 2017 – it was subsequently awarded a 15-month probationary licence and continues to be present on the capital's streets. Whether or not the hostility that was aimed at Uber's operations directly influenced the actions of the authorities, it's clear that regulatory approaches can be susceptible to the public mood and societal sentiment.

Lobbying remains especially influential in established democracies such as the US and UK. The CMS roundtable participants shared the perception that those in the CAVs space would benefit from combining forces to educate stakeholders and wider society on the advantages of automotive innovation, including that it will create dramatically safer roads.

Anthony Waller (CMS) says that societal education should go beyond the obvious and identify the extended benefits that come from safer streets. Brake, the road safety charity, has stated that one in five patients admitted to UK trauma centres in 2016 was involved in a road accident. Eradicating or even eliminating this source of hospital admissions could be a huge boost for the NHS and reduce pressure on its finances. With such a high percentage of public spending in the UK going on the NHS at present, a paradigm shift in road safety brought about by CAVs could have a positive effect on the public purse more broadly – who would argue against that?

Of course, society still needs to be convinced that it is safe for technology and AI to take over actions that have typically been performed by humans. On the road, human experience and instinct count for a great deal. A machine, in contrast, makes calculated decisions based on cold algorithms. This makes it harder for machines to earn the trust of the public. There was significant public disquiet following the fatal collision involving a self-driving vehicle in Tempe, Arizona, in March 2018 – despite the fact that tens of thousands die on US roads each year in accidents that are caused by human mistakes.

Consumers do tend to come around to new technologies eventually, though. When technology enables a product or service to become cheaper or makes life easier, the public has a tendency to forget its previous concerns. There was a consensus at the CMS roundtable that CAVs powered by AI can overcome consumer scepticism if their advocates make an enthusiastic case for the benefits they will bring about – not just for vehicle safety, but also in terms of social mobility, the environment, personal productivity, free time and economic opportunities.

As these benefits permeate the public consciousness, attitudes will alter. As Joel Vertes, an IP partner at CMS notes, society has long accepted high levels of automation in passenger air travel. Reports that automated systems in Boeing's 737 Max 8 jet may be to blame for the recent Lion Air and Ethiopian Airlines crashes have certainly caused trust issues with that particular model of aircraft, but air travel is still widely regarded as reliable and safe. As CAVs build up their own track record of positive effects on society, they will also be in a strong position to gain broad acceptance among consumers.

+3,900

It is estimated that more than 3,900 lives will be saved between 2019 – 2030 due to CAVs.

Source – SMMT: Connected and Autonomous Vehicles 2019 Report – Winning the Global Race to Market

Key catalysts (3): Generating viable models for effective monetisation

As societal concerns diminish and the public embraces what CAVs have to offer, there are clear opportunities for the autotech industry to improve the customer experience and develop new revenue streams. These extend from mundane matters such as enhanced vehicle diagnostics and maintenance to a host of broader services that haven't previously enjoyed a close connection with the automotive world.

In the same way that the mobile phone has evolved from its humble origins to a device that can control the heating in your home and identify alternative routes into work, the automobile is poised to transform from a simple mode of transport to something that can perform all manner of tasks. PwC's Digital Auto Report in 2018 predicted that 100% of new cars sold in 2022 will be connected to the internet, so the potential customer base for connected vehicle services is vast. Identifying the right business models for monetising these opportunities will be crucial.

Laurence Kalman, a partner in the Technology team and co-head of the Autotech Group at CMS, points out that a connected vehicle can effectively function as a sophisticated marketing device, with an intimate understanding of its owner and their interests: *"If I drive to work every day or make regular trips to other destinations, my vehicle can learn a lot about my commercial preferences and generate multiple opportunities for monetisation"*. Indeed, as increasing automation shifts the emphasis away from the driving experience and towards a broader user experience, OEMs' business models will need to adapt. Connectivity can vastly increase the opportunities for OEMs to gain insights into their customers' individual driving habits and preferences, which in turn may enable them to offer new, value-added and connected services.

Many view the wealth of data that CAVs will generate as the holy grail in terms of monetisation – after all, we're frequently told that data is the new oil of our modern economy. But there is more than one way to realise the value in data. Santino Pietrosanti (Jaguar Land Rover) believes that successful business models should focus on longer-term development and extraction of value, rather than sacrificing this to shorter-term data monetisation. *"Data can drive operational efficiency and a better customer experience"*, he says, which will generate lasting value, *"and then maybe you can monetise it somewhere down the line"*.

When developing these new business models, it would be wise for the autotech and AI industries to maintain their focus on less eye-catching, but equally valuable, services as well. Sai Lakshmi is the founder and CEO of Caura, a consumer-facing technology platform that is developing solutions to help customers address routine tasks such as managing their vehicle's MOT or renewing their insurance policy in less

than 30 seconds. He says there is a lot of low-hanging fruit for the sector to address: *"We need to fix what customers need today, which then gives you the opportunity to serve the same customers with future technology. And to take a leaf out of Apple's playbook, it just needs to work!"*.

On any analysis, then, the customer must remain king in the CAV ecosystem. In the automotive industry, OEMs are traditionally accustomed to 'owning' the relationship with their customers. As vehicles develop connected and autonomous features and the number of players in the value chain grows, will OEMs be prepared to hand over some of this power to technology suppliers and other service providers? *"It's a big ask for the OEM to build something entirely new and then expect them to allow others into their relationship with the customer,"* Anthony Waller (CMS) says.

This raises difficult questions for the industry's traditionally dominant players, and sacrificing some of their control over the customer relationship may be inevitable. *"Who owns the customer?"* asks Agustín Martín, CEO of Toyota Connected Europe. *"Nobody. We're going to see a new value chain. Car manufacturers are used to owning the customer, but who is now going to develop an A to Z solution? Not even the phone manufacturers can do that."*

> Who owns the customer? Nobody. We're going to see a new value chain.
>
> *Agustin Martin, CEO of Toyota Connected Europe*


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Vehicles as connected, mobile platforms of the future

Getting all of these catalysts right – putting the right regulations and standards in place; identifying enduring societal values around mobility and promoting consumer acceptance; and above all creating viable business models and suitable channels for monetisation – will be crucial in establishing a sound basis for CAVs to succeed in the coming years. What will that future look like? It can be hard to predict the shape of things to come in the automotive industry; Henry Ford was supposed to have wryly observed that: *"If I had asked people what they wanted, they would have said faster horses"*.

One thing that's clear is that vehicles are demonstrating their ability to act as a point of convergence for technology systems, media services and communications networks. Much attention is currently being focused on entertainment options and additional services that can be built into vehicles' infotainment systems. Enhanced connectivity will allow connected vehicles to become content platforms in their own right. Users will increasingly be able to stream film, TV and music, and access other services, while travelling, as cars develop into a mobile 'internet of things'.

This reflects a broader trend in the way in which we consume media content and related services in society. In 2014, only 7% of our TV-watching in the UK took place on non-TV devices. By 2017 it was 10% and by 2020 it's expected to be 15%. Automotive players are now joining this shift towards consumption of media and other services on demand. As they do so, they will face strategic decisions about how they go to market – and in particular the extent to which they associate their brand with their own, specific content.

One option for OEMs who want to introduce connected services into their vehicles is to create a largely in-house offering. This is attractive as it enables more effective differentiation and supports premium branding. The downside is that it's likely to be expensive and higher-risk, and it takes longer. At the other end of the scale, OEMs could fully adopt third party systems and content in their cars. This offers advantages in terms of flexibility, lower costs and greater speed to market – but it doesn't provide the level of brand differentiation that these marques have previously enjoyed. Over the next few years we may see different segments of the market opt for different models, and potentially hybrid solutions as well.

Leveraging and protecting new data sources

Running through all of the issues discussed at the CMS roundtable was the golden thread of data. It has been hard to get away from concerns about data over the last few years, particularly with the arrival of the EU's long-awaited General Data Protection Regulation (GDPR). And CAVs will undeniably generate vast volumes of information – including personal data as well as functional and technical information. Wide access to data is essential for the full benefits of AI and related technologies to be realised, but equally we need to be mindful of the need to protect privacy and maintain security.

Data gathering and analysis clearly have the potential to add value in their own right. A vehicle's ability to analyse its own performance and health could lower warranty costs. Insurers can design bespoke premiums and cover based on the data that the vehicle is generating. They can also apportion liability for accidents more accurately based on data gathered by the vehicle. Law enforcement authorities might use data to investigate crimes and road accidents.

All of this raises questions of data ownership and the data-related responsibilities that participants in the value chain must bear. In this context, brand strength in the automotive world is no longer purely an issue of acceleration, speed and handling. It's also about whether the customer can trust the technology and the data that the vehicle holds and processes. Like other segments of the 'internet of things', trust in the level of security and privacy guaranteed by a CAV becomes a major factor in the purchaser's decision making.

In this increasingly complex data landscape, we will need greater clarity over how data should be handled and the rights that are enjoyed by each interested party. *"How far and wide should access be given to vehicle-generated data?"* asks Caroline Cooper, an Associate in the Technology and Data Protection team at CMS. *"Who should be making the decisions – does there need to be further direction given from government, or should it be left to market participants to decide between themselves as part of their commercial arrangements?"*

Security and privacy concerns will be paramount whenever vehicles are connected to networks and to each other. Connected vehicles that are also autonomous could

become a prime target for cyber criminals. Stephanie Beaumont, Senior Legal Consultant at Toyota Connected Europe, emphasises the importance of designing and building CAVs with these concerns in mind. Similarly to the aerospace industry, she notes that *"manufacturers should have data and cyber security at the forefront of their considerations"*.

This isn't just a concern for manufacturers, though. In particular, their tier one suppliers have to be alive to this issue. This points to the broader alignment of interests that manufacturers and suppliers need to achieve in relation to CAVs. After all, they occupy closely related ecosystems. Saul Reichman, Global Director of Innovation and Corporate Venturing at Maxion Wheels, the leading wheel manufacturer, observes at the CMS roundtable: *"Tier one suppliers need to create more synergies with OEMs to meet the industry's evolving demands. Suppliers are dealing with a number of business-to-business issues in this context, including privacy and data protection strategies"*.

> Tier one suppliers need to create more synergies with OEMs to meet the industry's evolving demands.
>
> *Saul Reichman, Global Director of Innovation and Corporate Venturing at Maxion Wheels*

2019 – the year of the connected, autonomous car?

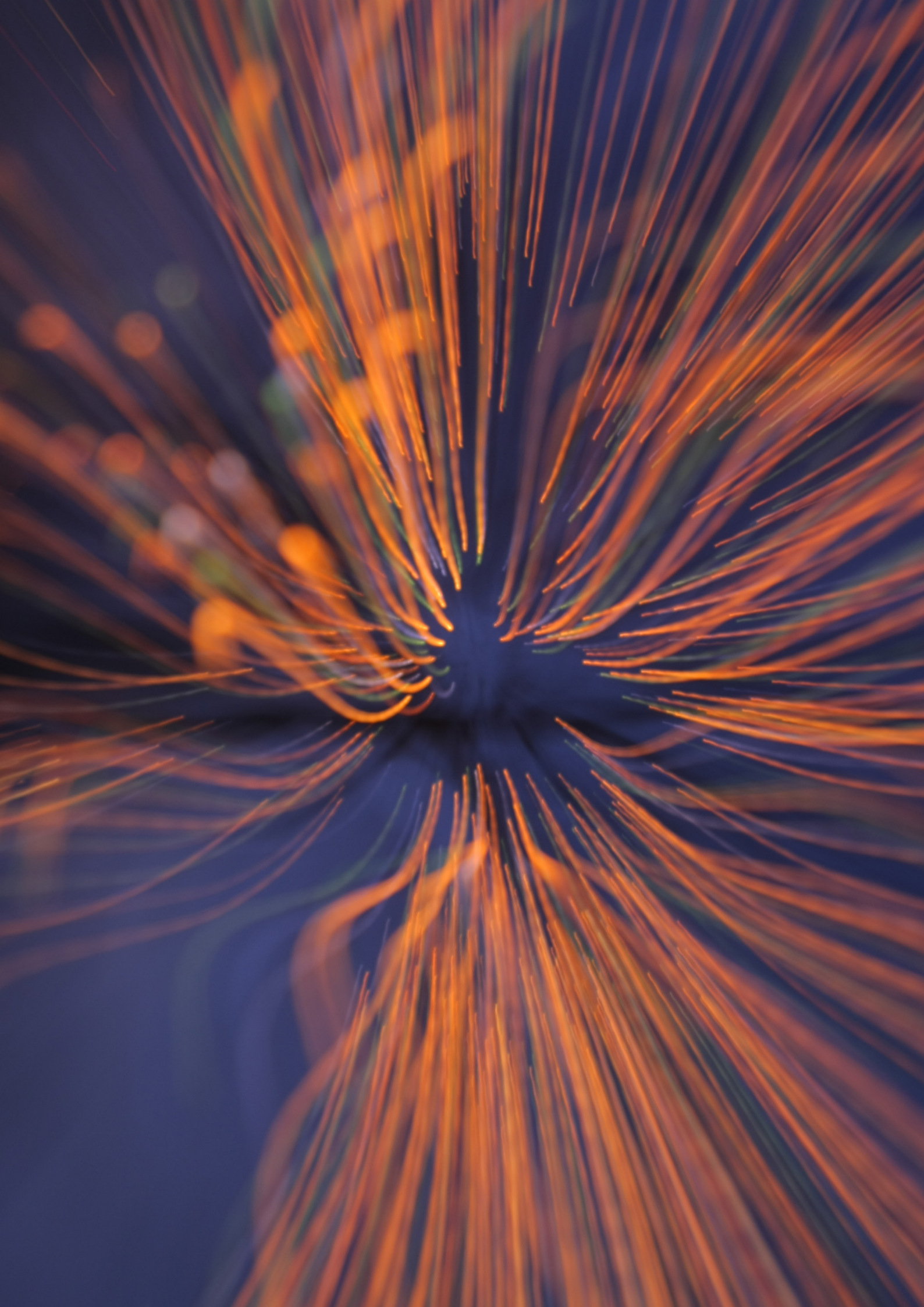
At the CMS roundtable, we began with the question of whether 2019 will really be the year when genuinely autonomous and connected vehicles reach our streets. Although we may need to rein in our expectations about 2019 in particular, there's no doubt that vehicle connectivity is already very much with us and that automation is becoming a reality as well.

These changes are happening in modest increments to begin with, but there is vast potential for CAVs to disrupt – and ultimately revolutionise – the way in which we consume mobility itself and a host of other services.

Regulation and standardisation have a major role to play. Societal norms and consumer enthusiasm need to be properly aligned. Business models that will generate returns in the long term must be established. The full potential of CAVs may then be realised – as long as we also ensure fair access to data, balanced with measures to protect individuals' privacy and security. We look forward to continuing to engage with leading autotech and AI players on these fascinating debates as the future of the industry unfolds.

More than £62bn of economic growth expected by 2030.

Source – SMMT: Connected and Autonomous Vehicles 2019 Report – Winning the Global Race to Market



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