
Digital Vision for Mobility

UK&I opinion paper



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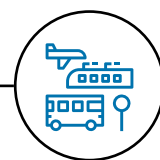
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Digital Vision for Mobility



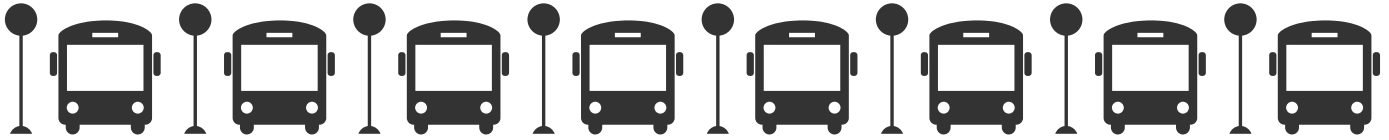
Adrian Gregory
Atos Senior Executive Vice President and CEO UK & Ireland

More change is now underway across the transport and logistics industry than at any time since the invention of the combustion engine. Vastly increased computing power and hyper-connectivity are helping to transform the operation and maintenance of vehicles and national infrastructure. New market entrants are devising completely new business models that disrupt personal mobility and global supply chains. There are also major operational challenges, including intense capacity pressures, together with environmental impacts that are greater than in any other sector.

As well as bold new thinking, collaboration between stakeholders and with digital leaders is essential in co-creating integrated, sustainable mobility infrastructures. Atos has a strong heritage and a major presence today in transport and logistics. Our close involvement over decades in UK rail and with some of the world's leading logistics specialists is continuing as we work with road, rail and logistics organisations to advance what is possible through digital transformation.

Connected digital technologies have reached a tipping point and the revolution in mobility is accelerating. This paper shares ideas on some of today's key opportunities and challenges for transport and logistics leaders and influencers. My team and I look forward to continuing work with customers and partners to help realise this digital vision as the new mobility ecosystem evolves.





Philip Chalmers
Senior Vice President, Sales and Marketing, Atos UK & Ireland

Safe and efficient movement of people and goods is at the very heart of a successful economy. Government investment in transport plays a vital part in generating employment and growth in all sectors. It is also central in helping people to stay empowered and connected in their everyday lives.

With delivery of a world-class infrastructure a key component of its Industrial Strategy, the Government has embarked on the largest transport investment programme in a generation. As the Government has made clear, the private sector has an essential role in digital innovation. Important partnerships are also emerging between mobility providers to share data and invest in digital platforms.

Atos is committed to supporting delivery of the Road Investment Strategy and the Rail Sector Deal, for example, which enshrine Government commitment to transform the UK's strategic road and rail networks and operate at the forefront of global mobility trends.

Digital technologies such as process automation, analytics and artificial intelligence are critical for transport and logistics providers to improve customer experience while optimising use of assets and reducing emissions. Atos has a proud history in transport and logistics; we are committed to playing our part in helping to drive transformation and shape the future of mobility across the UK and beyond.



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Transport is not, and has never been, just about transport. It's about better-connected cities, and about better housing. It's about rural areas and rural connectivity. It's about combatting loneliness and creating more inclusive communities and more productive businesses. It's about society and culture.

Jesse Norman MP, Former Future of Mobility Minister, Department for Transport

”

UK transport and logistics: always on the move

Road, rail and logistics operators and innovators are making advances every day that keep people, goods and the UK economy moving.

Road

Electric vehicles are projected to account for **69%** of passenger car sales by 2030¹

The cost of battery packs has declined **70%** in the past 7 years; batteries typically account for **40%** of the cost of an electric vehicle²

2040 is when the sales of new conventional petrol and diesel cars and vans will cease³

15 manufacturers have pledged to release Level 4 Autonomous Vehicles by 2025⁴

Rail

1.7bn rail journeys were made in the 2017-2018 financial year⁵

20,000 approximate daily services on the GB rail network⁶

London Waterloo is the UK's most popular train station, with 94m entries and exits a year⁷

565km of new railways to be delivered between 2026 and 2032⁸



¹ KPMG Mobility 2030 analysis, Mobility 2030: Transforming the mobility landscape, KPMG, February 2018. <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf>

² Lithium-ion battery costs and market, Bloomberg New Energy Finance, July 2017. <https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF-Lithium-ion-battery-costs-and-market.pdf>

³ UK plan for tackling roadside nitrogen dioxide concentrations, UK Government, July 2017. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/633269/air-quality-plan-overview.pdf

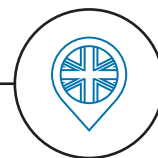
⁴ KPMG Mobility 2030 analysis, Mobility 2030: Transforming the mobility landscape, KPMG, February 2018. <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf>

⁵ How many people use the railway, Office of Rail and Road. <https://orr.gov.uk/statistics/popular-statistics/how-many-people-use-the-railway>

⁶ Rail Factsheet 2018, UK Government, December 2018. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/761352/rail-factsheet-2018.pdf

⁷ Busiest stations in Britain, Office of Rail and Road. <https://orr.gov.uk/statistics/popular-statistics/busiest-stations-in-britain>

⁸ The UK Rail Industry: A Showcase of Excellence, UK Government, April 2014. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/303255/UKTI_Rail_Brochure.pdf



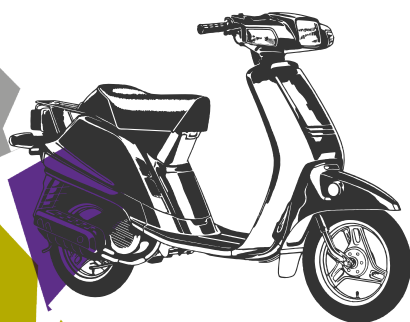
Mobility

The average car is unused **96%** of the time⁹

Autonomous Vehicle “as a service” provision could be up to **40%** cheaper than private vehicle ownership by 2030¹⁰

Half of car owners know today that they will no longer want to own a personal vehicle by 2025¹¹

The global mobility ecosystem is forecast to grow over **\$1tn** by 2030¹²



Logistics

89% of all goods transported by land in Great Britain are moved by road¹³

57% of Light Commercial Vehicle (LCV) sales could be electric vehicles by 2030¹⁴

150 - 250% is the projected increase in rail freight activity by 2050¹⁵

\$1.37tn is the projected global market value of logistics by 2023¹⁶

⁹ Future of Mobility: Urban Strategy, UK Government, March 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786654/future-of-mobility-strategy.pdf

¹⁰ KPMG Mobility 2030 analysis, Mobility 2030: Transforming the mobility landscape, KPMG, February 2018. <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf>

¹¹ KPMG Mobility 2030 analysis, Mobility 2030: Transforming the mobility landscape, KPMG, February 2018. <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf>

¹² KPMG Mobility 2030 analysis, Mobility 2030: Transforming the mobility landscape, KPMG, February 2018. <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf>

¹³ Road Haulage Facts and Stats, Road Haulage Association. <https://www.rha.uk.net/policy-campaigning/top-industry-issues/haulage-industry>

¹⁴ KPMG Mobility 2030 analysis, Mobility 2030: Transforming the mobility landscape, KPMG, February 2018. <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf>

¹⁵ Future of Rail 2050, ARUP, July 2014. <https://www.arup.com/perspectives/publications/research/section/future-of-rail-2050>

¹⁶ Logistics Market: Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2018-2023, Research and Markets, April 2018. https://www.researchandmarkets.com/research/kclz28/global_logistics?w=5

Mobility is getting public and personal

The history of transport is integral to human evolution: from the invention of the wheel to the development of the railways and the creation of the internal combustion engine, the ability we have to move has shaped our society and the world we live in. But the next evolution will be fueled by data and centered on us.

Increasingly with population growth and denser metropolitan conurbations, we see the need to support the mass movement of people and goods with efficient, effective and integrated multi-modal public and personal transport systems.

Transport operators all over the world are beginning to rely heavily on data: harvested both from within their own networks and systems and from the personal mobile devices of individuals.

A key game-changer in the availability of this type of travel data was the implementation of smartcard technology, such as the Oystercard in London and the Octopus card in Hong Kong. Multi-modal journeys could, for the first time, be integrated seamlessly for individual commuters. After the Oystercard was launched in 2003, it delivered huge value not only in the form of revenue protection – the entire network became a gated system by which access in and out could be recorded and charged – but also through the availability and analysis of vast amounts of data in order to model, predict and manage ever more effectively the transport network.

Transport operators have sought to progress and develop the value of these types of smartcard platforms by gradually integrating different systems to attain an ever-broader view operationally, while also tracking and gaining a greater understanding of individual movements.

The ever-evolving use of personal digital technology has now made 'personal mobility' easier to use and track too. It is why we have witnessed the massive expansion of platforms such as mytaxi and Uber, car- and bike-sharing apps, and journey-planning platforms such as Waze that correlate multiple live datasets. This more flexible and richer personal mobility mix has disrupted the industry, coupled with changes to journey / work patterns.

However we choose to travel, what we use to think of as a map is now a real-time journey advisor, our journey's friend, providing hints, tips and nudges along our route and layering on other relevant information: the location of the nearest favourite coffee shop, services that might be of interest or 'relevant' offers we might like to take advantage of as we go. When we do get into our cars, we can forget the basic Satnav that use to lead us down a dead-end because the data was out of date. We live

in a world where IoT vehicles not only know the route we should take, but also the speed we should travel, how to avoid the traffic as we go and even the weather we will encounter.

So where is all this information taking us?

With a myriad of personal mobility services and platforms being developed, what we should now expect is consolidation and increasing personalisation of services. In the past, transport authorities would have been the focal point for integration. Today, it could just as likely be a 'go compare' type intelligent personal mobility aggregator. With mobility information integrated, we'll be able to access our real-time options through our own personal mobility dashboard, showing taxis, bike hire, car share, rail and bus journeys, etc. – all organised with us at the centre and taking into account our preferences and variables – price, the traffic, weather, CO2 produced by the journey, best discounts available on certain routes, events, diversions, roadworks and of course, our favourite mode of transport.

To realise this vision of personal mobility, vast amounts of data from different apps and services will need to be aggregated. This will be a huge technological feat for innovative integrators and digital architects. Given the volumes involved, it will not be efficient or even practical to draw together data from every location into single points. We are entering the age of 'edge computing', when data will live where it is created: on individual devices, at the so-called 'edge' of the digital eco-system. Effort and creativity will also be needed to achieve the necessary cultural and behavioural changes; citizens will need to buy into the value of using an aggregator, feel confident in the services and be nudged into adoption, potentially using gamification and incentivisation.

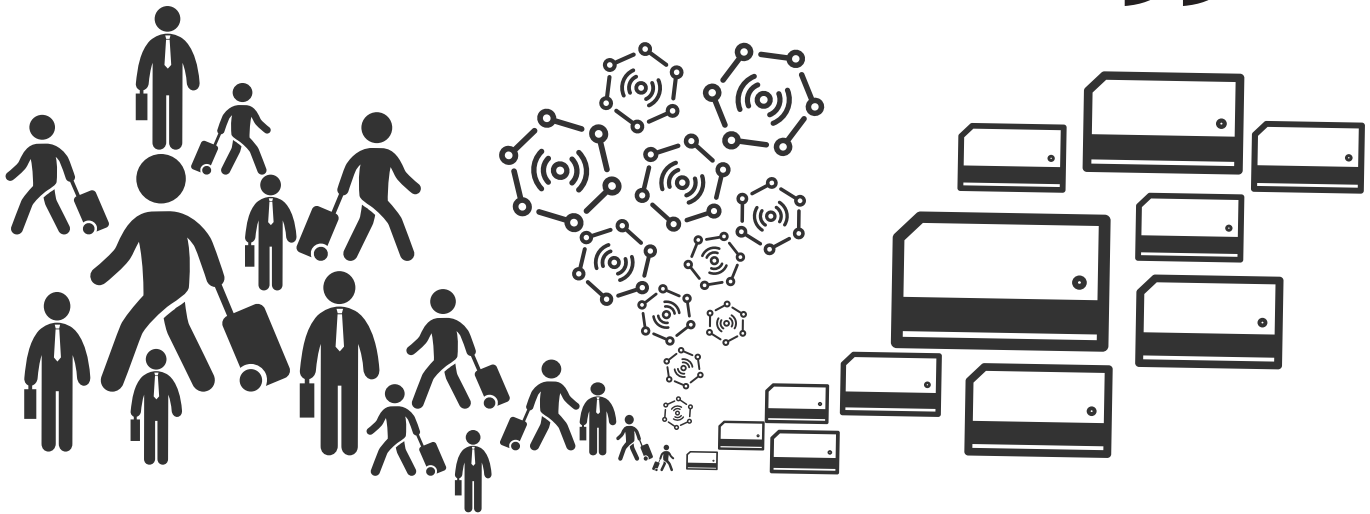
While there are clearly many challenges, with imagination, innovation and increasing collaboration, they are entirely surmountable. Historically the transport industry has always been visionary in leading the adoption of new technology. Motor cars, high-speed trains, jet planes and underground metros have all enabled and enhanced the world we live in, but this next transport evolution will be centred on the individual. The direction of travel will now be driven by the power of data, digital platforms and aggregation, creating efficiency, speed and exciting sustainable options for us all to select from, while making our personal mobility simpler and easier than ever before.



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Mobility as a Service: the new paradigm

Recent years have seen a marked shift away from private vehicle ownership, particularly in urban areas. KPMG's latest Global Automotive Executive Survey found that 39% of surveyed consumers say ownership of vehicles is decreasing and half of those surveyed expect that 50% of car owners will no longer want to own a personal vehicle by 2025.¹

Similarly, according to UK Department for Transport figures, the proportion of 17-20-year-old men in England holding a full UK driver's licence has fallen from 51% in the mid-90s to just 29% in 2017 (and from 81% to 69% of men aged 21-29). These changes will likely be exacerbated by the introduction and consumer acceptance of mobility 'as a service' as an alternative to owning and maintaining their own vehicle.

Unprecedented movement

In essence, the concept of Mobility as a Service encapsulates the move away from personal vehicle ownership towards service-based transport; this includes the aggregation of multiple transport modes, as well as on-demand mobility. Most notable in this space has been the rapid emergence of the digitally-enabled on-demand private car hire firms such as Uber and Lyft that are now so commonplace in cities all over the world; these are now expanding their platforms from their established mode of cars into mass public transport and ePersonal mobility (such as bike and scooter hire).

As it matures, Mobility as a Service will facilitate unprecedented ease and levels of movement for the benefit of a range of stakeholders: for transport operators and authorities to achieve their corporate objectives; for Government to deliver on its travel policies; and for consumers looking for convenient, comfortable and cost-effective mobility.

In its most developed form, Mobility as a Service would be presented to consumers through a single app so that people could move from place to place using and paying for different modes of transport seamlessly. They could use the app, or a computer or kiosk, to enter their travel requirements and preferences, and see journey choices that fully integrate public and private transport; they could make one payment automatically by a method of their choice; and they would have ready access to plenty of on-demand travel options along with real-time integrated journey and planning information.

Leveraging data

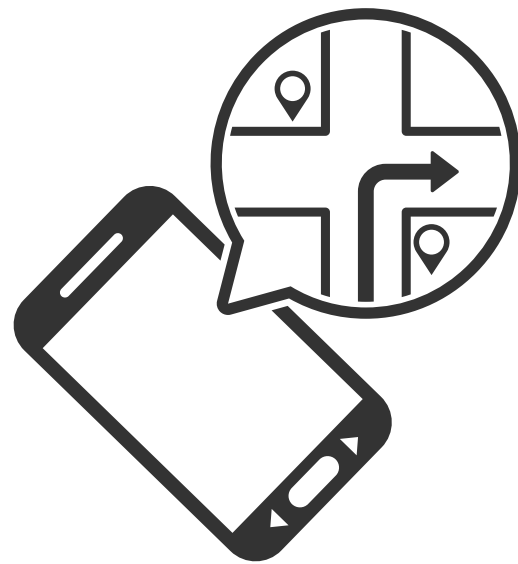
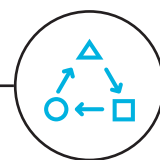
The core technologies for making Mobility as a Service a reality exist: IoT and artificial intelligence have already found their way into everyday consumer mobility in the form of smartphones. Connected devices and digital platforms deliver services such as taxi and shared car fleet apps whereby consumers can instantly see the location and availability of vehicles. These kinds of offers will continue to diversify and expand at pace thanks to the increasing availability of low-cost sensors and the ubiquity of high-speed over-the-air communications, including 5G.

For new and established transport operators and transport authorities, Mobility as a Service will be a platform to optimise utilisation and yield of their asset bases. As more and more assets become connected, increasing volumes of real-time data about their location, availability and condition will help companies to transform the way transport infrastructures are managed through, for example, predictive and pre-emptive repair and maintenance. Add in a layer of artificial intelligence and companies can optimise mobility services more dynamically and proactively than ever before. This will benefit consumers before they travel (helping to predict movement and suggest routing, products and services) and during travel (determining and avoiding likely results of delays). With multiple modes of transport optimised, congestion will be minimised and air quality and passenger comfort enhanced.

Far-reaching integration

In time, connected transport infrastructure, assets and data will give travel operators unprecedented operational insights, such as understanding how demand and use changes with performance and quality of service. Who knows? Data about the condition of assets could in turn drive new business models, such as consumers being offered a free ride if they're prepared to clean a vehicle.

¹ Global Automotive Executive Survey, KPMG, 2019

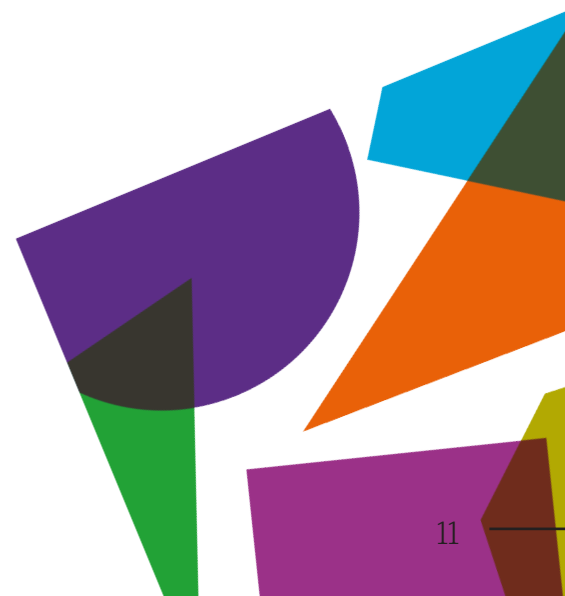


While there is already plenty of innovation, we are only at the start of the journey to Mobility as a Service. Its full potential can only materialise when there is far-reaching integration with and between mobility systems and operations. This requires a critical mass, both of customers and mobility services providers, which in turn requires the necessary technical, commercial and governance frameworks to be defined. Once baseline services can be established, creativity and collaboration will be needed across the mobility sector, and with government and digital providers. Mobility as a Service is a completely new paradigm: it has the potential truly to transform the possibilities of mobility for all.

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Transport for London's essential enabler: customer information

One of Transport for London's (TfL) most significant challenges is meeting the ever-changing information needs of our customers. We've advanced from the relatively slow-moving world of public information screens and boards to a digital one in which customers have access to vast amounts of data - literally at their fingertips.

There are two aspects to providing good customer information: firstly, ensuring that it's accurate and timely; and secondly, delivering it via the most appropriate channel. At Transport for London, our customer information strategy also focuses on improving the helpfulness of information - so rather than just telling our customers that something is wrong, we also want to advise them of what they can do next.

Modernising experiences

We want our customer information to be live, easily digestible, localised and actionable. Hardware is a key enabler; for example, in preparation for the Elizabeth line, we have deployed modernised customer information screens that produce a customer experience ready for the future. They are high-density screens (as opposed to the traditional amber LEDs) that mean we can provide a richer content experience: making use of multiple data sources, more colours and graphics, show videos, and independently control different information elements; all to provide more helpful content than we could traditionally do.

One of our strategic challenges is navigating our own digital journey alongside rapid advances in consumer technologies. The airline industry, for instance, invested heavily in integrated in-flight entertainment systems just as customers started to travel with their own devices and content. As a result, we are extremely mindful of where we invest and how tightly we can manage development and delivery lead times.

Moving to self-service

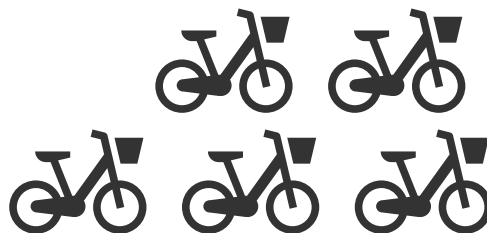
A key milestone will be the implementation of Wi-Fi across our transport network. This will enable customers to self-serve and reduce the demand for physical assets. The ability to push data to personal devices will help us reach a wide audience with highly targeted information and the choice to opt in or out to get their own customised information experience.

In the meantime, in terms of content, it's important to consider each touchpoint, that is, exactly where and when customers are using the information; for example, a countdown to the next service works well for buses or tube trains but may be less useful for certain low frequency timetabled services. We've also established information hierarchies so that secondary 'nice-to-have' information disappears from screens as soon as urgent advice is needed in the event of disruption, enabling us to be responsive in real-time.

Door-to-door journeys

Mobility as a Service has a significant part to play and how this is implemented will be key to success. We're exploring how to create a continuous digital journey with countdowns to relevant live departures, details of the closest Santander hire bikes and docking stations and so on. If legislation to permit e-scooters on public highways is introduced, we could see how any sharing schemes could also be integrated.

Given the advances in artificial intelligence and personal apps, we are preparing for the introduction of real-time personal assistants for planning journeys nationwide. As and when autonomous vehicles become a reality and car ownership decreases, customers could be able to arrange online to take an autonomous taxi, or to hop onto a bike, then take a train or hire an electric car, or whatever they need to complete their end-to-end journey.





New collaborations

Creating this seamless experience will require huge amounts of data integration, so specialist technology companies will inevitably get involved and different transport authorities will need to provide data feeds. At Transport for London, our scale and level of investment has put us ahead of the game. We already make all our bus and tube arrival information publicly available through an application programming interface and our Overground and TfL Rail train information is shared via the Darwin system for all national Train Operating Companies.

Significant disruption in this space looks certain and we welcome these opportunities to collaborate because more integrated, personalised services will make life easier for our customers. We may see a future in which if your digital assistant detects that service is disrupted, then your alarm clock is automatically set for earlier to give you extra travelling time. Our customers just want to get safely from A to B in the way that best suits them: it's our purpose to make that happen.

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Our ambition is to get to the point where if something is disrupted, we can instantly offer advice about alternatives across multiple transport modes. Our strategy is to evolve support for customer journeys, not just across Transport for London, but door-to-door.

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Digital dilemmas in mobility

As the promises of digital gain ever more momentum, so too do the imperatives for mobility providers and partners to respond. Yet the waves of change and the sometimes-divergent choices they present can introduce dilemmas for those responsible for leading and shaping digital transformation.

Types of digital dilemma

At their simplest, these dilemmas are reflections of alternative business strategies. Should we invest in our own data platform or procure a shared service capability? How do we deal with legacy infrastructure while also exploiting new digital technologies?

The rate at which certain technologies are maturing and evolving often outpaces the rate at which they can be adopted in a measured and effective way. As the boundaries of what digital technologies make possible are continually stretched, there are questions around how the corresponding regulatory frameworks and standards can evolve without stifling innovation.

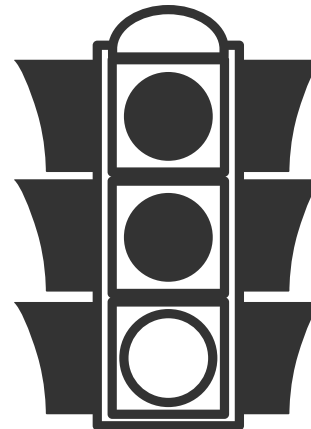
And there are dilemmas at the heart of how humans engage with the world of digital. How do we embrace automation? How can my business help to address the growing digital divide between certain demographics? Alongside the focus on enhancing customer experience, how can my organisation help address wider societal issues such as data privacy and employee wellbeing?

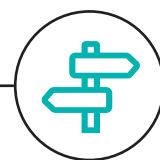
Possible versus permissible

A strategy of 'digital by default' is not the only response to real-world challenges. What is possible with digital technologies and what is desirable or permissible are not always the same. Making these distinctions is not wholly predictable. Rational and emotional responses are influenced by factors such as business value and economic sustainability, as well as personal and societal impacts, willingness and ability to change, and perceptions of trust and fairness.

Digital dilemmas and outcomes are shaped by balancing tensions in four key areas:

- **Insights created through data.** Being data-driven can be an invaluable differentiator for organisations while making life easier and better for customers and citizens. For example, demand-responsive transit is on the horizon, whereby train or bus services are dynamically optimised and airline services are highly personalised according to demand or preference. While it is easy to see advantages in both these new models, balancing those with individuals' rights to services and privacy will be equally important.





- **Inertia from the wider societal impact of digital.** The real world may be unable or unwilling to keep pace with technological innovation. Digitally enabled 'floating bike' schemes, for example, are easy and quick to set up; yet their impact on shared spaces could be more difficult to manage. Equally, regulation of use of drones is needed to catch up with technological advances.
- **Inequalities that could arise to inhibit adoption.** Digital technologies can cause a digital divide between those who embrace them and those who don't. New mobility apps and the growing gig economy offer customers and workers choice and convenience. Yet there are challenges from public opinion, competitors and public authorities to manage the impacts on wider society and other mobility providers.
- **Ideals that place humans at the heart.** Ideals and trust are balancing forces across all areas of digital adoption. Adoption of technologies will be strongly influenced by collective values and beliefs, for example in the use of facial recognition technologies on transport networks, the deployment of robotics, and the ethics involved in the safety of autonomous cars.

Individual and organisational responses to these digital dilemmas depend entirely on context. Where an organisation decides to strike the balance will shape not only its approach to digital transformation, but the evolution of its enterprise as a whole and the role it plays in its sector and in wider society.

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Ideals and trust are balancing forces across all areas of digital adoption.”

For more on digital dilemmas, visit Atos' Journey 2022 at atos.net/journey-2022



The future of mobility services: realising the vision

From active travel, such as cycle share schemes, to automated vehicles, commuter drones and completely new mobility business models, the way people move around is going through a period of acute transformation.

The UK Government has recently published its Urban Strategy for the Future of Mobility, which demonstrates the ambition and, in some cases, ongoing delivery of key outputs towards a more agile, interconnected and responsive mobility ecosystem.

We are also seeing other positive developments – for example:

- Establishment of the Centre for Connected and Autonomous Vehicles, a specialist body dedicated to leading on crucial innovation areas
- Recognition of the future of mobility as a grand challenge in the Industrial Strategy
- Allocation of formalised funding and support, such as the Automotive Sector Deal and the recently launched Rail Sector Deal
- Announcement of large-scale regulatory and policy reviews such as the Williams Rail Review

While it is easy to appreciate the potential benefits of the future of mobility, it is hard to understand what a more mature version of it will look like. This is a challenge for industry actors, policy-makers and innovators alike, as it is difficult to know what explicitly to aim for.

To support the innovation momentum that is brewing in the transport sector, techUK has released its own vision for the future of mobility services in the UK:

“A digitally-enabled, interoperable, integrated and inclusive transport network that connects our citizens with multiple modes of transport services that can offer door-to-door convenience, respond to dynamic pressures and cater to the specified needs of the citizens within the locality.”

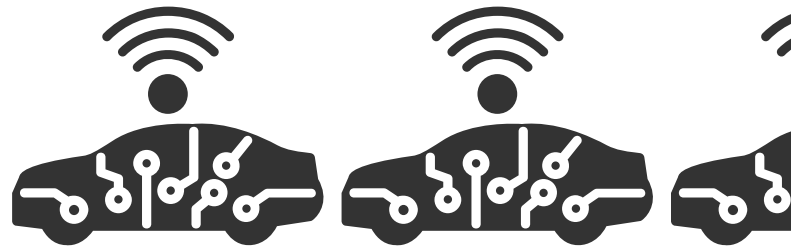
We know it’s not punchy, but every detail in our vision is there for a reason – because it can and should be considered as we look to deliver digitally-enabled mobility services.

Digital as enabler

The role that technology will play in the future of this country’s mobility services is undeniably integral. It has already started to fundamentally change the way we engage with mobility service providers and our expectations of service and capability. Digital technologies enable new ways of doing, including optimising services, increasing automation, and facilitating multi-modal functioning.

Digital has already started to drive a step change in mindset across the sector, where we are putting the end user – the traveller – at the heart of our mobility services’ design. This is possible because digital enables more meaningful engagement with travellers.

Many mobility service providers understand the need to start building in better customer engagement – the “how” and “why” an individual user engages with their services. This is now crucial to the industry, since consumer satisfaction, as measured by the proportion of journeys rated by passengers as satisfactory in terms of value for money, has been the lowest since 2008. For example, the legacy “ticket mindset” no longer serves the sector amidst a rapid shift towards digitalisation, and the strict regulation underpinning ticketing is stifling the emergence of new ways of managing journeys and payments in mobility services.





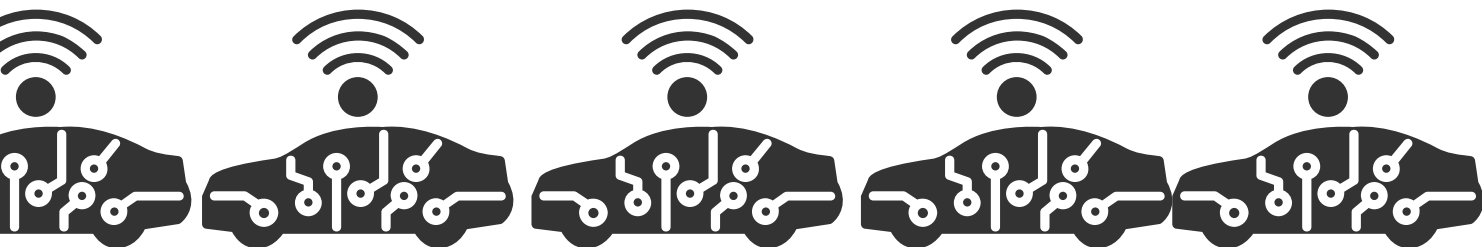
Setting the direction of travel

These changes won't happen simply as technology evolves. We have seen how innovation in bus services has been restricted in London, how user behaviour and pushback has thwarted bike share systems in Manchester, how uncertainty about the law regarding e-scooters has hindered adoption. Industry needs to come together and work with Government to help them understand changes and where regulation can be a positive shaping force, rather than a hindrance.

Looking into our crystal ball, there are a few key milestones that will need to be reached to supercharge the shift to the future of mobility services. Firstly, we have already seen positive direction from the Government. We believe that the Future of Mobility strategy helps to provide assurance to the market, which techUK has advocated for in our Future Mobility Services in the UK report. It brings forward principles for the future of urban mobility; and it encapsulates pedestrians, cyclists, freight, and both public and private transport.

As well as overarching principles, the strategy has set out some key outcomes that Government wants to deliver. It is now fundamental that Government continues to give the private sector assurances about what can be brought to market, and offer the same decisive direction to local bodies. With a clear and informed strategy in place, we should not have to wait long to see the full power of digital transformation reshape our mobility environment for the better.

“ Digital has already started to drive a step-change in mindset across the sector, where we are putting the end user – the traveller – at the heart of our mobility services’ design. ”



Transforming mobility: views from digital natives

Mobility beyond the city

As a digital native, I don't remember Y2K, dial-up or a time before MP3 players. Throughout my formative years I have been immersed in digital technology, growing up around smart phones, smart cards and smarter cities.

All this means that I naturally take for granted the highly connected mobility services around me, with the ability to travel across major cities within an hour, or roughly the same time it takes for a parcel to be delivered home.

However, I believe that the scope for innovation in mobility is not restricted to city limits. Outside the metropolis lies a plethora of opportunities for the disruptive technologies I see day-to-day to revolutionise deep into the heart of our country - making travelling outside major cities much more accessible.

When I travel outside the city, navigating the tight and twisty rural roads across wide distances between towns, I regularly come across a whole host of unpredictable outliers. My view is that the mobility services of the future will need to interact creatively with the existing infrastructure we see today.

As an example, the open landscape brings a unique opportunity to effectively employ drones, which have the ability to cover large distances between the most inaccessible towns and delivery hubs quickly and via a direct route, as opposed to heavy goods vehicles which may struggle to navigate meandering country lanes. This way, the local supermarket, post office or health clinic could have their resources delivered in real time, optimising their retail and service capabilities whilst reducing the need to travel into larger towns.

On the ground, I believe there is scope to totally transform how we interact with shared transport systems. Demand for shared transport can vary significantly in areas with fewer people, meaning the best solution might be to move towards methods of mobility that are responsive to the requirements of individual users.

In rural areas, access to towns and cities can be difficult, especially for those who do not have access to a car or live too far from public

transport routes. Therefore, autonomous vehicles could provide to a wider audience the same level of convenience currently enjoyed by privately owned car users, at a fraction of the cost. Through options such as private hire or ride sharing, there would be no need to own or maintain a car, or even hold a driving licence. The vehicle could arrive at your door, making journeys into towns, cities or the nearest transport hub much more accessible for all.

I see the way we move around in our cities today as the mobility goals for rural areas tomorrow. Automated vehicles and drone technology are just a few examples of ways to modernise the mobility mix in less populated areas, which require a much more flexible approach compared to major towns and cities.

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I see the way we move around in our cities today as the mobility goals for rural areas tomorrow.

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The commute of the future

As a digital native, technology has always been a major part of my life. However, I feel that, over the next several years, new and disruptive technologies are going to truly transform the way I move around the city.

I look forward to my commute becoming faster, more comfortable and seamlessly integrated across multiple modes of transport.

This (not so distant!) future could look like this:

My journey to work starts before I leave the house, as my smart speaker notifies in real-time about the best options for my route to work, based on my calendar commitments and local traffic levels. I decide to pick up an electric scooter from the hire station around the corner, as this is the quickest and healthiest way to the station. Once I arrive, I walk directly through the turnstile with my smartcard in my bag, without any hold up or congestion. Queues at the station turnstile are a thing of the past.

Trains arrive at the platform more frequently than ever before, thanks to combined improvements to infrastructure and analysis of commuter travel patterns. Transport companies coordinate seamlessly and can now plan new routes for buses and trains to serve commuters faster, making my journey much more straightforward.

It's a hot day in the summer, so I consult my app which tells me that by missing the next train and getting the one after, a seat will be available in my chosen carriage - which will be two degrees cooler. This helps improve passenger comfort on hot trains and reduces the number of uncomfortable standing commutes.

As I leave the station, my phone automatically opens my social network app which notifies me that two of my colleagues are due to arrive soon at the same station, and we could share an autonomous taxi to the office. However, I'm also alerted that, due to roadworks, I will get there faster by walking. I take the 2,000 steps to the office (which count towards my daily target!) via a new pedestrianised greenway - one of several that popped up recently, right where frustrated motorists used to sit in long traffic queues...

“

Transport companies coordinate seamlessly and can now plan new routes for buses and trains to serve commuters faster, making my journey much more straightforward.

”

Continuity and change: a rich shared history

Since its earliest beginnings, the rail industry has attracted trailblazers and change-makers with a passion for the railway. Atos and Worldline are no exception.

Our close involvement with UK rail stretches back over decades of sweeping commercial and technological changes.

For all rail organisations, passenger safety and freedom of movement sit alongside the urgent need to meet growing demand and assimilate ongoing change. As companies, Atos and Worldline have been shaped by the rail industry, with successive opportunities to grow our capabilities to help meet these complex challenges. In turn, we have played a part in shaping the story of rail through the evolution of core systems together with ground-breaking technological solutions.

“

The marriage of transport and technology has paved the way for new passenger experiences. Convergence between back-office systems and the customer experience - initially through smart cards, now by devices and apps, and in the future also through IoT - will continue to transform people's experience of rail.

Kulveer Ranger, Senior Vice President, Strategy & Communications, Atos UK&I

Modernise to transform

With a few name changes as a result of partnerships and growth - from Semra Group and KPMG Consulting, to Atos Origin, to Worldline and Atos - over three decades, we have retained delivery of core systems and services through thousands of competitive tenders.

Crucial to our history was the creation of Worldline as an Atos company in 2004, with our strong payment service capabilities and focus on rail. A new chapter opened in May 2019, when Worldline became an Atos alliance partner; our two companies will continue working closely to facilitate digital transformation across UK rail.

Along the way, we have collaborated with and acquired market-leading companies: from BRBS to Shere, each acquisition has been in response to rail industry needs. Throughout, we have consolidated and modernised legacy systems while delivering transformation, both in rail operations and in retail and customer information systems.

And now...

Given today's fast-evolving and increasingly connected technologies, the challenge now is to deliver the benefits of digital rail: to strengthen the railway's contribution to the economy, while improving passenger experience, maintaining safety and keeping running costs contained.

At the dawn of the age of digital rail, the rail industry, Atos and Worldline are on the next stage of our journey.

Atos' and Worldline's history are inextricably linked; through our stewardship, how people book their travel has changed beyond recognition.

Sunil Munsif, Vice President & Sales Director - Transport, Atos UK&I

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For decades, Atos and Worldline have helped make a difference to the way people travel and work on the railway every day.

Since before privatisation in 1997, through passenger self-service, to today's up-to-the-minute apps, front-end systems have been helping people make better-informed choices about their travel. Modern systems make it easier than ever to buy the right ticket in the right place at the right time across 2,563 stations in the UK.

At the same time, rail operations systems have delivered step changes in efficiency and responsiveness while continually evolving to keep pace with technological change.

“

The combination of our strong IT capabilities with deep knowledge of rail systems and data has been a key differentiator and a constant. There's a huge amount of inherent experience and know-how, with intimate knowledge of the industry landscape.

Vaughan Freeman, Head of Transport Systems Consultancy, Worldline UK&I

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Working together behind the scenes of UK rail

Including long-term relationships with key industry bodies such as the Rail Delivery Group and Network Rail, services delivered throughout our history include: design, delivery, integration and support of specialist and enterprise IT; data and process support; safety-related systems management; problem and change management; digital transformation; and a breadth of consulting capabilities.

123 million tickets managed yearly

over **80%** of railway station passenger information systems

286,000 daily public address announcements

17.8 million daily real-time train movement messages

scheduling for **25,000** staff

settling of **£1 billion** revenue between rail operators every 4 weeks



Stops on our journey with rail

British Rail: from IT department to market leader

In 1997, Sema Group bought BRBS (British Rail Business Systems), one of the last parts of British Rail to be sold as part of the privatisation of UK rail that created nearly 100 separate companies. Every one of those companies was a BRBS customer.

Privatisation created new opportunities, such as the provision of local applications for each operator to manage timetable, fleet and crew operations and provision of systems to supervisory government bodies to monitor overall and individual operator performance and compliance with franchise agreements. It increased the focus on an improved passenger experience, which is where much of the technology innovation has been created.

In turn, being part of a global organisation opened up new business opportunities. Customers were no longer internal to the organisation: they had to be competed for, and a world of wider experience and knowledge was brought to bear. Today, most of the original companies remain customers, including all the passenger and freight train operators, infrastructure maintenance companies, rail vehicle leasing and maintenance companies and Rail Settlement Plan, the body which ensures consistency and fairness of ticketing and settlement.

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Technological progress is at the heart of a sustainable rail network. We've always nurtured not only the right skills and knowledge, but also the right culture and mindset - a real commitment to the long-term future of rail and to collaborative innovation.

**Theo Quick, Vice President
& Global Market Leader:
Transportation & Hospitality,
Atos UK&I**

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2003

- First mobile ticketing for the Heathrow Express
First mobile or self-print tickets, downloading a barcode or a ticket to buy up to 10 journeys
- Lennon' system launch
Award-winning system that revolutionised how operating companies recognise annual revenue

2000

- Y2K challenge
Navigated without a hitch
- First portable ticketing solution
Brought portable ticketing to customers, transforming retail of up to 50 million tickets a year

1997

- Sema Group buys British Rail Business Systems (BRBS)
Ensured minimal disruption to essential systems and processes, many still in operation today
- First credit card transaction on a ticketing machine
Changed ticket vending forever



2019

- Computing DevOps Excellence Automation award
Recognised a joint Worldline/RDG³ team for replatforming the Lennon system in the cloud

2013

- Integrale system launch
Support for rail operations resource management, train service delivery and performance; enables operators to prevent delays and better manage disruption
- 10-minute reservations
Customers could now reserve seats as few as 10 minutes before departure

2018

- Transport for London's Wonderwall launch
Provides customers on the Elizabeth Line with a broader range of localised travel, news and assistance information than ever before
- Sensa system launch
Integrates seat reservation with occupancy data and customer information for LNER services, giving passengers and staff a current view of train service loading and helping passengers find seats more easily

2007

- WebTIS system launch
Gave Train Operating Companies (TOCs) control over ticket retailing in trains and stations

2010

- Atos acquires Shere
Acquisition of ticket-vending innovator to enable TOCs² to cover all ticket distribution channels; accelerated introduction of new self-service technology that later became digital retailing

2011

- RedSpottedHanky.com
Travel portal that we created and owned; today delivers £1 million of rail sales each week

2012

- Spectator journey planner launch
Fully integrated multi-modal travel app enabling spectators of the London 2012 Olympic and Paralympic Games to plan their journeys door to door

2004

- Worldline formed
To offer advanced payment services and strong industry focus

¹ Latest Earnings Networked Nationally Overnight

² Train Operating Companies

³ Rail Delivery Group

Simpler, better, faster: travel's time promise

The purpose of digital is, in part, to provide more convenient and responsive services for customers and higher revenue and cost-efficiency for transport providers. So, how far along the road to digital is the UK transport industry? And has it kept pace with customer expectations?

Transforming payment systems

In the 21st century, we live our lives looking for ease and efficiency that translate into one of our most precious commodities: time. We want the same kinds of easy digital experiences that we get from the FANGs (Facebook, Amazon, Apple, Netflix and Google) in other parts of our lives. And we want access to goods and services to be simple and fast. For any organisation, therefore, providing easy payment solutions is key to keeping today's 'time promise' to customers.

In the digital world, consumers can pay in more ways and much faster than ever before. Yet across the transport industry as a whole, there is still some way to go to modernise payment processing and customer experience. The days of thousands, if not millions, of fare and origin/destination combinations are in the past and there has already been a move to electronic and 'account-based' ticketing (whereby the passenger's ticket acts as a token and the right to travel is stored in back-office systems rather than on or in the ticket itself). However, these implementations have tended to follow existing ticketing and fare processes.

Open payment solutions

The principle of purchasing a ticket as a 'right to consume', for example, has long been held as the means to protect operators' revenue streams and pricing strategies. However, requirement that customers 'buy a ticket' is looking increasingly anachronistic in today's always-on digital world - and especially so when we start to consider Mobility as a Service.

Instead, implementing an end-to-end Open Payment solution can save customers time and improve their experience while delivering added operational and cost benefits for operators. With an Open Payment solution, customers, regardless of which bank they use, can pay for their travel via their contactless payment card, their smartphone or even their smartwatch. These electronic transactions now represent what used to be a ticket.

Multiple benefits

For mobility operators, this kind of Open Payment solution supports revenue growth, protects revenues, reduces cost of sales and, most importantly, increases customer satisfaction. Implementing paperless transactions also means that they can be organised around a central account for each customer, thereby fostering a more personalised and responsive customer service.

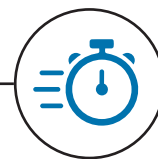
In Dijon - where Worldline implemented France's first-ever Open Payment solution with mobility operator Keolis Dijon Mobilités - the technology tracks and records every kind of mobility mode each customer uses: tram, bus, train, metro, bike. Customers can get a quick and easy-to-use overview of the services they use and this is being expanded to include other civic amenities, including libraries and leisure centres.

As a payments company, Worldline develops, delivers and invests in systems and services that enable the movement of money and data between billions of people and millions of businesses every year. While there may be concerns among some transport operators that changing payment systems will break their business model, failing to act may now be the riskiest option of all.

Keeping UK rail's time promise to customers

The UK rail industry has a unique structure, with the ongoing challenge of how to coordinate the introduction of new technologies into a complex rail ecosystem. All this must be done in the face of ongoing change and urgent demand for increased capacity and capabilities.

In response, close collaboration is needed across the industry and with partners to define a digital roadmap to embrace the potential - and the challenges - of digital transformation. In addition, there are now important opportunities to take a radical look at how core processes operate rather than being constrained by legacy systems and ways of working that have existed for decades.



To deliver the benefits of digital, there are two critical focus areas for UK rail:

- Customer experience
- Punctuality (not just whether trains arrive on time, but whether they arrive at the right time).

Great customer experiences: selling the time promise

The Fares Reform announced by the Rail Delivery Group in February 2019 sets out recommendations for vital reform that could be further accelerated through digital transformation. For example, when it comes to traditional ticketing and revenue allocation systems, new payment technologies could remove the need for the long-used Operational Computerised Allocation of Tickets to Services. The data now exists to enable Train Operating Companies to reach the holy grail of understanding exact revenue by train, with Rail Delivery Group's Fare Reform recommendations making this even simpler.

Customer information systems are at the heart of every rail customer's experience: they enable customers to pre-plan their journey and take well-informed decisions during their journey in the event of a change or disruption. The foundation of effective customer information systems is good-quality raw data that is increasingly linked to operational systems and other sources of real-time data. Data sources can be opened up to deliver improved communication to customers during times of disruption. For example, Worldline has built a Facebook Messenger and Alexa robot who can advise on timetables and recommend journey changes.

As consumers demand more and more from their service providers, business models need to change to keep pace, especially in advance of Mobility as a Service, which will require significant cooperation between many parties.

Punctuality: delivering the time promise

There are now significant opportunities to use available data to plan long-term timetables which can then evolve over time as capacity increases. Given that for rail customers, 52-week 'planning cycles' are not relevant, the data now exists to make this process much smoother across all entities.

Once the timetable is planned, the means of delivering it can also be improved by aligning, interfacing and cross-analysing traffic, stock and crew data. Instead of 'optimisers' that only cover one Train Operating Company's timetable, digital technologies can support more collaboration between operators and with partners and suppliers in order to drive change for the benefit of customers, similar to what is happening in the retail side of the industry.

Operational control systems also need to evolve so that they are easier to user and interface with. These are steps that Worldline is already taking, working directly with partners and academics to build true decision support capabilities that look at the whole, not the sum of the parts.

Rail's new promise

Harnessing technologies and data to deliver better, faster and more convenient systems, processes and interactions will give the promise of time back to customers. What's more, if train operators make it easier and simpler to access UK rail, then more people will travel. In the digital age, traditional assumptions around ticketing and timetabling no longer apply. Bold thinking, collaboration and coordinated change are needed across the industry to overcome barriers to digital transformation. Rail customers expect and want change, and the time for change is surely now.

A vision of the railway of tomorrow

Digital technologies are integral to the future of rail, enabling train operators and infrastructure owners to safely increase the capacity, reliability and efficiency of their networks and assets whilst increasing levels of passenger satisfaction.

Given the continued growth in passenger and freight numbers, any disruption or failure on a network can have major consequences.

A perfect example of the successful application of digital technology is the Thameslink Programme, a c.£7bn Government-sponsored programme which has transformed north-south rail travel through London.

Operating on one of the most congested parts of the UK rail network (passenger journeys in London and the south east having doubled in the last two decades), the number of peak-time trains at terminus stations had reached its limit, and so a radical rethink was required to help address the 'capacity crunch'.

Siemens Mobility worked in partnership with Network Rail on the Thameslink High Capacity Infrastructure programme to deliver a modern, digital signalling and train control solution to meet the capacity and train frequency targets, with the decision taken to signal the central core section with a European Train Control System Level 2 (ETCS L2) solution overlaid with an Automatic Train Operation (ATO) system for in-cab signalling. The first passenger-carrying train under ATO control ran in March 2018, representing the world's first application of ATO over ETCS on an operational, high traffic suburban mainline railway.

As a result of this project, Thameslink now has a digitalised connected infrastructure with large volumes of data flowing around it to help meet its operational challenges. And passengers are now benefitting from more connections, faster, more frequent and more reliable journeys, better stations and new trains.

Prediction and pre-emption

Maximising railway network availability, however, also involves the application of real-time diagnostics and 'big data' to predict potential failures and enable pre-emptive interventions to be made. To facilitate this, Data Capture Units (DCUs) can be fitted to a wide range of equipment, providing the opportunity for targeted and preventive

maintenance, rough ride/defect detection, improved passenger experience and energy consumption from predictive and efficient journey profiling.

The DCU is a data gateway which enables data, whether it is diagnostic, state of the railway or any other data for that matter, to be securely sent from assets to real-time analytic systems providing greater insight into the health and state of the railway.

Capacity and confidence

Advanced digital control systems enable optimisation and increased capacity, with solutions such as C-DAS (connected-driver advisory system) advising drivers of the optimum speed to travel in order to reach a given location at exactly the right time. This helps improve energy efficiency and reduce congestion and delays, in turn increasing capacity.

Reducing infrastructure

Following the success of the Thameslink Programme, Siemens Mobility is now developing ATO Track Side (ATO TS), one of the projects under the Shift2Rail European research programme, with test track operational testing due to begin later in 2019 in collaboration with Network Rail. Using Thameslink as an example, currently, each train has a map of the ATO network stored in its memory. ATO TS would transmit the current map to the train, avoiding the need to update stored maps on each train when the infrastructure or conditions change.

Whilst Thameslink features Level 2 of the European Train Control System (ETCS), a good deal of work has now been carried out in the UK on ETCS Hybrid Level 3, with Network Rail having demonstrated the concept over a year ago. Hybrid Level 3 builds on the existing ETCS level 2 system which transmits secure radio messages to onboard equipment which monitors the safe movement of trains based on trackside train detection. In Hybrid Level 3, suitably fitted trains can



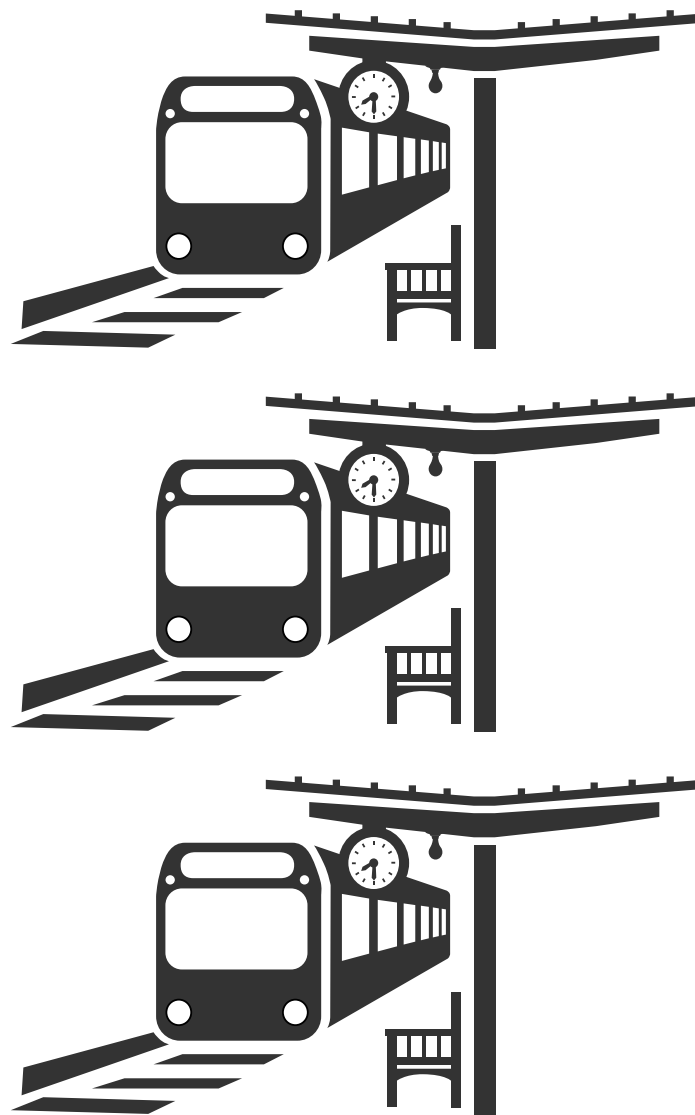
move more closely than in conventional signalling, sending accurate position reports directly from the train to the trackside. This allows optimal use of infrastructure at minimal cost.

Effectively drawing together mainline and metro technologies, this solution will unlock greater capacity and flexibility within the existing railway infrastructure, while also reducing trackside equipment. Apart from lower installation cost, fewer trackside assets offers the potential for fewer failures, reduced maintenance requirements and safer working conditions - all of which will deliver increased reliability and availability.

Transforming experiences

The Thameslink Programme is transforming travel through London, with the system designed to operate a timetable of 24 trains per hour, delivering metro-like performance on a mainline service.

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For operators and passengers, digital signalling and control systems together with advanced data and analytics are key to meeting intense demands while driving down costs - which can only be good for the UK's economic future.
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Stop problems without stopping service: revolutionising asset management

Modern asset management depends increasingly on transport operators' and manufacturers' ability to predict when, where and how assets need to be maintained.

By using data from sensors installed on trains, for example, maintenance teams can anticipate problems before they arise. This greatly reduces the time needed for trains to stop for routine checks or major repairs. As a result, operators can ensure high reliability and availability of their services, and benefit from lower maintenance costs.

High-precision maintenance

For any predictive maintenance on this scale, cloud technologies are essential. This is because to ingest, store, process and analyse data in this way would require a prohibitively large investment in on-premise infrastructure. In contrast, cloud services offer unlimited scalability, great connectivity, massive storage, plus data streaming and machine learning capabilities.

Using Google Cloud Platform, train manufacturers can revolutionise train maintenance by streaming data from sensors in real time and applying machine learning to stop problems without stopping service. They can collect, store and analyse high volumes of data from each train - including information on voltage, hydraulics, acceleration and temperature, as well as video of the driver's view. Not only does this data monitor the trains in action, it also feeds into high-precision machine learning models that predict maintenance needs so that the manufacturer can resolve them without disrupting service.

Talgo: a leading innovator

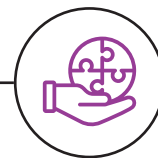
Take Talgo, for example, one of the world's foremost manufacturers of high-speed trains and a leading innovator in using new technologies to monitor trains while they're still on the move. The company has 80 trains in Spain and 36 in Saudi Arabia, with over 30 additional trains

scheduled for delivery by 2021, including vehicles for the UK's High Speed 2 project. Talgo's contracts with operators are demanding. In terms of reliability, its guarantees extend to journeys of over 30,000 km between basic inspection stops and more than 1.5 million km between failures. It must also ensure 99% availability of its fleet, whether its trains are travelling through a Saudi Arabian sandstorm or winter in the UK. Talgo's ability to leverage data to optimise its maintenance processes is therefore a business-critical activity.

Using Google Cloud Platform, Talgo has greatly increased the volumes of data it can collect, store and analyse from each train. The company's maintenance engineering department in Saudi Arabia and its headquarters in Spain use dashboards to monitor events in real time, including tracking train locations with Google Maps. Maintenance experts interpret the data from trains, comparing variables to keep track of the condition of each vehicle, make predictions, and decide what needs to be repaired and how. Predictions, recommendations, and evaluations of the condition of trains can be sent directly to engineers anywhere via their mobile devices. Data is also used for historical analysis, using machine learning.

Condition-based monitoring

Talgo aims to use cloud technology to move from preventative maintenance to condition-based maintenance, based on machine learning predictions. Its team is experimenting with using edge computing to control every single sensor, to change onboard patterns and rules, filter the information that trains send, and transmit messages directly to the sensors in the train.



Continuous advances

In future, Talgo plans to complement its trains' onboard data sources with installations on the tracks that will take measurements from the exterior of trains as they pass through at speeds of around 300 km/hour. New automatic inspection equipment uses cameras with artificial vision to detect if anything is loose or broken on the side of the train. This technology will mean that instead of needing to go to the depot every week, a train can go every three weeks. Given that it takes six hours to inspect a high-speed train, Talgo would save more than 200 hours of depot inspection time per train, every year.

With the power of continuous advances in machine learning and the ability to analyse almost boundless volumes of data, transport equipment manufacturers and operators will increasingly benefit financially, reputationally and operationally from predictive - and pre-emptive - maintenance. Ultimately, the goal is simple: to maximise the time that each train is safely available to take passengers where they need to go.

“

Train manufacturers can revolutionise train maintenance by streaming data from sensors in real time and applying machine learning to stop problems without stopping service.

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Google Cloud results with Talgo

Streams data in real time from 2,000 onboard sensors for immediate analysis, anywhere in the world

Collects 2GB of data per train, per day, from over 100 trains in several countries

Collects 2,000% more data per train, per day than using a previous system

Uses machine learning for potential savings of over 200 hours a year per train in maintenance inspection time

Transforming logistics: market overview

Moving a package across international borders is a complex business. Even domestically, in the face of tight margins and fierce competition, logistics companies are under pressure to retain market share and protect their bottom line. Industry 4.0 technologies offer important ways for smaller players to dramatically extend their reach, and for established companies to innovate to compete.

Here are five closely interconnected digital technologies that are revolutionising the logistics industry.

Big data and analytics

With recent leaps in computing power and data visualisation technologies, no logistics provider can afford to overlook its data as a business-critical asset. Analytics turn raw data into intelligence that can be used to improve speed, customer service, cost-efficiency – in fact, any aspect of a business. By gathering data from core systems and from sensors in fixed and moving infrastructure, companies can now predict events and spot trends and patterns over time. This can be used for anything from the procurement of aircraft (which is dramatically improved with accurate long-term forecasts on capacity, environmental impact, demand and so on) to predicting and therefore avoiding costly delays to millions of shipments a day along complex supply chains.

Artificial intelligence

Leading logistics companies are already harnessing artificial intelligence to shape their business strategies and drive up performance. Algorithms can measure and process boundless numbers of parameters, to learn from data and generate new insights that can be used for strategic and operational planning, such as where to place a warehouse or open a new office, or how to structure pricing strategies. It reduces the numbers of unforeseen circumstances and enables companies to react faster and more effectively if something unpredictable does happen.

Cloud adoption

In today's fast-moving business environment, old-style systems and ways of working are increasingly holding companies back. Legacy IT can be expensive and inhibit innovation. In contrast, moving business-critical systems and data into the cloud gives organisations evergreen solutions and unprecedented agility, with the change from CapEx to

OpEx investment and the flexibility for companies to scale up and down as required. Hybrid cloud services (blending private and public services depending on requirements) offer the most cost-effective and secure solutions. Critically, cloud is the engine for implementing new digital technologies.

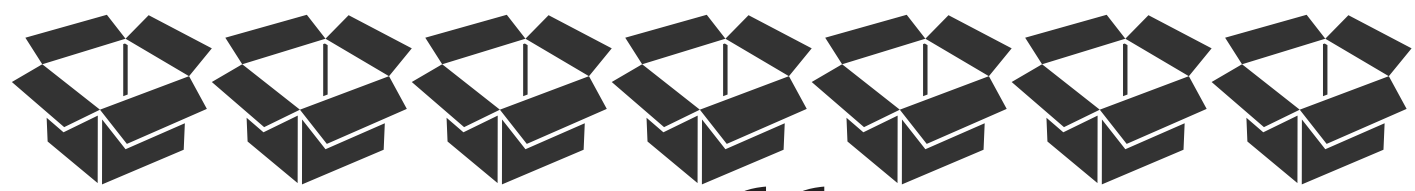
Automation and robotics

Many of the advances in the use of autonomous vehicles are being spearheaded in the logistics industry, with autonomous trucks and cars already in use at ports, for example. Technologies for unmanned aerial vehicles (drones) are also advanced and constrained only by the need for further regulation together with, for commercial purposes, requirements to carry heavier weights. Together with increased use of robotics in warehouses and for deliveries, automation, in combination with artificial intelligence, will transform operations and free human workers for higher-value assignments.

In the future, swarms of connected drones and autonomous vehicles will move together, increasing environmental and operational efficiency. Using edge computing, they will coordinate and interact, rather than in isolation or via a central control, with data stored and processed in individual devices and vehicles.

Blockchain

Blockchain is the first technology that offers a way to fully manage digital assets in a traceable, automated and predictable way. Trust is distributed along the chain, eliminating the need for a trusted third party to facilitate digital relationships. It's therefore easy to see the value of distributing trust along a supply chain, especially in relation to shipping dangerous or highly valuable cargoes (armaments, medicines, organs for transplant) or when a number of different parties are involved. Logistics giants FedEx, UPS and DHL Express (all members



of the Blockchain in Transport Alliance) have joined forces to advance industry-wide standards for use of blockchain to hammer out standards for such a system, and could be the first major logistics providers to deploy fully mature blockchain technology.

Radical transformation

The logistics and freight industry is vital to the UK's economic health and growth. As in other parts of the transport sector, it is entering a period of unprecedented disruption. We only need look to the entry into the market of transport network companies such as Uber, mytaxi and the emergence of Mobility as a Service; these models are set to shake up the logistics market.

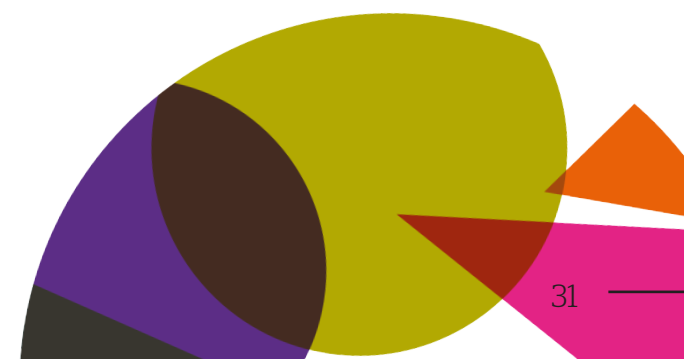
Equally, Industry 4.0 technologies are transforming the manufacturing industry. We are already seeing their impacts extend outside of the manufacturing plant, with machine-to-machine connections ordering spare parts and even parts that can be 3D-printed at logistics companies' premises.

We are on the cusp of a radical transformation of the logistics landscape. Digital technologies offer companies game-changing opportunities to meet their most urgent strategic and operational objectives while helping to deliver global society's most important economic and environmental goals.

“

The logistics and freight industry is vital to the UK's economic health and growth. As in other parts of the transport sector, it is entering a period of unprecedented disruption.

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Logistics 4.0: intelligent supply chains

A combination of forces is causing major disruption for the logistics industry. With globalisation, supply chains are becoming ever more complex and tightly managed, increasing the pressures on logistics companies.

At the same time, many customers are implementing widescale digital transformation that changes the demands they place on their logistics providers. In particular, the spread of Industry 4.0 technologies is set to revolutionise some supply chains: companies, especially in manufacturing, are starting to use the Internet of Things (IoT), automation, artificial intelligence and real-time analytics to optimise, accelerate and predict their operations. As a result, the logistics market is itself changing. New entrants such as Flexport and FreightHub are rethinking traditional logistics by leveraging digital technologies and incumbents must innovate to keep pace. Even well-established logistics service providers are developing new digital services to enhance their capabilities (including drive4schenker and DHL Resilience360).

Old siloes

One thing is clear: logistics companies' operations will need to be increasingly digitalised if they are to stay competitive. And for major logistics providers, the ability to leverage increasing volumes of data to improve or differentiate their services will be key to future success.

Traditionally, this has been difficult: organisations have tended to operate in silos, making it hard for logistics companies to see what's happening up and down the supply chain. As supply chains get leaner, longer and more complex, the results of this lack of visibility become magnified. If, for any reason, a logistics company cannot meet its service level agreements, as well as the reputational impacts, it costs their manufacturing customers, either through the need for extra warehousing or lack of materials or stock.

Myriad data

The arrival of IoT changes all that - and in partnership with Atos, Siemens has been working with manufacturing companies and their logistics providers to harness Industry 4.0 technologies to create what we call intelligent supply chains.

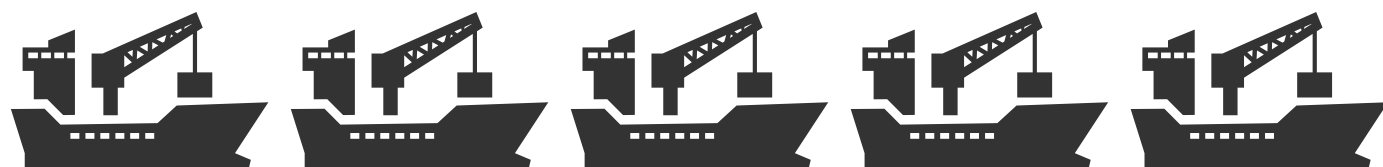
IoT connectivity can be used to gather real-time data from multiple fixed and mobile systems, devices and sensors along a supply chain. This data can come, in any format, from within customers' enterprise resource planning and SAP systems, from logistics companies' operational and planning systems, from sensors on the factory floor, on pallets and on goods in transit, and from telematics in trucks and on ships. It can be integrated with multiple external and open data sources, such as weather data, geo-positioning (land, air and sea) and geo-political advice and information.

When this data is overlaid with powerful analytics and machine learning, logistics providers can then use it to track, optimise and predict their operations. They can accurately monitor and adjust the movement of goods to maximise efficiency and even simulate complex supply networks. They can also share information and work more closely with customers and other partners.

Multiple benefits

Intelligent supply chains are a game-changer for any logistics company serving large customers or those with complex operations and distribution requirements. While digitalising operations and becoming data-driven enables logistics companies to meet service level agreements more precisely, critically, it also helps them get closer to their customers. Trust and confidence improve and logistics providers can better compete on the basis of helping their customers to maintain cashflow and just-in-time delivery, with security enhanced and risks minimised at every stage. In measuring the benefits of digital supply chains, McKinsey, for example, found that better logistics routing could produce 17% gains in operating efficiency, package/container tracking could yield 10-25% better utilisation of containers and 30-50% less damage with an overall 5% productivity improvement.¹

¹ Unlocking the potential of the Internet of Things, McKinsey Global Institute, June 2015



Transforming business models

Yet there are wider benefits of embracing digital. Logistics market leaders are transforming the services they can offer. For example, DHL has developed 3D printing capabilities so that when it receives an order and a design, this is queued and shipped straight out to the customer. It has also started to use drones to deliver blood samples to a testing site in Zurich.

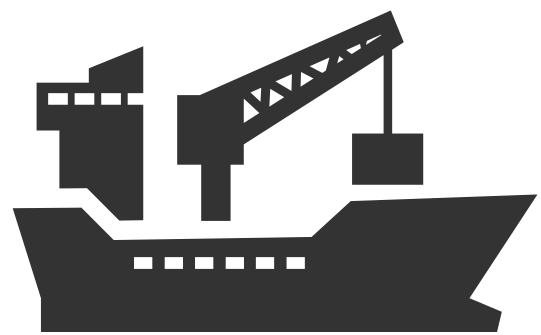
We are at a tipping point in digitalisation and moving to a world in which logistics providers will use artificial intelligence to predict impacts along their supply chains in order to take pre-emptive and preventative actions. To retain their place along today's fast-changing markets, forward-thinking logistics companies must prepare for a new phase in the evolution of the industry: Logistics 4.0.

Intelligent supply chains

Atos and Siemens have collaborated to create a unique Intelligent Supply Chain solution that brings together Siemens AX4, Siemens MindSphere and Atos Codex offerings. AX4 is our Digital Supply Chain solution; MindSphere is the cloud-based, open IoT operating system from Siemens, with seamless connectivity to harness and analyse data; Atos Codex is a complete portfolio for data-driven business transformation.

By combining these three data powerhouses, the Intelligent Supply Chain solution is unique in its scale and the power of its analytics capabilities. This ready-to-use platform gives logistics companies immediate, secure access to mature IoT and analytics capabilities as a service, with the ability to collaborate with hundreds of customers and partners.

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For major logistics providers, the ability to leverage increasing volumes of data to improve or differentiate their services will be key to future success.
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Making connected mobility a reality

Increasingly, the Internet of Things (IoT) is enabling local authorities and mobility providers to extract and use great volumes of data from fixed and mobile sensors.

As these technologies evolve, the centralised platforms that deliver them should be robust, secure and easier to use. They also should be scalable (vital for any IoT solution) and interoperable (so that data can more easily be collected from all kinds of places).

Atos' R&D team in France has developed a standardised IoT platform to address these challenges. The Smartcity Platform is available on demand and is based on a managed service developed in collaboration with technology partner Red Hat.¹ It is designed to collect and aggregate data from fixed and mobile devices that are tracked and mapped in real time. Systems, devices and sensors to collect this data can be on trains, buses, trams and cars, as well as fixed infrastructure, and also gather information about the objects and environments around them.

The platform is designed to analyse and visualise data for those involved in planning and managing mobility services via a set of dashboards and serves information to the consumers of those services via a mobile app.

Current applications

- Atos' Innovation Lab is working for the French Ecological Ministry in Bordeaux to deliver a road information management solution for cities. The solution employs new vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) ITS² communication technology and provides powerful analytics dashboards to aid real-time decision-making by city planners. While Atos' Smartcity platform collects many different sets of data, the real value comes from looking at where datasets intersect, for example measuring the impact on air quality of different planning decisions, such as closing streets, or adding extra buses. Over time, the city can identify trends to inform future planning decisions.
- The Atos team is also working with the R&D Institute VEDECOM in Versailles and local government to develop the platform to improve mobility services in Versailles by giving residents and visitors real-time information about cab-sharing, car-pooling and even use of integrated autonomous vehicles. The platform aggregates open data so that citizens can see a live dashboard to help them make better-informed transport choices in real time.



¹ Red Hat and OpenShift are trademarks or registered trademarks of Red Hat, Inc. or its subsidiaries in the U.S. and other countries.
² Intelligent Transport System

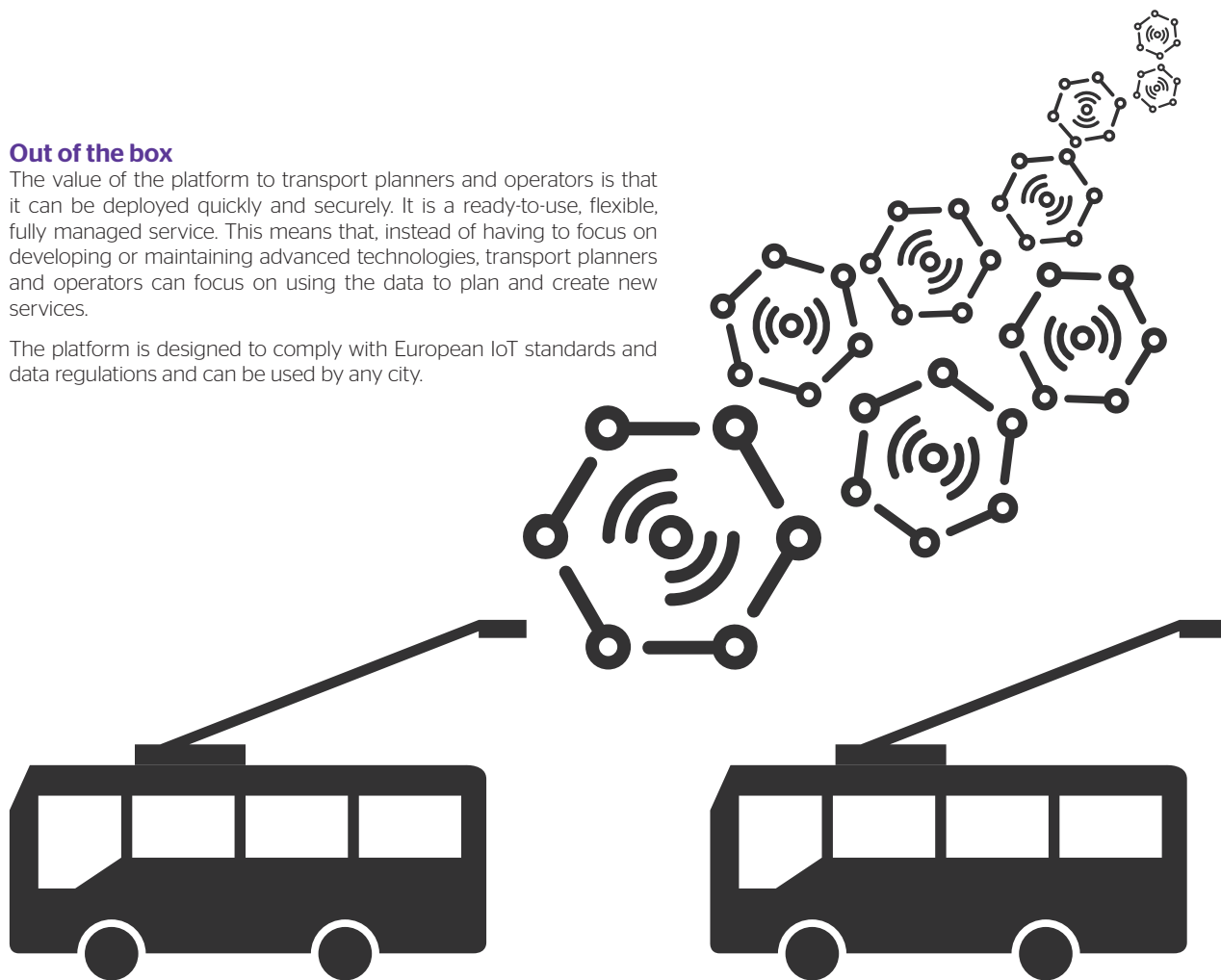




Out of the box

The value of the platform to transport planners and operators is that it can be deployed quickly and securely. It is a ready-to-use, flexible, fully managed service. This means that, instead of having to focus on developing or maintaining advanced technologies, transport planners and operators can focus on using the data to plan and create new services.

The platform is designed to comply with European IoT standards and data regulations and can be used by any city.



Rise of smart motorways

Smart motorways have had a mixed press. Public conversations and mainstream media have questioned whether hard shoulders should be lost as permanent refuge areas. Evidence shows, however, that they are dangerous spaces not suitable for refuge for more than a few seconds.

There are, of course, other major challenges in managing and delivering the UK's road infrastructure. Acquiring new land to build additional road capacity is costly and can be difficult. At the same time, the environmental impact of road vehicles must be managed.

Highways England's Smart Motorways programme started in 2006 with the M42 pilot. This was not a leap in the dark: the Dutch highways administration had been working on a similar concept that had itself evolved from early work by Highways England. Yet it was still a significant step, building on significant advances in detection and control technology, on the vastly improved reliability of vehicles since the English motorway design was conceived in the 1950s, and on the excellent safety record on UK roads. It was also driven by the need to increase capacity and traffic flow without expanding motorways themselves. While it is easy to see how these factors drove the smart motorway concept, it has taken visionary and determined management to make the first schemes happen and ensure the concept be permanently adopted.

Smart motorways at a glance

All forms of smart motorway depend on technology for their safe and effective operation. They are an excellent example of intelligent transport systems in daily use.

Smart motorways come in three types.

- **Controlled motorways**, the original concept, which only uses mandatory variable speed limits to optimise the efficiency of the motorway; this was a significant innovation in its time
- **Hard shoulder running**, which involves switching the hard shoulder in and out of general traffic use depending on traffic conditions and whether the hard shoulder is in use for an emergency; this was the concept first trialed in 2006

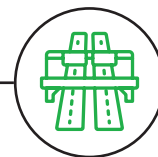
- **All lane running**, the permanent conversion of the hard shoulder into an additional traffic lane, is the latest step. The lack of a hard shoulder is partly mitigated in that modern vehicles do not break down as often as they did when motorways started, and partly by the installation of refuges. In the light of concerns about access to refuges, there is a gradual move towards having them once a mile instead of every mile and a half.

Measurable benefits

Over the life of its smart motorways programme, and in response to growing demand for road space and strong criticism of disrupted and unpredictable journeys, Highways England evolved and matured the M42 pilot into a permanent policy. Now, smart motorways have been in operation for so long that evaluation results are available.

Before smart motorways, congestion on the network caused 25% of accidents and the cost of congestion was estimated at £2 billion per year. By reducing congestion, smart motorways are reducing both figures. They have proved to be at least as safe as before, and on some routes there are fewer accidents. The current implementation plan will have added 400 miles of lane capacity when it is complete, making a significant inroad into congestion. Less publicised, but increasingly important, is that by making traffic flow smoother, smart motorways reduce emissions both from engines and from tyre/roadway friction.

The smart motorway implementations by Highways England in their various forms demonstrate the capacity for innovation, even in the face of mixed public opinion. Highways England has faced demand for keeping the hard shoulder on questionable grounds of safety, and equally strong demands for not using up any additional land at all to create brand-new road space.



Pioneering intelligent transport systems

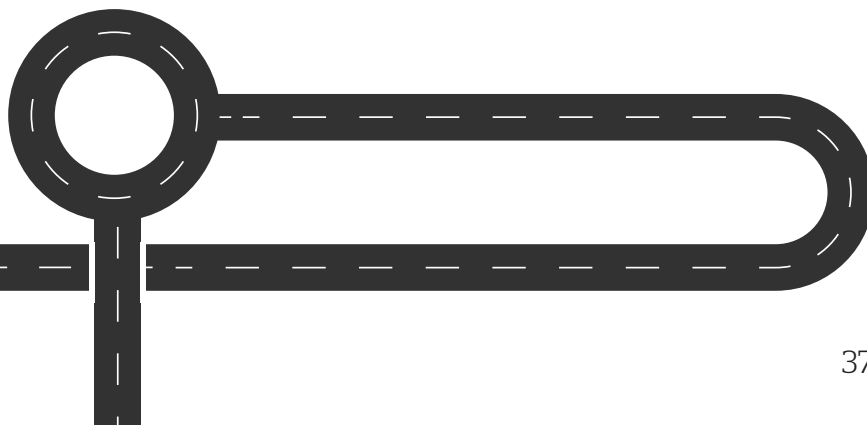
Highways England's 2015-2020 Business Plan includes a total of 15 smart motorway schemes. At present, four are completed, five are underway and six are planned. The final outcome will be a significantly improved network in terms of congestion, safety and air quality, at much less financial and environmental cost than building new capacity from scratch.

The UK led the world in the early adoption of intelligent transport systems in the 1980s. While other countries have now caught up, the smart motorways scheme stands as an example of the kind of pioneering intelligent transport systems implementation that is ongoing in the UK.

A successful, safe and sustainable road transport network will continue to be a critical part of the country's mobility mix. Innovative deployment of connected technologies and increased use of data, analytics and artificial intelligence will enable the UK to stretch capacity and minimise disruption while leveraging existing road infrastructure. Increased use of data from smart motorways, combined with smart technologies such as advanced telematics, the evolution of connected and autonomous vehicles, and urban and inter-urban traffic flow management will all be essential to meeting major environmental and cost challenges. Critically, a key benefit of continued technological innovation is that for drivers, passengers and pedestrians, a safer future will be secured.

Smart motorway technologies

- **Vehicle detection systems** provide data on traffic flow which is processed into the automated or semi-automated setting of **variable message signs** and **variable speed limit signs** on the smart motorway. It is also used for other purposes such as traffic information and route planning. Highways England's system uses inductive loops in the road (the traditional technology) and radar (a later development) to detect vehicle numbers, types and speed.
- **CCTV** is an important part of the portfolio. The actual hard shoulder is 100% visible via CCTV to the control centre and the rest of the motorway has good visibility, varying slightly according to location. The cameras are essential when opening a dynamic hard shoulder to general traffic, in order to check for obstructions, and helpful to operators at all times since we are not yet at the point of total automation of these processes.
- **Digital speed enforcement cameras** cover all lanes of traffic with one camera, and automatically recalibrate to take into account changes in the variable speed limits.

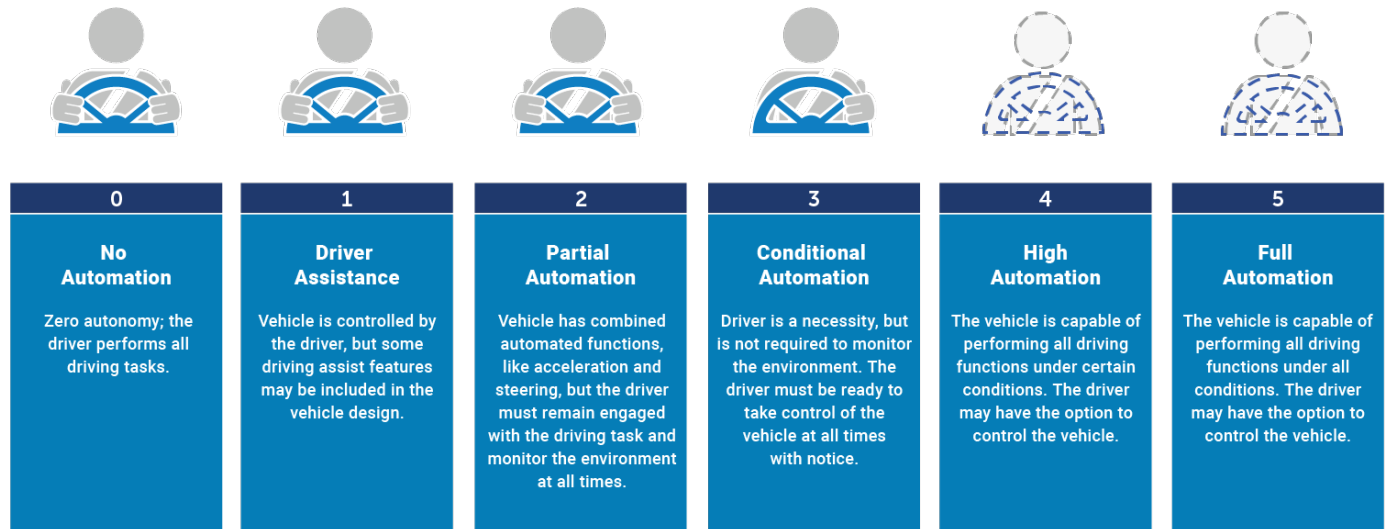


Autonomous vehicles: myth or reality?

The vision of our towns and cities full of driverless cars has captured the public imagination. Autonomous vehicles have been hailed as the answer to our traffic problems, with accidents and congestion eliminated on calmer and quieter roads and people freed up to watch TV, work or even sleep on the move. But is this vision of the future realistic and when is it likely to happen?

The likelihood is that we will see an evolving hybrid mobility mix of Connected and Autonomous Vehicles (CAVs), comprising both autonomous vehicles and connected vehicles driven by people. A useful reference point is the set of globally recognised levels of autonomous driving systems set out by the Society of Automotive Engineers. Level 0 vehicles have no autonomy and must be controlled by a human at all times. Level 5 vehicles are fully autonomous and don't require any help from a human to operate.

Society of automotive engineers (SAE) automation levels



Credit: SAE



Levels 1, 2 and 3 (with continuous supervision by drivers) are already available or will be available in the next few years by almost all vehicle manufacturers. They have major benefits for public safety (and insurance premiums) through more controlled, informed and safer driving. Level 4 driving systems (autonomy within certain parameters) have been around for some time in isolation: Rotterdam Docks, for example, uses completely automated vehicles within a geofenced site. However, the realities of introducing autonomous driving at scale and within a hybrid traffic environment bring a number of key challenges.

Computing at the edge

Autonomous vehicles require huge amounts of compute power: the technologies cannot make critical decisions in real time if they rely on cloud-based processing. There is simply too much latency that may cause unacceptable and dangerous delay.

Developing sufficient computing power is a work in progress, with edge computing at the heart of the solution. Edge computing helps transfer computing power out to the edge of the network, where devices collect and process all kinds of direct and indirect data and visual information required for effective and safe autonomous driving (including object proximity, traffic signals, pot holes and weather conditions).

Swarm intelligence

When these devices are mobile, they can form an intelligent swarm. Just as, in nature, swarms of insects or murmurations of starlings coordinate their interactions, so too we can expect the Internet of Things (IoT) to enable multitudes of entities and devices to combine, forming dynamic and intelligent collectives. In this way, a swarm of driverless cars could interact to move safely and efficiently at speeds that are just not possible if local control decisions are made in isolation. Vehicles could join or leave the swarm as needed, contributing their own localised insight to traffic and environmental conditions.

Smartphones already act as rudimentary swarms: they crowd-source traffic information by detecting when phones are bunching up and slowing down - but the vehicle driver still needs to decide how to act on such insights. Autonomous vehicles interacting collaboratively will generate a much broader view.

Security and safety

As connected vehicles enter the mainstream, so too does the potential for their malicious exploitation. There could be significant impacts on personal and public safety if hackers gain remote control of a vehicle or adversely impact its behaviour.

Any IoT-enabled system tends to lead to an extended 'attack surface'; so autonomous driving systems require more dynamic, scalable, decentralised and intelligent security mechanisms than less interconnected operating systems. Technologies like blockchain could be a means of immutably identifying autonomous objects, validating the authenticity of individual pieces of software and establishing trust within a network of entities that are otherwise unknown to one another.

And, of course, there are ethical and safety considerations - especially in a hybrid environment that inevitably brings human unpredictability. Testing of fully autonomous vehicles is accelerating the data ethics debate about how decisions are weighed up by algorithms when there is potential danger to a human being. And whose responsibility is it if an accident does occur? Is it the vehicle manufacturer, a technology provider or the public authority who authorised the vehicle? This is perhaps one of the biggest hurdles to overcome if individuals are to be willing to entrust their own lives to autonomous vehicles - algorithmic outcomes take on new significance when they may lead to driver safety taking lower priority than other 3rd parties.

Safer future

What is clear for now is that it's possible to achieve high degrees of autonomy in specific closed environments, including designated roads and tunnels, or even dedicated lanes running alongside traditional traffic.

In years to come, we can expect autonomous vehicles to operate as local swarms that make the whole experience of driving from A to B more consistent and reliable. A network of autonomous vehicles all reacting to one another's condition and context will be able to control speeds and manage traffic flows far more efficiently, making jams and collisions a thing of the past. The challenge, in the meantime, is how to manage the transition to this safer future.

Shaping the future of mobility for everyone

Digital mobility is fast becoming a critical element of transport. More and more technology is being introduced to cars; semi-autonomous functions have become an integral part of cockpits; and the routes from A to B are being reorganised, especially in urban areas, via multimodal mobility platforms or smartphone apps.

New models of transport and mobility that prioritise interconnectivity and sustainability have the potential to transform cities, creating greater opportunities for economic growth and changing how people live and work.

For businesses such as mytaxi, this is a revolution that is creating both opportunities and challenges. A whole new business model has taken shape, combining elements of transport and technology, connecting consumers and providers. But business models aren't static - they continue to evolve as a result of technological advancements and changing customer expectations.

As part of this change, mytaxi will rebrand to FREE NOW in the summer of 2019. FREE NOW will focus on offering consumers a range of options for all elements of this journey. Our aim is to make mobility available for everyone, regardless of age, location or income. We want to reduce car ownership, make cities smarter, make mobility flexible, free up more green spaces and make a real difference to how we move around cities.

Mobility is more than just a service - it is a fundamental part of how people live and work. We believe that it's time to rethink urban mobility, to improve inner-city conditions in alignment with responsible authorities, and to focus on developing customer-oriented, smart mobility solutions which bring back more quality into urban living.

Data as a foundation

There are already solutions on the horizon to build cities as places for people, with safe, sustainable, accessible and equitable transportation choices that support a strong economy and vibrant quality of life. Technology and innovation are driving this revolution, but this must be supported by investment and regulation.

We need a more dynamic and flexible regulatory model that places consumer choice at its centre. Our present regulatory system is outdated and designed for a different generation; we need a regulatory model that supports experimentation, encourages the sharing of data and prioritises working with industry and others to help shape the urban environment.

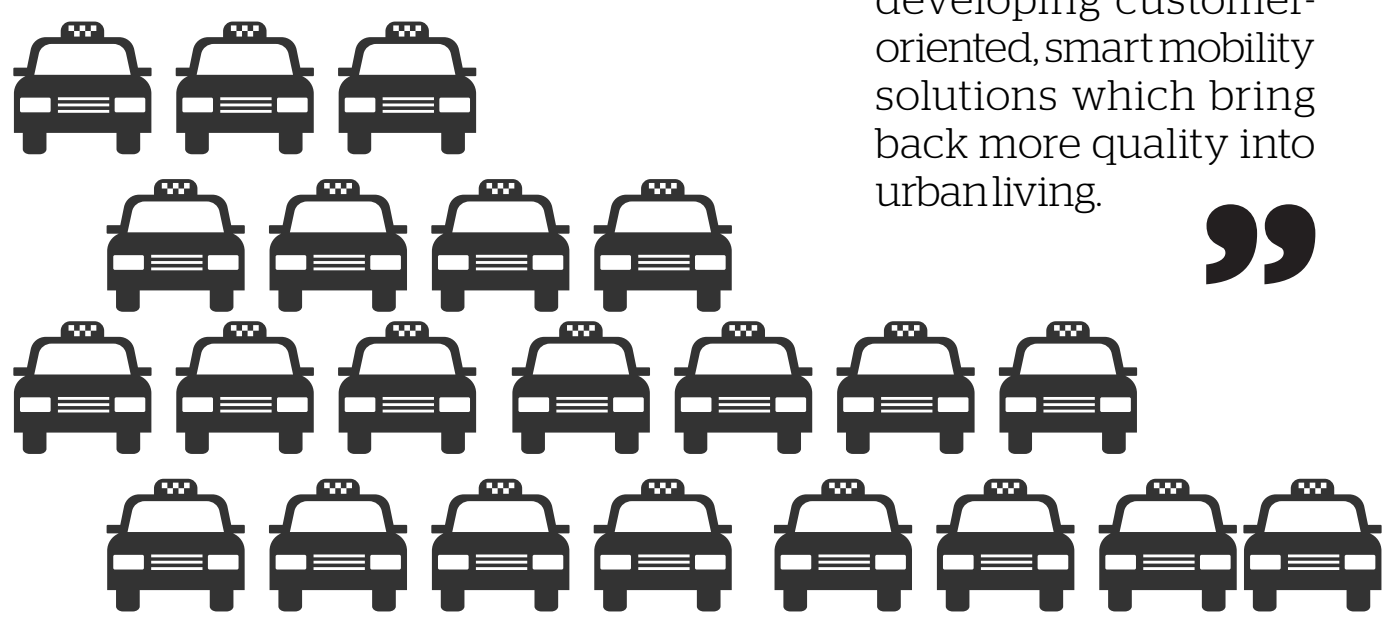
Part of this change is going to reflect the increasingly important role data is going to play in delivery of this agenda. Future regulatory, planning and investment decisions must be based on strong data, combined from public and private providers and intermediaries.

The mobility revolution

We must be bold and ambitious in shaping this new mobility revolution. Collective failure to do so will mean more congestion and a less sustainable model of mobility that limits rather than enhances consumer choice. We believe that the recent government statement¹ on the future of urban mobility represents an important step forward.

It is an exciting time to be part of the mobility transformation journey. The next step is to make the journey faster, safer, more affordable and more sustainable. We look forward to being part of it and working with all stakeholders to realise these benefits for all.

¹ gov.uk/government/publications/future-of-mobility-urban-strategy



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In summary...

We are on the cusp of a new era of connected mobility. Transport and logistics are leading other markets in digital transformation that will drive wider economic growth and societal change.

Given the need to dramatically reduce environmental impact, traditional linear models of 'take, make and dispose' are becoming outmoded. New circular economies, particularly Mobility as a Service, will transform personal mobility and the movement of goods. More personalised and demand-responsive services will rapidly expand; private car ownership will continue to fall.

For logistics companies, given today's complex supply chain, Logistics 4.0 creates the potential for new operating models, not just the gig economy and autonomous delivery vehicles but also new value-add services such as 3D printing.

Public transport providers have already embraced open data, enabling thousands of new transit apps and providers. This will continue, with open payments and collaboration between operators both critical factors for integrated mobility services.

With advances in edge computing, swarms of connected cars, buses, drones and trucks will make travel smoother and more sustainable. Pushing intelligence to the edge will further enable predictive performance monitoring and asset management.

On the railways, digital technologies are critical to meeting safety, capacity and reliability demands. Predictive operations and maintenance are emerging; digital train and signalling control systems will further enhance passenger experience; transformation of timetabling and revenue allocation systems will improve the flexibility and efficiency of train travel.

Cyber security, trust and compliance are all critical enablers for a data-driven mobility ecosystem. Systems must be secure by design, utilising advanced predictive security; accessibility and environmental sustainability must be assured and regulations need to evolve.

On our roads, intelligent transport systems, including smart motorways, connected vehicles and intelligent traffic flow management will improve safety and reduce emissions and congestion. Robotics and advances in automated vehicles will further broaden a hybrid mobility mix.

Transport operators and logistics companies must be able to transform or they will see others overtake or replace them. They need a digital roadmap and a strategy to address the challenge of legacy technology while rethinking how they operate.





Acknowledgements

We would like to thank the following contributors. If you wish to send feedback, please tweet using **#DVfM** or email: **AtosDigitalVisions@atos.net**

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Let's start a discussion together



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