

# The Future of Transport

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## Global cities look to technology to drive change

The need grows for better connected and more efficient networks, reports *Tanya Powley*

A time traveller from the 1950s visiting London today might be surprised to find that the fundamental aspects of the public transport system have not changed dramatically.

Buses have had a design overhaul, but they are still flagged down by passengers at the side of the road. Trains continue to move along on steel rails, but station guards wave signal paddles instead of blowing whistles.

A big problem in modernising transport systems, particularly in the developed world, is dealing with ageing infrastructure, according to Lynne Goulding, an analyst at Arup, the engineering group.

Several countries are focusing on electrifying rail tracks to accommodate

faster trains, including the UK, Germany and France, but it can be difficult to modernise existing infrastructure. In the UK, attempts to electrify some train routes have been hit by delays and overspending.

While the perception might be one of slow change since the 1950s, transport experts say there has been a lot of work behind the scenes in using technology to improve signalling systems and road-side infrastructure. Safety has improved dramatically over the past 50 years.

Not all modes of transport have been slow to alter over that time. Stephen Glaister, a transport specialist at Imperial College London and a former Transport for London board member, points to the considerable improvements made to the car. "It's still got four wheels and is driven by a person, but otherwise



Trail blazer: an all-electric, zero emission French ferry — Jean-Sebastien Evrard/Getty

it's a completely different thing," he notes. Its cost relative to average income has fallen and it is much safer. Road networks across the world have also greatly improved, Mr Glaister adds.

Car affordability has created problems in cities, not least congestion. Space has been taken up by cycle lanes and roadwork and construction projects have risen.

In central London these factors have played a part in cutting road capacity by about 30 per cent since 1996, figures from the city's traffic agency show. Experts say politicians must either act or watch snarl-ups on London's streets worsen — a problem made more pressing by the predicted growth in the capital's population from 8.6m to nearer

'As technological change tends to be exponential and not linear, these things are rapidly progressing'

10m by 2030. Mr Glaister says transport planners may have to come up with radical solutions, such as a network of underground roads to help ease congestion. Some cities have tried this, for instance Boston in the US with its "Big Dig" project, which cost at least 10 times its original budget. Other countries, such as China, have chosen to go over-ground and construct triple-deck roads.

Most countries are working towards better connected and more efficient transport networks, using technology to improve their infrastructure. The internet is revolutionising the way in which passengers plan their journeys, while smart ticketing systems are helping shave seconds off the time it takes to get through a station. The "smart city"

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The Future of Transport

Beleaguered industry takes aim at lower fare challenge

Taxi wars Legal challenges and disgruntled drivers apply pressure to cab apps, writes Murad Ahmed

Taxi apps are causing disruption to a decades-old market. The likes of Uber, Lyft and Hailo, have made it easier than ever for taxi drivers to find nearby fares. These online services are used by thousands of eager passengers, who can call up a driver at the touch of a smartphone screen. Depending on what facilities are available in each country, these services are also often cheap. Billions of dollars in venture capital are being poured into taxi app start ups, allowing them to engage in price cuts in the battle to attract passengers. In the face of sudden and intense competition, established taxi groups scream foul play, claiming the taxi apps are often skirting decades-old regulations on who can be hired for fares. But the one group essential to the industry – the drivers – seem unsure what to make of the maelstrom. "You can't go to other companies because Uber has taken most of the business," says one disgruntled minicab driver in London, who asked not to be named for fear of repercussions. "The industry of cabbage has turned upside down because of Uber. Drivers were told they would make more money and have an

easier life. But they show you one hand and slap you with the other." But a French Uber driver, a young man of Arab origins, says he loves driving for the San-Francisco-based service. He says that at a time of high youth unemployment, Uber created the opportunity to make extra money from taxi fares, in between part time jobs. During another recent ride, a London-based Uber driver misunderstood why I was asking a torrent of questions about working for the service, leading him both to recommend driving for the taxi app company and offering to help me become an Uber driver. Travis Kalanick, chief executive of Uber, says the company is a force for good, creating hundreds of thousands of jobs by opening up the cabbage industry to people who had been shut out by monopolistic taxi incumbents. But he also concedes it can be "quite tricky" to find a "middle ground" that balances the interests of drivers and passengers, as Uber experiments with new pricing and services. "In many cases it's good for one side and bad for the other," he says. Mirroring legal challenges elsewhere in the world, this year Britain's GMB Union, which represents thousands of



Black mood: London taxi drivers protest against the Uber app

professional drivers, sued Uber over allegations that the ride-hailing service does not provide basic worker rights, such as ensuring people are being paid the minimum wage or for holiday. They also accused Uber of failing to adhere to health and safety standards, such as making sure drivers take breaks or work no more than a certain number of hours. In July, Steve Garelick, branch secretary of GMB's professional drivers' branch, said it had been approached "by various [Uber] drivers who were not happy with their lot in life". The action is ongoing. Uber says: "One of the main reasons drivers use Uber is because they love being their own boss. As employees, drivers would drive set shifts, earn a fixed hourly wage, and lose the ability to drive elsewhere, as well as the personal flexibility they most value. The reality is that drivers use Uber on their own terms: they control their use of the app". The main issue appears to be low fares. When the likes of Uber and Lyft introduced heavy price cuts for passengers, they protected drivers' income, saying the taxi app group would pick up the difference. However, the companies gradually began reinstating their own share at the expense of drivers.

If you're earning £10,000 a year and they take away 15 per cent, how would you feel?

Mr Kalanick has argued that lower fares lead to more frequent rides. So, overall, drivers' income rises. But not all are convinced. The disgruntled London driver claimed that he had to work longer hours to make up the difference. "If you're earning £10,000 a year and they suddenly take away 15 per cent to give more discount, how would you feel?" he asks. "You're using your own car, your own fuel, and paying your own taxes. You work out how much a driver is left with." Some believe that, in time, Uber and other taxi app groups will have to end their price wars. Karhoo, a new taxi comparison app due to launch next year, aims to provide users with access to thousands of cars run by established operators – including London's black cab drivers. The 10-month-old company has raised \$250m, and aims to raise more than \$1bn to fund its global rollout. Daniel Ishag, Karhoo's chief executive, says his app will allow the established taxi companies it works with to set prices, taking a small cut from every sale. He believes the business model will work because: "[Uber] can't subsidise prices forever; they have to be profitable, especially if they want to IPO."

Global cities look to technology to drive change

Continued from page 1 approach is a concept adopted by policymakers around the world, in the hope and expectation that digital technologies can be deployed to make cities both more efficient and liveable. "I think technology," says Arup's Ms Goulding, "will be one of the biggest drivers of change in the transport sector. As technological change tends to be exponential and not linear, these things are rapidly progressing." The problem is how to integrate different modes of transport, such as rail, bicycle, walking and automotive, into one convenient, safe and sustainable system. Some cities are already making inroads into recreating themselves as places where vehicles are electric powered and emission free. The port city of La Rochelle in south-western France has recently launched zero emission electric passenger boats for travel around its waterways and boasts solar-powered electric bikes. In the UK, Milton Keynes and Coventry are trialling the government's autoviv programme, which will develop autonomous vehicle technologies and integrate driverless vehicles into existing urban environments. In Asia, Singapore is expanding its underground system, almost doubling the size of the metro, to improve public transport on the island. It is also considering the introduction of autonomous vehicles trials as part of an effort to reduce private car ownership. Automation will play a big part in traffic management systems in which driverless cars, buses and lorries ease congestion problems on railway networks. "Ultimately we'll see all of the systems talk to each other," says Cameron Jones, chief commercial officer at UK-based software company SilverRail Technologies. "You'll have an app that will help you plan the most efficient journey, with each of the modes of transport seamlessly interacting with each other so that

Berlin emphasises the environmentally sustainable

Case study The German capital leads the nation in alternative forms of getting around, reports Jeevan Vasagar

With a youthful population, a history of development built on public transport rather than cars and a reputation for embracing the new and fashionable, it is not surprising to find that Berlin is at the forefront of technological change when it comes to personal mobility. Car-sharing has surged as Berliners increasingly feel little need to own a personal vehicle. Meanwhile, the overall proportion of daily trips Berliners make by car has dropped in recent years as cycling has grown in popularity. Germany's capital has more than 400 electric car-charging points and four hydrogen refuelling stations, making it the leading city in Germany for alternative forms of transport. A major expansion of this infrastructure is under way. And while lacking Google's resources,

a team at Berlin's Freie Universität has developed its own driverless car, which has been licensed for trials on the city's streets since 2011. The car recently completed a 2,400km driverless journey through Mexico. City authorities are determined to build on these environmentally friendly trends, as Berlin grows and parts of the city become more affluent. Berlin is Germany's biggest city, with a population of 3.5m. It is growing by about 50,000 people a year – excluding refugees – as the city's vibrant culture and cheap living draws people from across Germany and Europe. Burkhard Horn, director of the city government's transport department, says: "It is important that these people travel using environmentally sustainable transport, that is compatible with the city – on foot, by bicycle or with public transport."

Sustainability: Burkhard Horn

There is potential for replacing longer distance car trips with public transport, Mr Horn says. The challenge is expanding and modernising the transport authority's fleet, as well as building new commuter rail lines. The geography of Berlin is suited to public transport rather than private cars. With its broad central boulevards, the city was originally traversed on foot or, for its wealthier inhabitants, by horse-drawn coach. More recently, the city grew outwards along the rail network, with residential and industrial areas congregating round the newly developed underground stations. From genteel Charlottenburg to working class Prenzlauer Berg in the east, Berlin was organised around districts, reducing the need for cross-city commuting. Berlin's history also plays a

role. Its cold war division and the physical isolation of West Berlin within the communist state meant that the development of a commuter belt was delayed until after reunification. Mr Horn says: "After reunification in 1989 there was a significant rise in motorisation and car traffic in Berlin, with demonstrably negative consequences for the environment. Through a shift in the transport strategy, we have succeeded, over the last 10-15 years, in stopping this and turning it around." The city has pursued a combined planning and transport strategy, while investing in public transport and promoting combinations of cycling and trains. Its size and population density make Berlin ideal for car-sharing. Details from BMW's car-sharing service DriveNow indicate that 165,000 Berliners have signed up to the programme. "The number of new registrations in Berlin runs at around 4,000-5,000 per month," says Aurika Nauman press officer for DriveNow. "That's around a third of the total DriveNow registrations in Germany." The car-sharing scheme collaborates with Berlin's public trans-

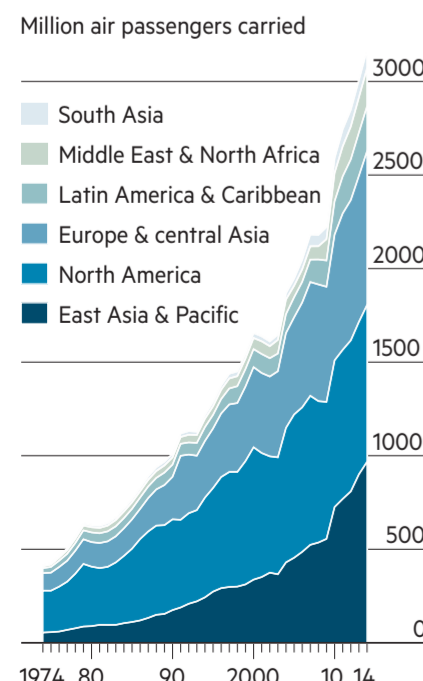
port authority, offering a special rate for public transport season ticket holders and integrating its vehicles into the transport authority's mobile app. Ms Nauman says: "Each DriveNow vehicle has replaced three private cars. That has freed parking space, and reduced the amount of time spent looking for a space. Parking pressure has been reduced and so have emissions." One notable transport flop has been the ride-sharing service, Uber. Its low-cost ride sharing service UberPop has been banned by city authorities, who cited safety concerns and the threat to licensed drivers from unregulated competition. The company endures as a taxi-hailing service in competition with rivals such as Daimler's mytaxi. In the more distant future, the autonomous car may shake up the city's transport options. But city authorities say it is too early to forecast the impact of such technology on transport choices. While self-driving cars may reduce accidents, they will take up as much space as human-driven cars. "Public space on our streets is too precious to devote it to traffic," Mr Horn says.

30% The amount road capacity in central London has been cut since 1996. 200,000 Number of taxi journeys sold by Sweden's national rail carrier

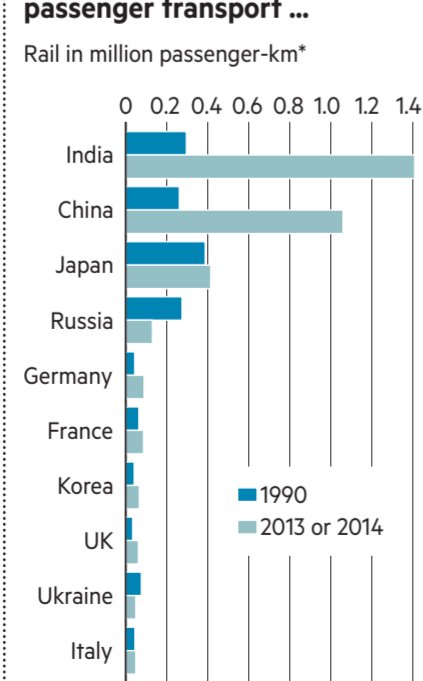
there isn't a point of anxiety across that trip," Mr Jones adds. He points to SJ, Sweden's government-owned passenger train operator, which works with taxi companies to enable passengers to book a full rail and cab journey in one go. The taxi company uses live data from the rail carrier to plan the pick-up from the station, putting an end to long queues at the taxi rank. "Without being heavily marketed SJ sold almost 200,000 taxi journeys in 2014, which would be like selling almost 2m taxi journeys in the UK when considering relative market sizes," says Mr Jones. Ms Goulding believes technology will enable solutions for many transport problems, but concedes that the pace of development creates a problem in itself. "There is a real challenge that by the time it is built the technology is already obsolete," she says. As she adds: "At the moment everyone is looking at how to put WiFi on trains, but there's already a technology called LiFi that is meant to be a much faster way of doing WiFi."

Planes, trains and automobiles

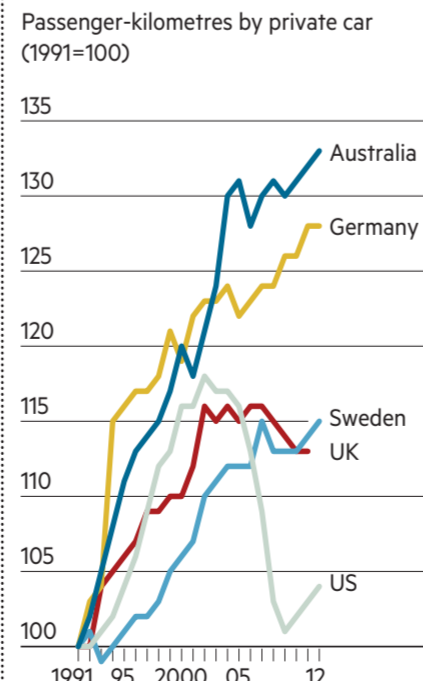
Air transportation is booming, particularly in Asia ...



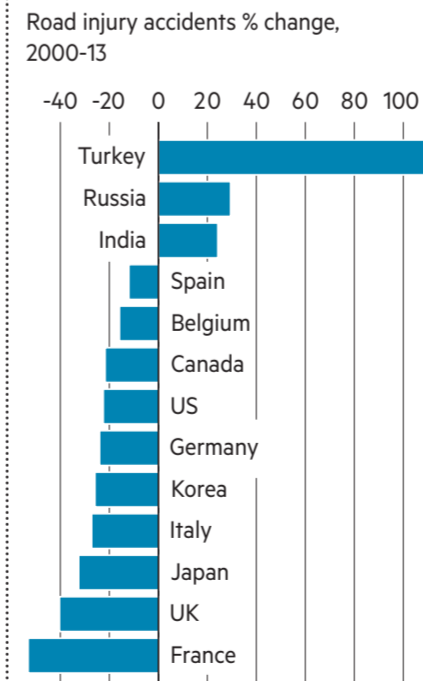
... while India and China dominate the global rail passenger transport ...



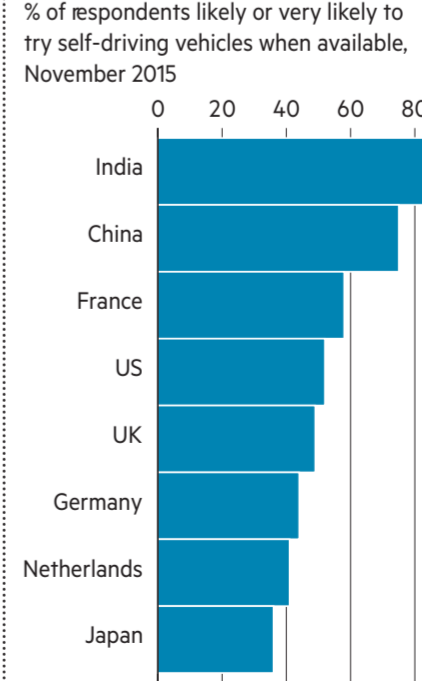
... and private car usage declines in some developed countries...



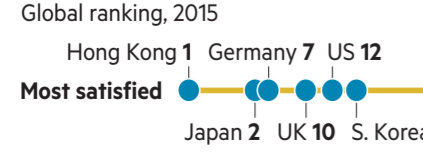
... as well as road accidents ...



... while the public is generally positive about self-driving cars



Level of executives' satisfaction with infrastructures varies greatly across countries



FT graphic. Sources: World Bank; OECD; World Economic Forum; World Conference Board

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## The Future of Transport

# Hackers in 'white hats' join effort to thwart the bad guys

**Cyber security** Old and creaky systems leave travel networks vulnerable to attack, says *Hannah Kuchler*

Commuters in the Israeli port city of Haifa fumed during a particularly tedious traffic jam two years ago, never guessing that the logjam was caused not by an accident or some other relatively customary event – but reportedly by cyber attack.

It shut the city's Carmel tunnel for eight hours, with the Associated Press later reporting a cyber attack, although the authorities never confirmed this. A hacker used a "Trojan horse" – a malicious computer programme – to shut down the security cameras monitoring the tunnel, the report said.

As transport networks – from cars to planes to trains – connect to the internet in hundreds of ways, hackers have found ways to disrupt the arteries of major cities. A single flaw in one device connected to a complex network can have major consequences in the transport industry. With vehicles having the ability to communicate remotely and supply chains being so extensive, it can be hard to monitor the security of every component.

Tim Best, cyber security director at Ernst & Young, says it is this "network of

networks", often made up of old and creaky systems, that makes transport so open to attack.

Automakers often rely on external software providers or third party hosting organisations, which they cannot easily monitor. The option of WiFi on planes, meanwhile, has created problems when the passenger internet is linked to the systems controlling flying.

Computer security experts – so called "white hat" hackers – who look for digital system weaknesses, have made considerable impact in the transport field this year. Vulnerabilities in the Jeep Cherokee reported in June at a Las Vegas hackers conference led Fiat Chrysler to recall 1.4m vehicles. One security researcher was questioned by the FBI in April after taking a United Airlines flight, during which he claimed in a tweet that he had hacked into its computer system. United has since introduced a programme of awarding air miles to hackers who inform it of vulnerabilities.

Cesar Cerrudo, chief technology officer at IOActive, a security research company which discovered ways to hack satellite communications



WiFi dilemma: the internet is linked to the systems controlling flying – Alamy

equipments on planes, says companies tend to drag their feet on security until they are in "water to the neck".

Mr Cerrudo adds: "One problem with a car system is that it is already designed with this weak architecture and design is very difficult to change. If you change the design, you change all the components, how everything interacts and works."

Automakers need to build security in from the beginning, rather than adding it on top, but that will probably take time, Mr Cerrudo says. "The technology we are using today was built three years ago, so if they start investing hard in security now, we will probably see the results in a couple of years."

Philip Lacombe, vice-president for information systems and security at Parsons, an infrastructure company, said there had been a "dramatic change" in every part of the industry. From metropolitan transport agencies to airline operators and carmakers, it is paying more attention to cyber security.

As boardrooms get worried about fulfilling their responsibilities, they are putting more contracts for cyber security services out to tender and hiring

more specialists in the field, Mr Lacombe says.

Mr Lacombe believes co-operation between the public and private sectors is essential. There are already concerns that cars could be used to spread viruses into systems managed by government, for example, when cars are checked by emissions control systems. Soon, publicly owned traffic lights will "converse", as it were, with private cars.

In the private sector, groups such as Intel's automotive security review board are conducting testing and creating best practices for the industry. A recent white paper warned about risks ranging from "ransomware" – malicious software that holds cars to ransom – to petrol stations being used to infect vehicles with computer viruses.

Regulators are paying attention to the problem. In Germany, for example, the country's IT security act applies primarily to critical infrastructure, including that for transport.

It outlines "state of the art technical and organisational measures" to improve infrastructure and to encourage companies to report security incidents anonymously.

# Urban planners learn to pedal harder

**Bicycles**

Rise in rider numbers has led city policymakers to invest more and plan better, reports *Robert Wright*

The recommended route for a cyclist heading north from Vauxhall, in central London, across the river Thames used to be confusing and intimidating. Official maps directed riders first on to a series of narrow paths that wound round pavements by Vauxhall's busy streets. Then the cyclist was pitched out on to a bus lane to ride amid six lanes of dense traffic on Vauxhall Bridge itself.

But since November, the experience has been transformed. A well-built, mostly wide, two-way cycle track now runs through the maze of junctions on the south side of the river before leading riders on to a wide path segregated from traffic on the bridge.

The work on the route – part of what will soon become a network of protected bike lanes, or cycle "superhighways", around the UK capital – illustrates London's determination to have bicycles make considerably more than twice their current level of trips in the city by 2026. It is an aspiration similar to those of scores of other cities around the developed world – including such conventionally car-oriented metropolitan areas as Los Angeles and Houston in the US.

Many city leaders are keen to encourage cycling because bicycles make far more efficient use of scarce road space than private motor vehicles. Encouraging cycling is a far cheaper means of expanding transport capacity than building new roads or rail lines. Increasingly, too, the public demands it.

Paul Stealy White, executive director of Transportation Alternatives, which campaigns for better walking and cycling access in New York, says residents of any world-class city now demand protected bike lanes of the kind that now crosses Vauxhall Bridge.

"Protected bike lanes are today like

city parks a century ago," Mr White says. "They're something you have to have if you want to be a city where people want to be, where people want to raise a family."

In London, the efforts to build protected lanes come after more than a decade of steady growth in usage has made the bicycle a significant part of the transport mix. Lilli Matson, head of strategy and planning for Transport for London (TfL), the London mayor's transport agency, points out that more than 600,000 daily trips are made by bicycle in London, or about a fifth of the number of journeys made each day on the London Underground.

In many cities, a combination of opposition to a shift to cycling and reluctance to encourage it has stood in the way. Although there was significant growth in cycling in New York while Janette Sadik-Khan was transport commissioner from 2007 to 2013, official census figures show only about 1 per cent of commuting trips are by bike – against about 4 per cent in London.

Mr White says it has become clear in recent years in New York that there is – although many long doubted it – a true demand to move round the city by bicycle. "The real limiting factor is the Department of Transportation's ability to deliver projects," he says. "They aren't keeping up with demand."

At the heart of the rising demand for urban cycling is a reversal over the last three decades of the earlier confidence that private motor vehicles could provide effective, flexible transport in big cities.

Many urban motorways have turned out to generate so much new traffic that they have been congested almost since opening.

Tom Bogdanowicz, senior policy and development officer for the London Cycling Campaign, makes reference to TfL's commitment in its business plan that come 2026 Londoners will be making 1.5m cycling journeys each day. That would commit TfL to providing equivalent capacity on other means of public transport, if cycling growth fell short of target.

# Hybrid technology still draws a company crowd

**Oil price**

The fall in fuel prices has raised sales of pick-up trucks and SUVs, but fuel-efficient autos are still sought after, reports *Robert Wright*

On March 31, on a cold day in New York's west midtown, Duncan Aldred, head of General Motors' GMC brand, outlined a plan that would have seemed unthinkable as little as a year previously. Mr Aldred announced that GM planned to boost the US market share of GMC – which produces only premium-quality sports utility vehicles and pick-up trucks – from 3 per cent to 5 per cent over the coming 10 years.

The brand has outstripped the growth of every other GM brand in the US over the year, posting growth of 12.5 per cent for the year to the end of October, against a 5.3 per cent average for the company as a whole.

GMC is one of the most obvious beneficiaries of a series of changes across transport markets that have followed the sharp fall in the price of oil from a peak of \$112 a barrel of Brent crude in June 2014 to about \$45 at the end of November this year.

The fall has revived sales of sports utility vehicles and pick-up trucks, raised speculation that airlines might cool on orders for more fuel-efficient aircraft and led to rumours that shipping lines might end speed reductions brought in to save fuel when prices were high.

The US auto market – where the relatively low taxes on fuel mean that changes in the underlying oil price create especially high volatility in pump prices – has demonstrated some of the most dramatic changes.

According to Michael Sivak and Brandon Schoettle of the University of Michigan's Sustainable Worldwide Transportation project, the average fuel economy of new vehicles sold in the US has slipped by 0.8 miles per US gallon – 3 per cent – from a peak of 25.8 mpg reached in August 2014, shortly after fuel prices started falling. The decline reflects a jump over the same period in the market share of three types of relatively fuel-hungry vehicles – compact SUVs, whose market share has



Fuel change: Ford's F150 hybrid

risen 2.9 percentage points to 29.6 per cent, pick-up trucks, which are up 0.6 of a point to 14 per cent and large SUVs, up 0.1 points to 7.1 per cent.

Mr Aldred insisted, after announcing the plans for GMC's growth, that the company could succeed even if recent fuel price declines were reversed. "Really the GMC success story is... five successive years of growth," he told reporters after the announcement.

However, there is little doubt the unexpected oil price fall has produced big changes in auto markets that were, after the economic crisis and fuel-price spike, expected to shift towards smaller, more fuel-efficient vehicles and new, less oil-hungry propulsion systems.

'It's hard to plan a product portfolio on gas prices'

Mark Reuss

Bill Fay, head of the core Toyota brand in the US for Japan's Toyota Corporation, insists that his company – the pioneer in fuel-efficient hybrid technology with the Toyota Prius – is continuing to invest in more fuel-efficient technology. But he adds that the company is building many more of its RAV4 and Highlander SUVs than previously and as many pick-up trucks as it possibly can.

"I do think every manufacturer is working toward making adjustments in their products and production to meet the current consumer demand," he says.

Yet, while consumer sentiment has

been quick to change in response to the oil price change, the latest versions of Ford's F150 pick-up truck, the US's best-selling vehicle, show that companies' reaction to the change continues to be far more cautious. Ford brought a revolutionary, aluminium-bodied version of the truck – 13 per cent lighter than its predecessor – to the market late in 2014, just as the oil price plunged.

Ford's move illustrates how, while manufacturers are adjusting their launch schedules to reflect changing consumer demand, many decisions about products just coming to market were made while prices were still high. Companies are also cautious about assuming that oil prices – which have fallen unexpectedly – will not be subject to a rapid, unforeseen increase.

Caution about the duration of the oil price fall may be one reason why airlines are mainly currently sticking by the vast orders for new, more fuel-efficient aircraft placed in recent years – although most are holding off ordering new aircraft. Ship owners are mostly continuing the practice introduced during the oil price spike of sailing ships far more slowly to save fuel – although crude oil tankers, for which rates are high, are starting to run faster.

Mark Reuss, head of product development for General Motors, says there is a mismatch between long-term, capital-intensive product development timescales and fast-changing fuel costs. "It's hard to plan a product portfolio on gas prices," he says.

The challenge for automakers and builders of aircraft, ships and trains, meanwhile, is that oil prices are only a part of what influences their products' design. There are also regulatory pressures, including, in the US, the requirement that automakers more than double their new vehicles' average fuel efficiency between 2012 and the 2025 model year, which goes on sale in 2024. For example, under state regulations, automakers selling vehicles in California are effectively required to offer some plug-in hybrid vehicles – those with a normal engine but which normally run on electric power – or battery-electric vehicles.

Mr Reuss says GM remains "deeply committed" to such vehicles – including the Chevrolet Bolt, an electric vehicle that he and others hope will transform perceptions of the technology, whatever future oil price movements.

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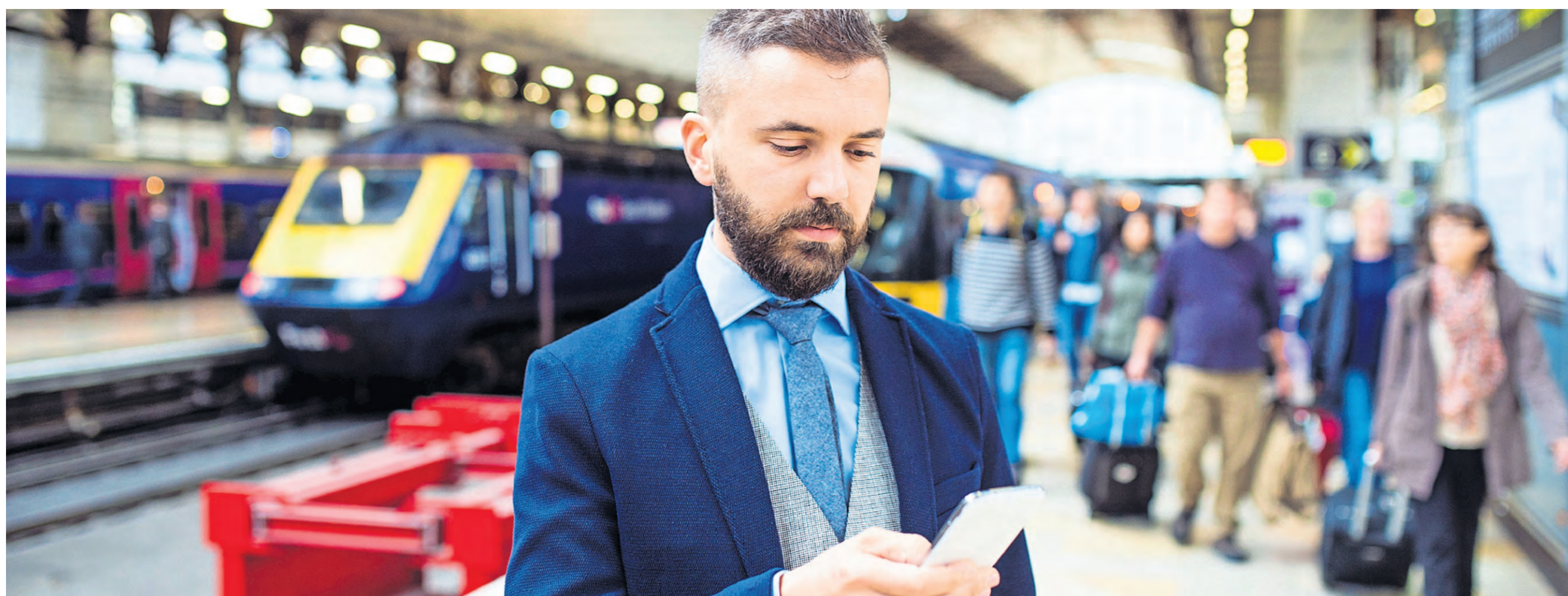
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## The Future of Transport



# Developers help shake up public transport

**Travel apps** Technology puts the passenger at the centre of rail travel, reports *Tanya Powley*

Imagine being able to know which carriage of a train to get on, in order to make sure you get a seat and can rest your weary legs after a long day at work. This is just one of the innovations that train companies are looking at as the industry turns to technology to improve passenger journeys.

The UK's rail industry has historically been slow to innovate compared with its peers around the world and other transport sectors, particularly when it comes to using new technologies to improve the customer experience of travel.

Part of the problem is due to the way the rail system is operated in the UK, with short-term franchises to run routes being awarded by the government, which some believe has discouraged investment in technology.

"The fragmented nature of Britain's rail industry makes innovation difficult

to promote and spread. For example, getting real innovation in ticketing has been hard, so passengers are stuck with outmoded tickets and fares structures," says Stephen Joseph of Campaign for Better Transport.

However, recognising that technology has the potential to improve train journeys, the government has shifted innovation up its priority list to become an essential part of what companies must include in bids to win rail franchises. Smart ticketing and reliable WiFi on board trains are two examples of technology being rolled out over the next few years.

Cameron Jones, chief commercial officer at SilverRail, believes train companies are finally understanding the need for change. "A number of carriers are working hard on initiatives to try and drive that innovation into franchise renewals as they get rolled out, and are really putting the customer at the centre of their thinking," he says.

This year the industry hosted two so-called hackathons, where software developers around the world were challenged to help tackle overcrowding,

delays and patchy WiFi on the network. At the first 'Hack the Rails' event in March, the winner was Reroo, an app that helps customers find the cheapest alternative train routes.

Apps have already played a big part in improving how commuters plan their journey. Both Network Rail and Transport for London, the UK capital's transport authority, have opened their data banks in the hope developers will conjure up ever more useful technology to take the uncertainty out of travel.

Citymapper has been one of the big app successes, allowing Londoners to plan their journey in the quickest possible route across several different modes of transport. However, Mr Jones says there is still room for improvement with journey planning apps, such as being able to plan a route and buy tickets at the same time.

Apps are also becoming a focus for train operators looking to make sure that their staff have the most up to date information to give to customers. London Overground Rail Operations (LOROL), which runs part of the city's local train network, has rolled out smart

**Innovative: smartphone ticketing and reliable WiFi are important**

Stock

watches and an app to its staff to give them targeted information, including data on train delays.

"We saw that people were using their own phones looking at apps to get information that we weren't providing. We realised we needed to give information as quickly as possible to them," says David Wornham, customer services director at LOROL.

Some train companies are exploring how to use GPS co-ordinates and local positioning technology to work out which carriages are full to help improve passengers' journeys.

Mr Jones says rail carriers could use GPS to know the location of travellers, plus closed circuit TV monitoring and carriage weight sensors to suggest which is the best carriage to get a seat. He notes that the Swiss Federal Railways are using GPS technology to identify a customer's train usage, while Hitachi in Japan uses technologies that include station CCTV and train carriage weight. Others are looking at improving ticketing systems. A multi-pass is now on trial on the Cambridge-London route in the form of account-based

ticketing. Journeys are captured by the customer's multi-pass app and e-wallet which synchronises with the cloud, where the best-priced ticket is identified and charged. Trains are equipped with iBeacon sensors to see when a multi-pass holder boards and departs a train.

Moves such as these will one day help create more efficient intermodal transport systems. A project backed by the European Commission, called "All Ways Travelling", aims to create a ticketing system that would allow passengers to book one ticket for air, rail and urban transport across Europe. This could put an end to the days of relying on layers of paper tickets to get you, for example, from your home in London to Barcelona for a weekend away.

"It is surprisingly difficult to create such a system because there are so many different operators and systems in place, says Lynne Goulding of Arup, the engineering consultancy. "But it is definitely one of the main advantages of technology to be able to create a truly intermodal system that allows people to have tickets valid for buses, trains and bikes."

'We saw that people were using their own phones looking at apps to get information that we weren't providing'

## Self-drive trucks bring new era for hauliers

Commercial

The first automated vehicle has been licensed, but will it take off, asks *Andy Sharman*

The driverless vehicle debate revolves primarily around autonomous cars, piloted by top tech companies such as Google and Tesla. But what about driverless trucks?

Truckmakers and logistics companies are salivating at the potential gains to be had by introducing automation into road-going freight transport.

"Maybe it's not as eye-catching as a person reading his newspaper behind the wheel of a passenger car," says Niklas Gustafsson, chief sustainability officer at Volvo Group, the Swedish truckmaker.

"But in the trucks business... the reason for automation is maybe not so much for the driver. It's more about trucks in platoons saving a lot of fuel."

Fuel consumption represents about a third of the running costs for road hauliers. Driverless heavy duty trucks offer the potential for "platooning", whereby trucks travel in convoy at very close distances behind one another. That could mean a saving of as much as 20 per cent on fuel costs thanks to aerodynamics, says Mr Gustafsson.

Driverless trucks have so far been successfully employed in specific areas – for example around mines or in container ports.

Road-going trucks are already benefiting from semi-autonomous safety features. For example, all new trucks sold in Europe since November must by law be fitted with autonomous emergency braking. Other features, such as MAN's lane guard system, keep drivers within their lanes and warn truckers if they are veering off course.

Several truckmakers, including

Volvo, MAN and Scania, offer advanced intelligent gearboxes that use GPS to spot when a hill is approaching and help drivers know when to accelerate and when to coast to limit fuel consumption.

Further moves are being made towards full automation. Daimler of Germany this year revealed the first self-driving truck to be licensed for commercial use. Trials of platooning are also set to take place in the Netherlands early next year.

The rewards go beyond fuel consumption. Autonomous commercial vehicles would, for instance, be better at maintaining the concentration that can fail human truckers on long-haul and routine journeys, while avoiding fatigue.

"The system never gets tired," Wolfgang Bernhard told the FT this year speaking at the launch of the Freightliner truck. "It never gets distracted. It's always at 100 per cent."

Some say it would be possible to designate lanes on long highways to autonomous vehicles – effectively moving road transport into the realms of computer-assisted transport employed in the air and on the rails.

"If there were dedicated lanes on the

'The system never gets tired [or] distracted. It's always at 100 per cent'

roads, this automated technology would be introduced even faster," says Mr Gustafsson.

But, as with driverless cars, regulation needs to be resolved before autonomous trucks head on to the highway.

Platooning, for instance, is technically possible using radar-based adaptive cruise control – a technology that effectively tracks the car in front.

But in countries such as Germany, legislation says that trucks have to keep a safe distance of 50m from the lorry in



Saving fuel: Niklas Gustafsson, Volvo

front – and that is too great a gap to achieve aerodynamic gains.

The regulation issue is more acute for trucks, analysts say, since they tend to drive long distances across national borders and between jurisdictions.

As such, Frost & Sullivan, the consultancy, believes that while autonomous highway driving in passenger cars is due to become mainstream by 2020, driverless trucks will not be introduced for platooning until closer to 2022.

There is also the question of business models. "In a platooning train, the first truck and the last truck will carry the load," in terms of air resistance, says Mr Gustafsson. "So you need to find a business model for sharing the costs for the first and last truck."

Truckmakers also say hauliers will be reluctant to truly embrace autonomous commercial vehicles until the trucker is able to fully disengage from driving in transit and perform tasks, such as processing cargo.

"[Until then], this is no business case for any customer," says Manuel Hiermeyer at Volkswagen Truck & Bus, the holding company for MAN and Scania. "When the driver is still behind the wheel, he is not able to take on other duties."

"Only in the next step, where a driver is not required during a defined use – such as the highway – then there is a business case."

But that in turn raises the question as to whether truckers will want to carry out functions other than driving. "Personally, I do not see that they want to do logistics with an iPad," says Mr Hiermeyer.

## Automated autos may be a game changer for health and safety

Autonomous vehicles

Human fallibility means a crash-free future is unlikely, writes *Andy Sharman*

Road safety statistics make for grim reading. Almost 1.3m individuals die in traffic accidents worldwide each year, and up to 50m more suffer non-fatal injuries, according to figures from the World Health Organisation.

The National Highway Traffic Safety Administration, the US transport regulator, says the economic cost of the 33,000 or so crashes in the country each year is almost \$250bn, whether in lost productivity, legal and court costs, congestion or emergency services.

But much of this could be eliminated if automakers and tech companies have their way: by taking away control from the people who cause more than 90 per cent of road accidents – human drivers.

Self-driving cars are hailed as a game-changer for health and safety on the roads, with their potential to dramatically reduce accidents. "One of the advantages of autonomous vehicles... is increased situation awareness," says Randy Visintainer, director of autonomous vehicles at Ford. "You have 360-degree awareness between your lidar [remote sensing technology], radar and cameras versus the [human] driver, who can realistically only look in one direction at a time."

Although highly automated cars are unlikely to be seen outside trial settings until the end of the decade, the incremental strides being made towards that point are already bringing safety benefits. Advanced driver assistance systems (Adas) are helping to reduce accidents. For instance, automatic emergency braking (AEB), which uses radar camera-based technology that automatically brakes to avoid stationary obstacles at low speeds, can cut rear-end collisions by 38 per cent, according to research by Thatcham, the vehicle safety experts. The same technology was found to

cut injuries by a third. Only a small fraction of new cars sold come with AEB. But this year 10 carmakers pledged to fit the technology – considered the most important safety development since the seatbelt – as standard in all new models. Yet despite these advances, manufacturers and researchers warn that moving beyond basic Adas features towards full automation is riddled with complications.

Fully driverless cars, for example, will have to interact with conventional vehicles and fallible human drivers for some time. That is proving to be a considerable problem. A recent report by the University of Michigan's Transport Research Institute found that self-driving cars had a higher crash rate per million miles travelled than conventional vehicles. But the self-driving cars caused none of the accidents recorded.

Similarly, cars equipped by Google, the tech company that is seen as the leader in driverless car research, have been involved in a dozen or so accidents, but largely as a result of being reared by distracted human drivers.

"We're still trying to understand how autonomous cars interact in a completely autonomous environment as well as how they interact with normal drivers," says Mr Visintainer. "We still envision that these cars will have to interact with human drivers."

Further complicating the picture, manufacturers from Google to Tesla to Ford are each at different stages of progress with their technologies, and approaching the challenge in different ways. Ford, for instance, is adding Adas features to achieve a high level of automation, like many automakers keen to

build market-ready tech that can boost revenues. Ford is also running a separate project to build a Google-style, fully driverless car.

All of this means that there will probably be grades of automated car, further increasing complexity on the roads and presenting a difficult transport infrastructure challenge to governments and regulators. Volvo, one of the leaders in autonomous driving, says it is also concerned that, once automation has reached a certain level, drivers will be so unused to intervening that it becomes unsafe to ask them to take back control.

"We make this [technology] better and better, we add functionality – we come to a point where the driver almost never has to intervene," says Erik Coelingh, senior technical leader for safety and driver support technologies at the Swedish automaker.

It takes about five to 10 seconds for a driver to fully engage with his surroundings after having been "out of the loop", focusing on a task other than driving.

"The intervention of the driver is almost never required. If it happens only once every other day, once every week, I would be really concerned the driver wasn't ready to take over when needed," says Mr Coelingh.

That means that manufacturers adding incremental pieces of safety kit will at some stage have to make the leap beyond this problematic grey zone and create cars capable of coping with all traffic situations and weather.

Even if manufacturers reach the fully driverless nirvana, the prospect of a totally crash-free future seems unlikely.

"There will be the opportunity for automation to reduce greatly the number of collisions we see on the roads – but not all of them," says Nick Reed, senior academy fellow at the UK's Transport Research Laboratory.

"There'll still be the pedestrian that walks out at entirely the wrong moment and the laws of physics dictate that at some point that kind of crash will be unavoidable."

Tech savvy: Google is considered the leader in driverless car research

