New transport technologies and the future of the City

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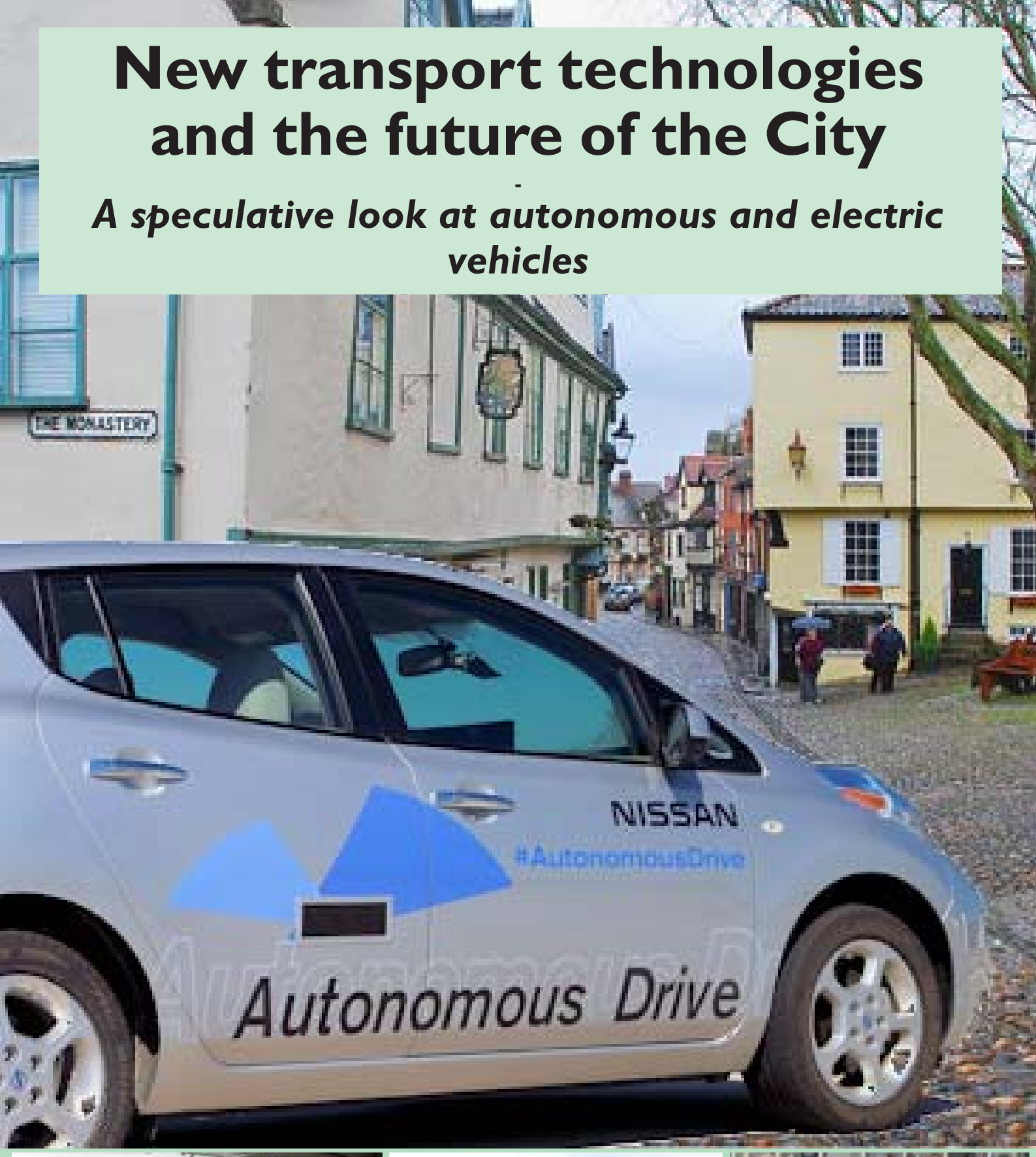
A speculative look at autonomous and electric vehicles



The Norwich Society

Autonomous & electric vehicles: what the future might look like

Introduction

Autonomous (self-driving) vehicles are coming. That is probably the only certainty when considering their future and the effects that they may have on our cities. So this paper is speculative but is intended both to examine some possible consequences and to draw a few lessons for the immediate future.

In this context, the date when autonomous vehicles will be in the hands of ordinary customers is almost irrelevant, as the analysis of the possible ramifications is not time-dependent.

Nevertheless, it is worth pointing out that the first fully autonomous vehicles to go on the market will probably arrive ahead of most people's expectations. Many new cars already include some of the elements for self driving, including autonomous emergency braking systems, lane departure warning systems and automated parking.

And it appears that the day when ordinary customers can buy a completely autonomous car is imminent. All new Tesla vehicles already include the hardware needed for full self-driving capacity; the self-driving features will be enabled remotely by Tesla as testing proves each to be reliable. Volvo will hand over fully autonomous cars to a hundred normal families in Gothenburg for testing in 2017. And Ford has announced that it will mass-produce a self-driving car without a steering wheel or pedals by 2021.

The new Tesla vehicles include eight surround cameras to provide 360-degree visibility around the car for a range of up to 250 metres as well as ultrasonic sensors that can detect both hard and soft objects at nearly twice the distance of Tesla's previous system. A forward-facing radar enables the car to 'see' through heavy rain, fog and dust.

Ford has successfully tested an autonomous car in the snow

In January 2016 Ford became the first manufacturer to test an autonomous car in the snow. Their Fusion Hybrid test car used a LiDAR laser guidance system that is much more accurate than GPS, identifying the vehicle's lane location right down to the centimetre. LiDAR emits short pulses of laser light to precisely allow the vehicle to create a real-time, high-definition 3D image of what is around it.

Significantly, rival carmakers are collaborating to overcome some of the challenges. For example, Daimler, Volkswagen and BMW have acquired HereMaps, which has its own mapping cars to build up detailed information for autonomous vehicles. The consortium intends to use the HereMaps system with the high-precision cameras and sensors that are already installed on modern cars to utilise information from the everyday driving of car owners to identify roadworks and other changes and update data and maps in real-time.

This kind of crowdsourcing data is also being used by General Motors which has joined forces with Mobileye, a company that also makes software for driverless cars, including those manufactured by Tesla.

Indications of the timescale for the introduction of autonomous vehicles include plans by the Singapore company NuTonomy to commence self driving taxi services in that city by 2018 and expand this to another ten cities by 2020. Using Renault Zoe and Mitsubishi i-MiEV vehicles configured for autonomous driving, NuTonomy began testing the service in 2016 with an engineer sitting with passengers to monitor the system and assume control if needed.

General Motors, Toyota and Volkswagen have all forecast that fully autonomous vehicles will be on sale by 2020. Their introduction may well herald changes in the traditional car ownership model, with families ceasing to own their own car.

But cars may not be the first to generally become self-driving. Some authorities have suggested that the initial major market for autonomous vehicles will be goods vehicles as the technology will overcome the limits on efficiency imposed by legal limits on driving time. Already a self-driving 40 tonne tractor-trailer loaded with beer has driven 120 miles through Colorado totally autonomously: the Colorado Department of Transportation hailed this as 'A monumental step forward in advancing safety solutions that will help Colorado move towards zero deaths on our roads'.

Speed of introduction

No one really knows how long it will take autonomous vehicles to become ubiquitous, although in 2015 the US Secretary of Transportation suggested that driverless cars would be in use all over the world by 2025. Uber has forecast that its whole fleet will be driverless by 2030, by which time it claims that 'car ownership will be obsolete'.

It is worth remembering that photographs of Piccadilly Circus taken in 1894 were full of horse-drawn carriages but that the only vehicles in photographs taken just 18 years later were petrol driven.

Transport can change rapidly: in 1894 (top) there were only horses and carriages in Piccadilly Circus; less than 20 years later (1912, bottom) there was only motorised transport

Motor manufacturers are forecasting that autonomous cars will be on general sale by 2020

The impetus for change is likely to come from three sources.

First, autonomous vehicles will be considerably safer than those driven by humans. Ninety per cent of all road accidents are caused by human error: according to the Association of British Insurers, autonomous emergency braking systems have already cut personal injury claims by around a fifth.

Second, autonomous vehicles will be a real boon for people who either cannot or do not wish to drive.

Finally, many people – especially those under 30 – the ability to continue to use social media and mobile video entertainment while travelling is already proving more attractive than driving.

Once the great majority of people are using autonomous vehicles, the pressure to ban humans from using what by then is likely to be seen as lethal weapons may become irresistible.

Issues to be overcome

There are still a number of issues to be overcome before the mass introduction of autonomous vehicles.

The first is insurance: if a car that is being driven autonomously is involved in an accident, is the 'driver' responsible or the manufacturer? The Association of British Insurers (ABI) has suggested that, as the control input transfers from human to computer, it is possible that liability will follow that transfer of risk, especially if the driver is unable to override the system. The ABI is recommending that drivers should continue to buy a single motor insurance policy to cover both manual and automated driving. The Association also wants

insurers to have a new legal right to recovery, allowing them to get costs back from motor manufacturers, software companies or other parties in cases where the vehicle or software was found to have been at fault.

The regulation and insurance of autonomous vehicles also needs to take account of the fact that these will sometimes be driven with no one in them or when the only occupants are passengers who may not even be facing the front of the vehicle.

American legislators are already tackling some of the other problems. For example, California is amending the law to allow autonomous goods vehicles 'platooning' on Interstates to minimise their following distances. New Jersey has instructed its Motor Vehicle Commission to adopt regulations authorising the operation of autonomous vehicles. Florida is exempting the ban on texting for vehicles operating in autonomous mode.

At the international level, there is recognition that the Vienna Convention on Road Traffic – which standardises the way in which vehicles are approved for use in individual countries – needs to be amended to allow for the everyday use of autonomous vehicles. The Swedish and Belgian governments have proposed redefining the term 'driver' to mean 'any person or a vehicle system which has the full control over the vehicle and is in conformity with international legal instruments'.

Autonomous technology also needs to take account of the fact that there will be no eye contact between the 'driver' and other road users such as cyclists and pedestrians. So some way of indicating that the vehicle has detected their presence and that it is therefore safe to cross the road will be needed. One car manufacturer has tackled this by producing a concept vehicle which had a set of LEDs on the front of the vehicle to project a pedestrian crossing onto the road with lasers.

Next year, Volvo will put a hundred autonomous cars in the hands of ordinary drivers in Gothenburg, primarily to test the reaction of other drivers

R & D in the UK

The UK Centre for Connected and Autonomous Vehicles has been set up to co-ordinate research and development for autonomous vehicles. Around £250 million is being invested in a number of demonstration projects, one of which is to facilitate the testing of autonomous software. This is using five Land Rover Discovery vehicles fitted with autonomous safety systems that run in the background whilst being driven normally so that the researchers can compare what the autonomous system would have done with what the human driver actually does. This enables manufacturers to fine tune the software to ensure that it reacts in the correct way.

A second project is focusing on the societal impact of autonomous vehicles; this will study the reaction of members of the public using autonomous shuttles to assess whether passengers accept them and the way in which passers-by react. Future trials will look into how autonomous systems can increase accessibility to transport for impaired users and also test automated delivery systems.

Another concern that has still to be properly addressed is the risk of hackers taking over the control systems of autonomous vehicles, possibly with disastrous results. And there are also concerns about the privacy of those using autonomous vehicles, as these rely heavily on electronic communications with external information sources and, almost certainly, other vehicles. The US House of Representatives has called for an assessment of the readiness of the Department of Transportation to address autonomous vehicle technology challenges, including consumer privacy protection.

Electric vehicles

It is not just autonomous vehicles that will transform some aspects of cities. Electric vehicles will also change the city environment and the speed of their introduction seems more certain and is already accelerating: by the end of 2015 there were more than a million electric cars on the road worldwide, almost half bought that year. A number of car manufacturers have suggested that they will have completely phased out petrol and diesel vehicle production by 2025, by which time they expect that the cost of electric vehicles to be equivalent

The park and ride bus fleet in York is moving to clean and quiet electric vehicles

or less than their oil-powered alternatives and that improvements in battery technology will have extended their range.

The virtual disappearance of petrol and diesel vehicles from our roads could be relatively rapid as fuel stations find it uneconomic to supply petrol or diesel for a dwindling number of customers.

How will cities be affected?

There is a growing view that the introduction of autonomous cars will lead to a majority of people choosing not to own their own vehicle. Ford, for instance, has predicted that 'We will all be paying Spotify-style subscriptions for transport in future. In return, we will be able to jump into different Ford cars. Fancy a convertible for the weekend? Or a van to lug around furniture? It will soon be possible.'

It is worth noting what a poor investment privately owned cars actually are. A study in the Estonian capital Tallinn, for example, found that, on average, cars are left unused for 23 hours a day and even when they are in use they carry only 1.3 people each. And the cost of ownership is high: in Tallinn, more than 12% of the average household income was spent on transport. That figure is even higher in the UK, with the Office for National Statistics reporting in 2016 that transport accounted for almost 14% of UK household expenditure, a third of which was for vehicle fuel.

> "The roadblock is much more about public perception and public tolerance, but how would our lives change if we had on demand access to transport that could take us anytime, anyplace, anywhere, for less than the current cost of running a car?"
>
> *Stephen Hamilton, partner at the law firm Mills & Reeve*

For most people, these factors are currently greatly outweighed by the sheer convenience of having their own car. But that convenience could be matched in future by a simple system of Uber-style ordering of a particular autonomous vehicle best suited for an individual journey that arrives at the door when needed, often providing a service at a lower annual cost to a household.

If individual car ownership does diminish, then the effect will be dramatic: on-street and off-street parking could disappear, as could the need for city centre car parking with autonomous cars dropping you off at your destination and then going to pick up their next passenger for another journey.

On-street parking could become a thing of the past

The demand for road capacity may also reduce as it has been estimated that autonomous vehicles will increase capacity by up to 50% as they drive so much more efficiently than most humans. However, there could also be a temporary increase in the number of journeys as empty privately owned autonomous vehicles that have dropped off their passengers drive somewhere else to park; this increase would drop off as car ownership falls and as shared use of vehicles increases.

An increase in journeys may also come from people who previously did not drive making use of autonomous cars to take more journeys

The head of the MIT Department of Urban Studies and Planning has suggested that autonomous vehicles could allow removal of up to half of the current paved surfaces of cities and that roughly a third of all development in the United States is devoted to car-related infrastructure (although that figure may be less in the UK).

Combine this with the fact that autonomous vehicles will stick to speed limits and react to the risks of people straying into their paths significantly more quickly and reliably than a human driver and it should be possible for streets to become genuinely safe shared spaces - whether residential streets or those in city centres. Substantial space would also be freed up for greening residential streets and introducing seats, play equipment and other features to encourage people to use them to relax and socialise, hopefully leading to greater community cohesion.

Once autonomous cars become ubiquitous much street clutter can be removed

Of course, much of the paraphernalia required to enable drivers to get around easily and relatively safely - direction signs, traffic lights and so on - will become unnecessary, greatly reducing the clutter that damages the appearance of the public realm and, incidentally, considerably reducing the cost to local authorities of maintenance and enforcement.

The replacement of diesel and petrol vehicles by clean alternative fuels may also have a significant effect on the use of the public realm as it will greatly reduce air pollution and cut the noise from vehicles, again contributing to making urban areas, especially city centres, much more pleasant and encouraging greater use and enjoyment of outdoor areas.

However, electric vehicles do require their own recharging infrastructure and this may be more intrusive than the simple post recharging points that are becoming familiar in car parks and on the street. At the moment, the UK has fewer than 10,000 charging points and many more will be needed.

One research project suggests that recharging points should ideally have a canopy carrying solar panels. The

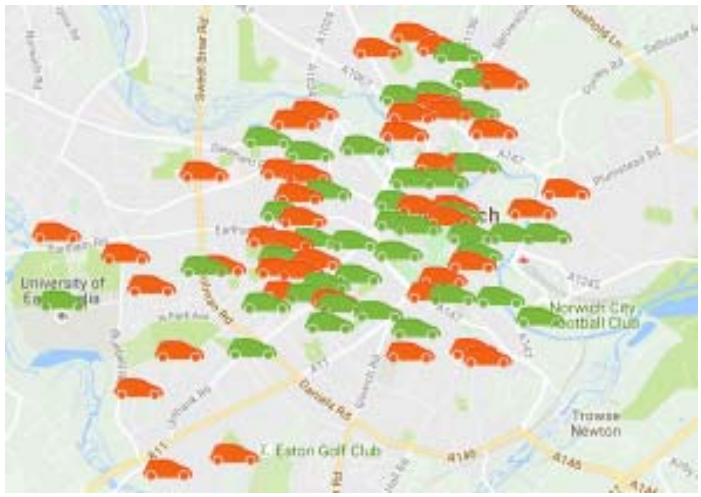
Research suggests that providing canopies carrying solar panels for the charging points can be advantageous

researchers suggest that this would make the recharging points both safer and more sustainable and, significantly, more obvious, thus overcoming the problem of identifying such spaces: this is an issue with some users.

Some lessons

Some cautious lessons can be drawn from these scenarios:

♦ The trend towards city centre homes being built with very limited parking provision should be encouraged and matched with a move towards car sharing. Unfortunately, car pooling schemes in several places in the UK - London and Greater Manchester, for example - are being scrapped rather than enhanced, a trend that seems short-sighted. Norwich is fortunate in having the Norfolk Car Club, the largest and fastest-growing car sharing scheme in the UK with 41 pickup points where members can collect or drop off a car, and around another 50 pickup points planned. This scheme and the Norfolk Liftshare scheme operated



The Norfolk Car Club is already the largest in the UK with pickup points throughout the City

Milton Keynes is testing driverless pods to take people around the city centre

by Norfolk County Council to encourage people to share regular journeys should be developed.

♦ Encouraging city centre dwellers to use the Car Club in place of owning their own vehicles will begin to prepare the way for on-demand autonomous cars.

♦ The potential for helping people with mobility difficulties get around the city centre using small electric autonomous vehicles should be examined soon: Milton Keynes is already trialling these and will have 40 in operation at the end of 2017.

♦ Any substantial investment in providing city centre car parking should be closely examined to see if any short-term benefits outweigh the likelihood that autonomous cars will make it unnecessary in the relatively near future. Any investment in city centre parking should also keep in mind the likely future redevelopment of such sites once city centre parking demand falls.

♦ The significant improvement in terms of reduced air and noise pollution that will be brought about by electric and alternative-fuel vehicles create opportunities for using some city centre spaces for more open air social uses and consideration should be given how this can best be facilitated.

♦ Although battery technologies are improving and extending the range of electric cars, the current lack of recharging infrastructure is inhibiting customers from switching to clean vehicles, so more charging points are needed.

The UK currently has fewer than 10,000 public charging points for electric cars

♦ The implications of what seems likely to be the inevitable and possibly quite rapid switch from conventional taxi services to Uber-style autonomous vehicles needs planning to provide proper pickup points and areas to hold vehicles waiting to be called.

♦ The forthcoming review of the Norwich Area Transport Strategy should take account of a future with autonomous and electric vehicles largely replacing those that we are using today. One possible conclusion is that public transport on all routes will become demand driven with comparatively lightly used routes being serviced by on-call autonomous vehicles with intensive routes continuing to require rapid mass transit systems as the infrastructure will still be unable to cope with a mass of small vehicles.

The new Rose Lane car park is only half full at peak times, although this may change if new office development materialises

St Andrews	100%
Chapelfield	100%
Castle Mall, Market Avenue	95%
John Lewis	82%
St Giles	97%
Rose Lane	52%
The Forum	99%
Castle Mall, Farmers Avenue	96%

Rose Lane car park average occupancy: 1pm during the first week of December 2016

Switzerland is testing whether autonomous shuttles could allow new services and forms of mobility in areas that are not currently accessed by public transportation

♦ New development in the City centre should be planned around the likelihood that individual car ownership will diminish in the coming years and that the need for conventional parking provision for visitors is also likely to reduce.

♦ The disruptive nature of autonomous vehicles should not be underestimated. By definition, forecasting its effect is difficult but this should not stop a continuing analysis to try to ensure that planning for the future takes account of the possibly-quite-rapid switch from individual car ownership to a reliance on Uber-style services and from cars driven by humans to totally autonomous vehicles.

Rapid mass transit systems will still be required for intensive routes

This report

This report was published in January 2017 by the Norwich Society to raise awareness about some of the issues that are likely to arise from impending technological changes to the way we travel, especially for the future planning of urban centres.

The Norwich Society has worked for more than 90 years to increase public awareness of Norwich's remarkable architectural heritage and to ensure design quality in new developments.

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