



CUSHMAN & WAKEFIELD

Dashboard

56265145155
73231646548
78456494245

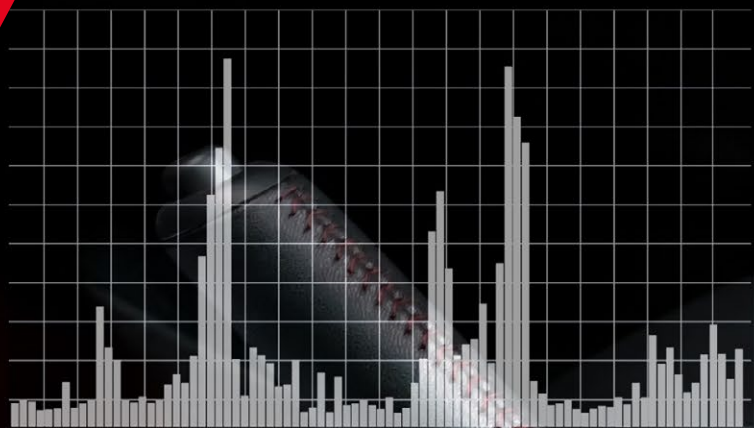
21561545314
56265145155
23231646548
78456494245
23611694845
97654297569

UNDERSTANDING THE IMPACT OF AUTONOMOUS VEHICLES ON COMMERCIAL REAL ESTATE

2018

A RESEARCH & INSIGHT PUBLICATION

Self-Driving Mode



72

09:21

1011010110 110110101010 01000010100010111001
0001100010100101 010110101101101010 0101010000101000110
1110011000110000101001011010110101010101010101000010
100011011100110001100 100011011100110001100
101101011010 10110101010101010000010100 1101110011
0001100010100101 10110101101101010101010 0101000110

1011010110
1011010110
1011010110
1011010110
1011010110
1011010110
1011010110
1011010110

101101
00110001010
1001100011
101101
00110001010
1001100011



EXECUTIVE SUMMARY

RAPID URBANISATION COMBINED WITH INCREASING DEMAND FOR GOODS AND PEOPLE TO BE MOVED IN MASS AND AT SPEED MEANS MOBILITY MATTERS MORE THAN EVER. LOGISTICS COMPANIES, MOBILITY PLATFORMS AND VEHICLE ORIGINAL EQUIPMENT MANUFACTURERS (OEMS) ARE COMPETING TO LEAD THE WAY, AND HAVE INVESTED SOME \$80BN GLOBALLY IN CONNECTED AUTONOMOUS VEHICLES (CAVS).

However, the fast pace of change and wide range of trends driving investment in AV technology means identifying some short term priorities to ensure the sector can meet the changing expectations of occupiers, developers, landlords and regulators.

Short-term Priorities

Watch the innovators and the legislators: The property sector should look to both market investment trends and government policy to anticipate technological advances and responses.

Focus on the transition, not just the final outcome: It is easier to think about an entirely AV city than it is one with mixed road use, making it difficult to understand how landlords should adapt buildings. Planning for flexibility and adaptability is key to avoiding obsolescence.

Look beyond AVs to how the world of mobility is changing: Interest in AVs is driven by demographic, political, environmental, and technological factors whose impact is not limited to the question of who is behind a vehicle wheel. Landlords, developers, and occupiers need to understand how end-user expectations about mobility, environmental quality, and data are changing.

Long-term considerations

Investment Opportunities: Investors and landlords should evaluate opportunities in buying, selling or conversion of car parks.

Rethinking Distance: Better commuting means location and accessibility may no longer be everything. Landlords need to think how amenities can make their developments more attractive.

Leading the way: Emphasis on sustainability and public realm favours landlords who champion car-free or reduced-car development, both in terms of place branding, maximising developable land, and securing planning permission.

Futureproofing Design: It may not be right to go car-free yet, but designing new cars with conversion in mind may create value in the future.



OUR PREDICTIONS

Full deployment of Level 5 (fully driverless) AVs is not likely to happen before 2030 - 2040. This is due to a range of factors, including the cost, demand for the phasing out of non-AV capable vehicles, and the performance of AV vehicles in terms of safety and performance over the next five years.

1

CAV fleets are likely to be operated in geographically defined areas within the next 5-10 years. This could include filling the gaps in last-mile connectivity left by mass transit or providing a dedicated mobility solution for a large and contained site such as an innovation district, airport, or university campus. Services will be run by private companies, public transport operators, or by cross-sector partnerships.

2

More cities will adopt Mobility as a Service (MaaS), allowing residents to plan, book, and pay for a range of public and private mobility solutions through a single outline platform. This will favour cities with good levels of existing public transport and open data infrastructure.

3

AV technology will be adopted more rapidly for transporting goods rather than people. The extent and timing of deployment is likely to be strongly influenced by the response of those working in the sector, and the possibility of resistance towards reconfigured roles, redundancy, or redeployment.

4

DEFINING AUTONOMOUS VEHICLES

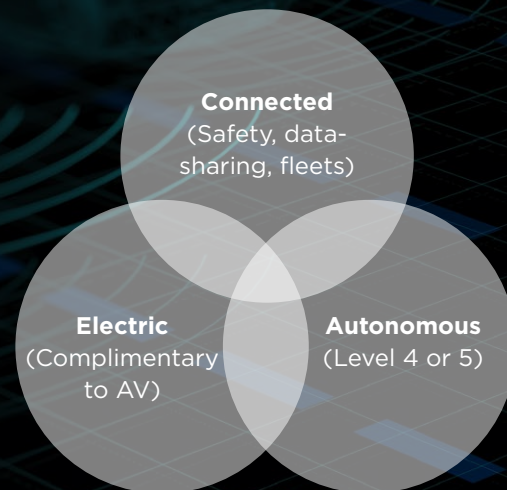
AV technology, whilst developing rapidly, is still largely in the prototype or testing stage. This is particularly true for those technologies required for vehicles to be truly 'driverless'. Unexpected benefits or disadvantages are likely, some of which may not be realised until AVs reach high market penetration.

AVs are not necessarily 'driverless' as some vehicles may self-navigate only in certain environments or certain circumstances and so may still occasionally require human drivers. Nevertheless, the case for increasing the amount of driving tasks that can be automated is based on potential to minimise human error, which is responsible for over 90% of vehicle crashes.

The table below summarises the Society Automobile Engineers (SAE) International standard definition of automation levels. Each level refers to the degree to which driving tasks can be automated, and in which environments.

The impact that AVs will have on CRE depends not just on advances in levels of automation, but the operating models of vehicles. For example, non-connected AVs may have less of an impact on car ownership than CAVs, as the latter supports ride-sharing and the deployment of self-driving fleets.

Fig 1: Connected Autonomous Vehicles - the convergence of three technologies



Level	Description	Examples and Scenarios
0 No automation	Human required for all tasks and must monitor road at all times	Majority of existing cars
1 Driver assistance	Computer assistance for either steering or speed control. Human work and monitoring essential	Jaguar off-road cruise control
2 Partial automation	Steering and speed controlled by Advanced Driver Assistance System in defined use cases. Human monitoring essential at all times	Tesla Autopilot or Mercedes Distronic Plus Includes adaptive cruise control, lane-keeping assist and automatic emergency breaking
3 Conditional automation	"Automated Driving Systems", with vehicle monitoring environment to make decisions. Human control available to intervene, for example, in adverse weather conditions	Tesla Autopilot, including the remote parking function Volvo are aiming for full autonomy on motorways by 2021 using autopilot option on a premium vehicle
4 High automation	All safety-critical driving functions are automated within Operation Design Domain (ODD). This technology is applicable to driverless shuttles operating in private or managed environments such as worksites	Ford aiming to deliver fleets of geofenced Level 4 AVs for commercial ridesharing by 2021 Toyota expect Level 4 vehicles operate within specific areas in the next decade BCG research estimates Level 4 vehicles could make up around 10% of global sales in 2035
5 Full Automation	Vehicle requires no driver either for tasks or monitoring environment, in any domain	Bosch and Daimler aiming for Level 4 and 5 by 2020



RETHINKING DISTANCE

When it comes to real estate and property valuation, location is key. Whether it is

proximity to natural resources, similar firms, or simply the right kind of people, occupiers and investors are willing to pay more for a property located where they want to be. Connectivity to transport is no exception – whether this be airport, mass transit, or a road network.

If widespread CAV use makes commuting either more productive, attractive or simply cheaper, the relative importance of distance reduces, and that of other locational factors like amenities or built environment design increases. CAVs could theoretically prompt the reappraisal of the time factor in commuting, meaning that the value of location and proximity to the city centre is potentially adjusted. It has been argued that this reappraisal of the trade off between location and mobility not only makes suburban living relatively more attractive, but could eventually reduce the importance of travel time as a limiting variable in urban planning. (Maurer, 2016).

Some studies expect CAV deployment to reduce congestion and increase road capacity, particularly once the transition stage is completed and CAVs dominate the road. This reduction in congestion would further accentuate the process of re-evaluation of distance outlined above. However, CAV deployment is not guaranteed to reduce congestion, as savings made on stopping distances or parking-induced congestion could be negated by an increase in the number of vehicles on the road due to lower barriers to entry and the potential appeal of time spent in the vehicle as a positive utility.



CITY CORES

City cores with high levels of connectivity and public transport provision are less likely to see AVs have a transformational impact on CRE. The sheer scale and density of people that need moving within urban cores means CAVs are unlikely to replace mass transit. This is particularly the case in cities like London, where population growth and high density development puts pressure on existing road space. Similarly, CBDs will continue to enjoy a locational premium based on their density of amenities, skilled people, and economic activity.



However, CAVs will become part of the range of transport available in a city core, either in the form of ridesharing or driverless shuttle buses. OEMs and ride hailing companies are already making major investments into on-demand, autonomous and electric vehicles. General Motors announced a \$500 million investment in the ride service Lyft, with the aim of building a new generation of autonomous taxis. Ford has invested \$1bn in Argo AI to create a fully autonomous vehicle for use in predefined areas by 2021. Daimler have a deal with Uber to roll out their self-driving vehicles as part of the platform, with Uber also investing in 24,000 AV-ready vehicles from Volvo. The axiom that the world's largest taxi company owns no vehicles is no longer quite true!

For economies and locations which thrive on the ability to attract and retain high-skilled talent, high-performing infrastructure, good air quality, and attractive public realm are key to success. Individuals are increasingly aware of the negative

impacts of air pollution on physical health, and on long and crowded commutes on mental wellbeing. Developers are keen to promote walkable public realm, and landlords offer facilities that offer end-users a choice when it comes to commuting, including bike storage and showers. Assessment schemes such as Fitwel and the WELL Building Standard include a number of measures aimed at supporting active transport solutions, such as the provision of bike parking or location in walkable neighbourhoods. Indicators may extend to include innovative methods of supporting sustainable transport. For example, if many users or visitors use private hire vehicles, landlords may identify accessible drop-off points to avoid engine idling or encourage logistics consolidation using EVs. More ambitious landlords will try to better understand the commuting patterns and mobility behaviour of end users to improve not just the environmental performance of buildings and their surroundings, but the range of mobility solutions on offer.

Commuting and Congestion

The British Council for Offices found that almost half of UK office workers complain that they endure an unpleasant and stressful trip to work, with almost three quarters of train commuters and nine in ten tube passengers citing overcrowded journeys as their chief grievance. BCO (2014) Making the Business Case for Wellbeing: the 2014 Wellbeing at Work Study.

A 2017 study of 34,000 workers across the UK found that longer commutes have a negative impact on productivity. Employees commuting less than half an hour to get to work gain an additional seven days' worth of productive time each year compared to those with commutes of 60 minutes or more.



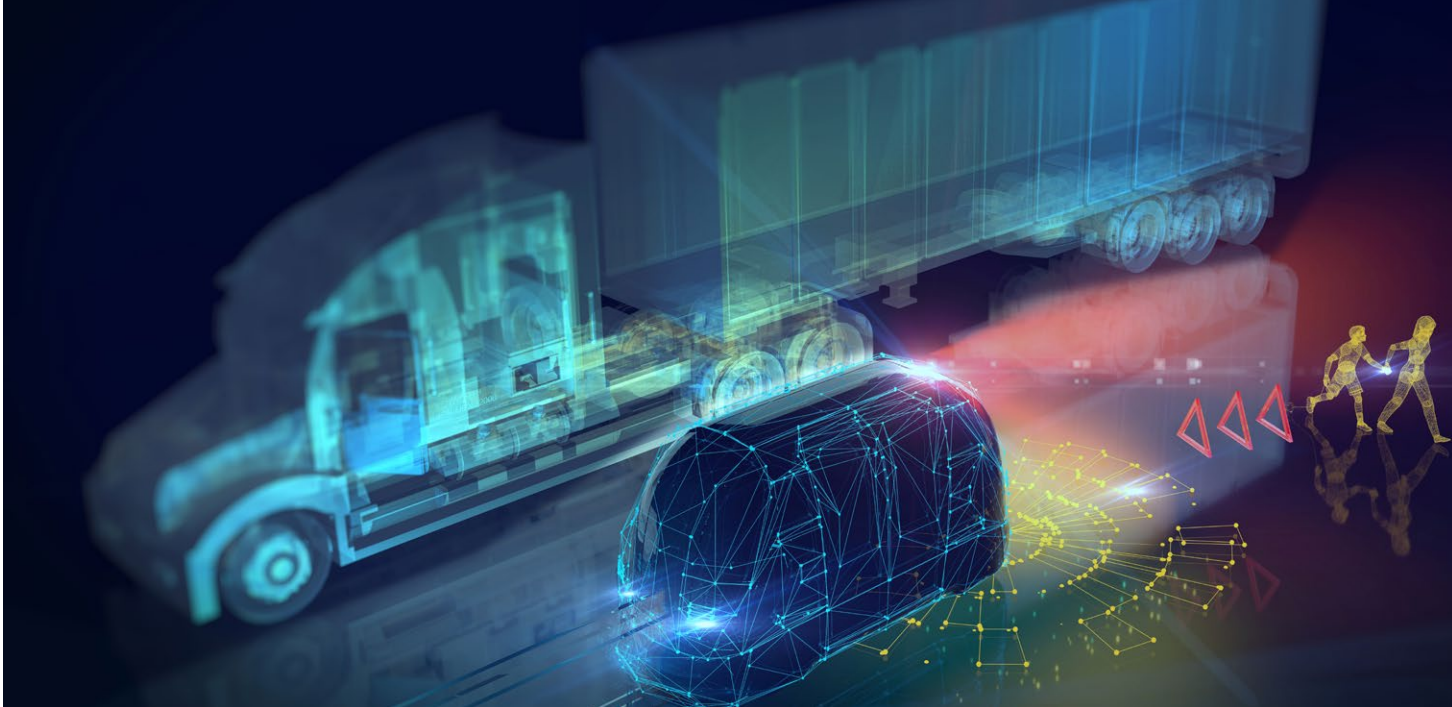
RETAIL

Assessing the impact of AVs on current retail locations requires understanding not just shifts in customer behaviour and perceptions of convenience, but existing changes to retail, including the rise of online shopping and the experience economy.

- **An improved and more accessible driving experience is likely to extend catchment areas.** This is based on a willingness of people to travel further, and the provision of enhanced mobility for those previously unable to drive, including the disabled and the elderly.
- **A lower cost of driving and parking may mean the reappraisal of the relative benefits of retail locations.** The benefits of improved accessibility, potentially reduced congestion, and decoupling parking from retail locations could benefit centrally located shopping destinations.
- **A reduction in the number of visitors parking on site is likely to lead to a reduction in the amount of parking required.** This freeing up of land could offer opportunities for landlords to diversify land use on site, for example by providing additional amenities or selling land for residential development.
- **If online retail can harness new AV technology, the economics of home delivery may improve sufficiently to meet demand for online deliveries.** Thus, the positive impact of AVs on retail locations will be tempered by the increasing popularity of online retail.

AVs can provide a last-mile service connecting retail centres with public transport hubs. While this last-mile provision may be enabled by AVs, it is not necessary that these last mile solutions are autonomous, as they could operate on an on-demand, micro-transit basis.

Retailers could also collaborate with AV providers to offer AVs as a customer service. A Google division called Intersection is already looking at technology that can be used to offer a premium experience for customers arriving to retail centres using AVs, for example, by alerting a concierge to their arrival and preparing their favourite coffee. It is possible that shopping centre operators or retailers will partner with AV operators to offer premium MaaS, including targeted in-vehicle entertainment and marketing. These services will rely on the collecting and sharing of data about both mobility and consumer habits, and can be used by retail park operators as a means of reducing the need for carparking.



LOGISTICS

The use of automation in warehouse environments is not new, with many

companies using software applications for sorting or restocking goods. In contrast, current limits to dexterity of hardware (i.e. robots) and their high cost in comparison to human labour means such technology is not yet widespread, and is primarily limited to assisting workers.

However, there are reasons to suggest AVs will play an important role in logistics within the next five to ten years. Urban logistics is expensive – 50% or more of total supply chain costs in Europe – meaning that manufacturers, retailers and third party logistics companies are looking to technology to improve efficiencies and reduce costs.

Investment by logistics companies in AV may also be prompted by changes to employment legislation which could make existing courier systems less flexible and more expensive. City targets to reduce congestion could also mean a push for new solutions.

A large proportion of logistics vehicles spend much of their time operating in more predictable environments, or “operation design domains”, to use the SAE terminology. This makes partial and conditional automation of freight vehicles relatively achievable, and indeed desirable, given the expected benefits of automated braking, lane changing and cruise control on safety and fuel efficiency.

Growing demand for online deliveries, in terms of both scale, product lines, and customer services means that companies are looking to innovative solutions to meet real estate and delivery infrastructure needs. One option is for delivery companies to invest in fleets of CAVs to replace delivery vans. This has the advantage of reducing labor costs and operating beyond the restrictions of

working hours. Without a delivery worker on board, the proposed scenario is that these CAVs essentially operate as a set of lockers on wheels, allowing the customer to retrieve their goods by entering a code. As with passenger carrying CAVs, it is feasible that such systems could operate within geographically defined areas within the next five years. However, the question of exactly how customers retrieve goods and whether a human worker is required for customer services purposes will need to be resolved if they labor-saving benefits are to be fulfilled.

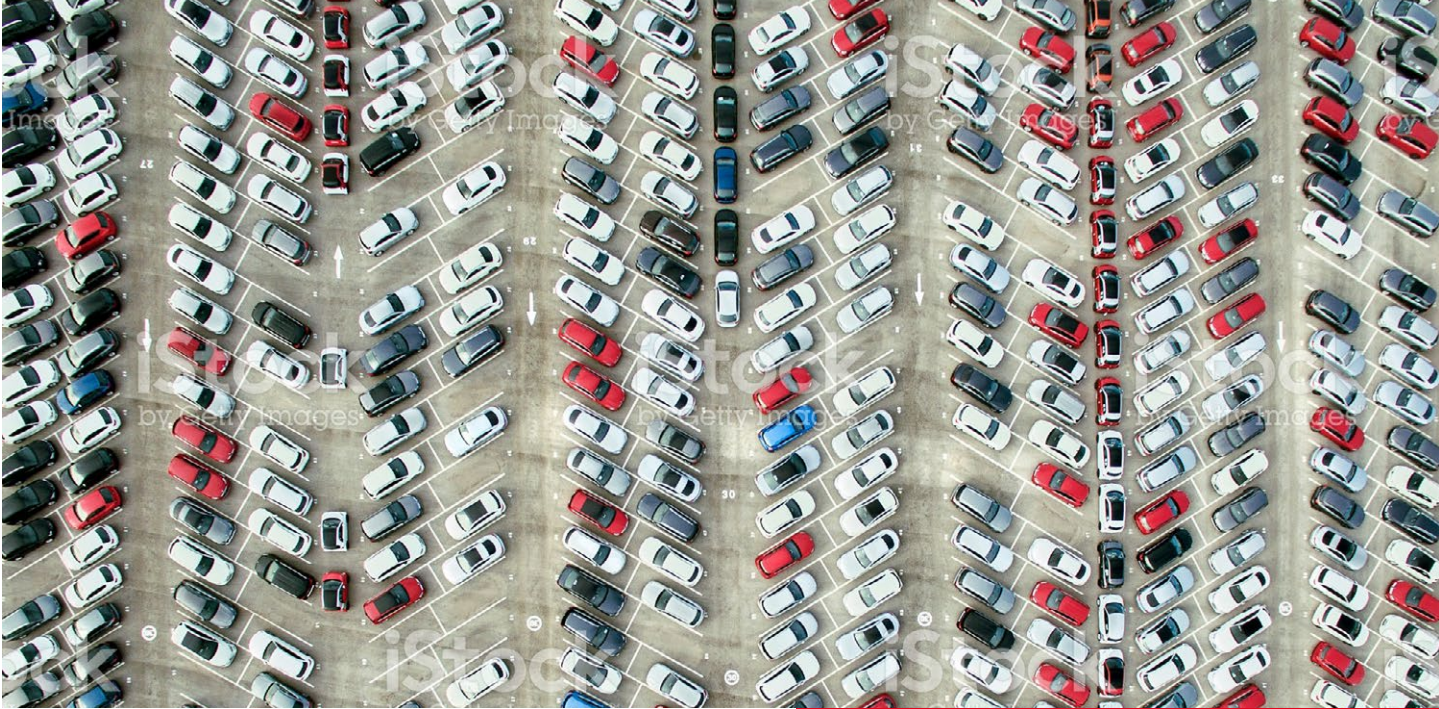
One of the more eye-catching innovations is the use of drones for delivering goods. While there are clear advantages in terms of avoiding traffic and being able to deliver within specified time slots, the scalability of drones

for delivery has been questioned. Drone delivery is unlikely to have a major impact on the built environment as their use is likely to remain a niche solution in urban areas. However, drone use in surveying, construction, management and marketing is on the rise, particularly in the US, where 1 in 5 drone exemptions has been for real estate purposes.



One means of avoiding the challenges of concerns around safety is to deploy drones that

operate on the ground – droids. These are small pods that operate on pavements, and can carry up to 15kg. London-based company Starship Technologies has carried out 60,000 miles of deliveries across 100 cities in a range of countries, partnering with companies such as Just Eat with a focus on decreasing the cost and increasing the efficiency of on-demand last-mile delivery. However, the limited pavement space for these AVs means scalability is a challenge, and reduction in congestion is unlikely, particularly if the solution is compared to the relative fast pace and low cost of bicycle couriers. Delivery giant UPS began trialling an electric-powered bike trailer in London in 2017, allowing couriers to carry up to 200kg of parcels.



PARKING

A reduction in carparking spaces is not necessarily contingent on the deployment of AVs, but could be prompted by improved connectivity,

expansion of Mobility as a Service, or a commitment to a 'car park free' vision, or simply the ability to get better value from land.

Carparks may be sold or redeveloped for retail, office, or even logistics space – often depending on land values and the initial design of the car park. In 2017, Westfield Europe submitted plans to convert an entire floor of the car park at Westfield Stratford City to retail use based on exceptional demand from retailers for additional space.

Predictions as to the exact reduction of parking spaces are difficult, as it depends on locations, AV usage and end-user needs. The fate of existing car parks will depend primarily on ownership, design, management and land values. For example, it is feasible that publicly owned car parks (for example those held by TfL) are ringfenced for the development of housing, with set quotas of affordable housing. Such a model has already been proposed by the New York Regional Planning Agency.

Research suggests that a near complete removal of parking spaces and road space simplification within a new development would gain an estimated 15-20% additional developable area. A reduction in parking is also likely to be viewed positively by planning authorities, and could become a branding or sales point for new developments as "AV only" zones.

Working out what to do with existing parking is one thing. Understanding the amount of parking needed in the future is more difficult. New developments, both residential and mixed, present an important opportunity to introduce AVs alongside reductions in parking and road space. Parking space allocation is also likely to reflect target occupier demographics and development location.

Single land ownership or management makes planning more straightforward and presents an opportunity for developers or landlords to partner with AV fleets to deliver services.

INNOVATIVE APPROACHES TO CAR PARKS

Changing Residents Behaviour

Residential developers Moda are partnering with Uber in Manchester to offer a bespoke service to residents in exchange for foregoing a parking space. Residents are offered up to £100 credits per month if they agree not to have a car parking space within the development, with the aim of freeing up land for amenities such as a fitness centre and entertainment room.

Flexible Car Parking

AvalonBay, a major residential developer in LA, has plans for a garage that can accommodate 1000 vehicles, but that can later be converted into shops, gym, and a theatre due to the use of level rather than inclined floors. Avalon Bay developments also include electric-car charging and drop-off points for ride sharing.

From parking to logistics

Chronopost Beaugrenelle is a 3000 sqm logistics hub covering two levels of an underground car park in Southern Paris. The facility services two large freight vehicles a day, distributing last mile deliveries using 10 electric vans and ten diesel vans. The benefits of the space include noise reduction thanks to the basement location and ready-made vehicle accessibility. The company is looking for further parking facilities in the capital to continue the consolidation of its distribution network.

DRIVING TRENDS - UK CONTEXT

The framework below uses a STEEP analysis to set out the motivating and limiting factors affecting AV technology and its deployment. While the factors are applicable in most contexts, national and regional differences would occur. The table below references UK data where relevant. It is recommended national, regional, and sectoral data is taken into account where possible.

SOCIAL



Cultural attachment to vehicle ownership

Concerns around security threats and algorithmic morality. UK public unsure of using or interacting with AVs



Reduction in car ownership, particularly in younger age groups.

Densification of urban core

Consumer expectations for on-demand travel and delivery. UK online sales are expected to grow by 10% by 2021

TECHNOLOGICAL



Lack of ubiquitous internet - less than 22% of UK roads have full 4g coverage (SMMT)

Technological limitations to full AV, for example, in adverse weather conditions



Increase in internet coverage

Data storage and processing

Battery and charging technology

ECONOMIC



R&D budgets impacted by economic policy (ie. tax breaks), market conditions (especially for business R&D) and macro-economic trends (both private and public R&D).



Consumer purchasing influenced by macro-economic trends

ENVIRONMENTAL



Concern that AVs may detract from investment in, and benefits of, active and public transport

Question as to extent to which AVs will reduce congestion, especially in city centre if vehicle numbers not managed



Commitments by national and regional governments to reducing air pollution and congestion, or to reduce car ownership or car use within certain parts of a city. Target for London to be carbon free by 2050, and UK ban on sale of petrol and diesel cars from 2040

Emphasis on air quality and public realm in terms of wellbeing and competitiveness

POLITICAL



Negative performance in trials or in roll-out may lead to legislation restricting use

Differences between national and regional legislation

Resistance to technologies that may impact labour market such as the automation of goods vehicles or that may be seen to restrict the freedom of motorists



Safety performance of AVs during trials and early roll out will be pivotal. Major increase in safety could prompt regulation phasing out cars without AV capacity. This follows legislation for increased automation of driving to improve road safety eg. ABS

Government funding and support for R&D and AV trials. Includes establishment of Centre for Connected and Autonomous Vehicles in 2015 and trials taking place in Bristol, Greenwich, Coventry, and Milton Keynes



To conclude, uncertainty around the impact of AVs on driving behaviour and parking needs leaves cities and developers with a range of options.

The challenge for the CRE sector is to view advances in CAV technology in the broader context of changes to urban density, end-user behaviour, and mobility solutions. For some this may mean simply monitoring the social, technological, economic, environmental, and political landscape to ensure decisions around design, location, and accessibility can adapt to trends. One is to design car parks with adaptability built in, including lightwells and other floors.

For others in the CRE sector, a response to AVs may be shaped around a long-term vision for the sustainability of a development, using AV technology to achieve specific goals around congestion, on-demand transport services, and public realm management. Whilst it takes courage for developments to go parking free, planning and investment in alternative options, including ridesharing credits and drop-off points, and working with a range of transport providers, may give end-users confidence in a parking free vision.

Finally, landowners must decide what they want to do with surplus parking, and planning authorities will need to decide how much to intervene with the market.

The message for the sector as a whole is that while advances in AV technology are not to be ignored, decisions around investment, design, and management should place people before vehicle, regardless of who is behind the wheel.

Full deployment of Level 5 AVs is not likely to happen before 2030 - 2040. This is due to a range of factors, including the cost, demand for the phasing out of non-AV capable vehicles, and the performance of AV vehicles in terms of safety and performance over the next five years.

CAV fleets are likely to be operated in geographically defined areas within the next 5-10 years. This could include filling the gaps in last-mile connectivity left by mass transit or providing a dedicated mobility solution for a large and contained site such as an innovation district, airport, or university campus. Services will be run by private companies, public transport operators, or by cross-sector partnerships

More cities will adopt MaaS, allowing residents to plan, book, and pay for a range of public and private mobility solutions through a single outline platform. This will favour cities with good levels of existing public transport and open data infrastructure.

AV technology will be adopted more rapidly for transporting goods rather than people. The extent and timing of deployment is likely to be strongly influenced by the response of those working in the sector, and the possibility of resistance towards reconfigured roles, redundancy, or redeployment.

RECOMMENDATIONS

- > **Watch the innovators and the legislators:** While investment trends may indicate the models of AVs that will be deployed, for example, AV fleets rather than private ownership, government legislation and regulation will impact both demand and take-up, which is likely to differ based on geography.
- > **Focus on the transition, not just the final outcome:** It is easier to think about an entirely AV city than it is one with mixed road use, making it difficult to understand how landlords should adapt buildings. Planning for flexibility and adaptability is key to avoiding obsolescence.
- > **Look beyond AVs to how the world of mobility is changing:** Interest in AVs is driven by demographic, political, environmental, and technological factors whose impact is not limited to the question of who is behind a vehicle wheel. Landlords, developers, and occupiers need to understand how end-user expectations about mobility, environmental quality, and data are changing.



AUTHOR



KAT HANNA
Insight Associate
Research & Insight
kat.hanna@cushwake.com

BUSINESS CONTACT



JAMES MADDOCK
Head of Global Occupier
Services, EMEA
james.maddock@cushwake.com

This report has been produced by Cushman & Wakefield LLP (C&W) for use by those with an interest in commercial property solely for information purposes and should not be relied upon as a basis for entering into transactions without seeking specific, qualified professional advice. It is not intended to be a complete description of the markets or developments to which it refers. This report uses information obtained from public sources which C&W has rigorously checked and believes to be reliable, but C&W has not verified such information and cannot guarantee that it is accurate or complete. No warranty or representation, express or implied, is made as to the accuracy or completeness of any of the information contained in this report and C&W shall not be liable to any reader of this report or any third party in any way whatsoever. All expressions of opinion are subject to change. The prior written consent of C&W is required before this report or any information contained in it can be reproduced in whole or in part, and any such reproduction should be credited to C&W.