Navigating the future: How autonomous vehicles will benefit business, mobility, and the environment

Just the ticket: Can a new rail franchising programme transform the passenger experience?

Cleared for landing: The real-time data initiative that is slashing delay times at British airports
Britain has a long history of transport innovation: from the shipbuilders who paved the way for globalisation, to the railways that underpinned the industrial revolution. We pioneered the era of modern aviation, the airline industry, air traffic control, and even the development of radar. Britain is still a world leader in transport innovation, and the Transport Systems Catapult is positioning the UK at the forefront of the next revolution in how we move people and goods around the world.

From driverless vehicles and improved airport data systems to integrated logistics, sentiment mapping, and smart traffic lights, we are harnessing emerging technology to make transport more efficient and connected.

The global market for the evolving Intelligent Mobility sector is estimated to be worth £900bn a year by 2025. The Transport Systems Catapult is helping the UK secure as much of that market as possible – supporting business, creating jobs, and driving economic growth.

Only one year since our launch in June 2014, we’re already delivering significant impact for the UK. There is now an extra £360m in the economy thanks to the work of the Catapult. This represents investment in driverless car technology, more innovation in the rail system, and increased efficiency for the UK’s airports.

There has never been more opportunity for businesses and researchers working in areas related to Intelligent Mobility. The Transport Systems Catapult is ensuring that the best ideas in the UK lead to commercial success by driving innovation and stimulating enterprise.

Will Whitehorn, Chairman, Transport Systems Catapult
CONTENTS

05 AT A GLANCE
The Transport Systems Catapult’s highlights of the year

06 INTRODUCTION
Why Intelligent Mobility matters. By Catapult Chief Executive Steve Yianni

08 DRIVING CHANGE
Sit back and relax. Driverless vehicles are on their way

14 INNOVATION ON TRACK
How tech is transforming end-to-end rail journeys

20 FROM BRAINS TO BUSINESS
Forming the link between universities and enterprise

22 BLUE-SKY THINKING
Smart control systems are set to maximise UK airspace

28 MODELLING THE FUTURE
What does the future hold? Modelling has the answers

32 CHAMPIONING SMALL BUSINESS
A new fund puts SMEs on the map

34 IN NUMBERS
Key achievements over the past year and projections for what’s ahead

SEPTMBER 2014
SPONSORS OF THE LOW CARBON VEHICLE CONFERENCE
The Transport Systems Catapult outlines its goals as event focuses on current technology and future trends

OCTOBER 2014
BBC FILMING
BBC films an episode of Click at the Innovation Centre, giving viewers an opportunity to view the interactive tabletop simulator and the sentiment mapping projection

NOVEMBER 2014
CIVIL SERVICE AWARD
The Innovation in Rail Franchising project is shortlisted for a Civil Service award for its work in supporting innovation and growth

DECEMBER 2014
COMPETITION WIN
Two students win the Pods of the Future schools competition, earning them a trophy, work experience, and the chance to bring some of their visions alive in future

JANUARY 2015
£79.3 MILLION INVESTMENT
MP Greg Clark visits the Catapult to announce a £79.3m regional investment as he gets a glimpse of the future of transport

FEBRUARY 2015
LUTZ PATHFINDER LAUNCHED IN GREENWICH
The LUTZ Pathfinder, a driverless pod that will be the first autonomous vehicle in the UK to work on public footpaths, is launched at a government event in Greenwich

FEBRUARY 2015
NEW OPPORTUNITIES
Modelling for Intelligent Mobility, a report commissioned by the Transport Systems Catapult, highlights new opportunities for modellers

MARCH 2015
£100 MILLION INVESTMENT
Chancellor George Osborne unveils a further £100m government investment in the development of driverless vehicles

APRIL 2015
£50-£100 MILLION SMEs INVESTMENT
The Transport Systems Catapult announces it will help create the world’s first Intelligent Mobility Investment Fund to pump £50-100m into fast-growth technology SMEs
What is Intelligent Mobility and why does it matter?

A growing, ageing population and the rapid duplication of our traditional energy resources, and the corresponding impact on the environment, is arguably the three biggest drivers of change in today’s global economy. A fourth is urbanisation. Seven years ago, United Nations figures estimated that the number of people living in cities around the world had for the first time surpassed the number of rural residents. The same report predicted city dwellers would account for 70 per cent of the world’s population by 2050. With people and businesses clearly seeing strong benefits in being physically close to other people and businesses, this is why we deploy technology that will determine which cities prevail.

Equally, a mind shift is needed among policymakers, industry and the public that focuses more on the end-to-end journeys and less on individual modes of transport - on mobility rather than transport. Intelligent Mobility, if you will.

Recent improvements in route-planning software that consider multiple transport modes as an example of the first steps being taken towards achieving this, but there is still a long way to go. Part of our remit at the Transport Systems Catapult is to overcome the silo thinking that has typically dogged the transport sector, and encourage collaboration among all transport providers.

Of course, it is easy to dismiss talk about connected journeys and smoothly running transport systems as something that would be ‘nice to have’ by authorities whose efforts are focused on ‘bigger issues’ such as healthcare provision and revenue raising. But Intelligent Mobility is crucial to a city’s well-being and prosperity, and will become essential in the years to come. People and businesses function best when they are close to other people and businesses. While connectivity between different cities will continue to be of major importance, the risk of increased congestion within our rapidly growing global cities will ensure that the efficient movement of people and goods inside the city limits is of equal importance.

Research by architect and urban planning consultant Tim Stonor suggests that the most connected city areas are those that are able to attract retailers and generating high property prices than their less connected counterparts.

This demonstrates how cities can improve their citizens' quality of life by using intelligent systems to improve mobility, rather than resorting to the old land-expensive approach of simply throwing more infrastructure at the problem. It should offer comfort to transport providers and city authorities to know that more can be achieved with less. Important to too that authorities see improving transport systems not just as something that needs funding, but as a long-term revenue source.

A recent study into the business potential of Intelligent Mobility suggests that the global market for this new sector will be worth over £900bn per year in just more than a decade, our vision: an overview of the transport systems Catapult is to help unlock that commercial potential, how? By bridging the so-called “valley of death”, when great ideas are born but fail to achieve commercial reality, often because an SME or research organisation lacks the business knowledge and contacts to turn their invention into a successful product or service.

One example is the LUTZ Pathfinder programme. Managed by the Catapult on behalf of the UK Automotive Council, this project will trial three self-driving pods on the pavements of Milton Keynes, with a focus on “last-mile” journeys. The vehicle’s developer, RDM Group, is an example of how the Catapult’s projects serve as springboards for innovation. Winning the LUTZ contract, RDM has won a major government contract and is being courted by potential clients worldwide.

In another project, a move away from silo thinking has resulted in a ‘whole system’ perspective. The Department for Transport is being courted by environmental and customer benefits across the UK air transport network. Elsewhere, the innovation in Rail Franchising initiative looks set to transform the rail travel experience. Many projects are informed by and feed into the Catapult’s data visualisation programme, which, by deploying and visualising data holds huge potential for Intelligent Mobility. This enhanced understanding of the transport system is entirely adaptive and responsive to user needs.

CHAMPIONING INTELLIGENT MOBILITY: ABOUT THE CATAPULT

Our Vision
To drive UK global leadership in Intelligent Mobility - promoting sustained economic growth and wellbeing through integrated, efficient, and sustainable transport

Our Goals
• Growth and Jobs
• Global Success for UK Businesses
• Improved Journeys
• World-leader in Intelligent Mobility
• Thriving Organisation that Delivers on Commitments

Our Business Units
• Automated Transport Systems (a key area for growing UK capability for Intelligent Mobility, covering automation in movement of people and goods)
• Modelling and Visualisation: developing and demonstrating new technological capabilities in order to better understand the benefits of Intelligent Mobility and to promote a ‘whole system’ approach.

Our Commitments
• Information Exploitation: capitalising on existing datasets to facilitate the development of new applications, insights and capabilities that enable Intelligent Mobility.
• Customer Experience: facilitating the move towards a seamless and user-focused journey, in which joining the transport system is entirely adaptive and responsive to user needs.
The saying that ‘good things come in small packages’ certainly rings true when it comes to the LUTZ Pathfinder pods – the small, two-seater, driverless vehicles that are soon set to roll along pedestrianised areas of Milton Keynes. Launched in February, these pioneering pods are enabling the UK’s first public-space trials of driverless technology, and, crucially, providing valuable business opportunities for small and medium-sized companies.

The LUTZ Pathfinder project was one of the first to be picked up by the Transport Systems Catapult, following enthusiastic conversations with the Automotive Council UK, a group of senior figures across the automotive industry and government.

“The Automotive Council discussed everything from the current situation – where cars can park themselves or control their speed using adaptive cruise control – right through to the future vision of having vehicles that drive themselves in all scenarios,” says Neil Fulton, Programme Director of the Transport Systems Catapult’s Automated Transport Systems (ATS) unit.

One way of walking through the steps needed to achieve this vision was to run a project that would use a different environment to a road, whereby the autonomous vehicles could learn the information they needed through interaction with pedestrians, cyclists or other obstacles.

The end result is a pod that will be trialled on pedestrianised areas of Milton Keynes at variable speeds of up to 24kph. The vehicles are fully designed and built in the UK, tapping into the UK’s expertise in the automotive and autonomous robotics sectors. Constructed by Coventry-based RDM Group, the pods use navigation and control systems developed by Oxford University’s Mobile Robotics Group.

The vehicles are also sustainably run on a lithium ion battery connected to an electric motor, which can be recharged in a similar way to existing models of electric car. Such vehicles have huge implications for addressing climate change: road transport currently contributes about one-fifth of the EU’s total CO₂ emissions, which could be significantly reduced with the advent of ‘cleaner’ cars.

A recent report by the Intelligent Transportation Society of America found that ‘intelligent transportation systems’, including autonomous cars, could achieve a 2-4% reduction in oil consumption and related greenhouse gas emissions each year over the next decade.

At the moment, progress is being made slowly and carefully. The LUTZ Pathfinder rollout is limited to the three pods that are being introduced in Milton Keynes later this year. The trial, Fulton says, will serve to gauge public perception – a vital piece of the autonomous driving puzzle.

“We will be engaging with members of the public and the different interest groups that might end up either using these pods or benefiting from them,” he says. The launch of LUTZ Pathfinder is significant not just for future travel, but for British business too.
vehicles or are affected by them, and we want to address as many of their concerns as possible.” Milton Keynes is already on the way to Milton Keynes, however, with a total of 40 such vehicles commissioned from RDM for the UK Autodrive project, which will trial not only pods, but also regular road-based cars equipped with autonomous and connected-car technologies.

Fulton envisions the ultimate use of autonomous vehicles in Milton Keynes as a way of seamlessly linking different parts of the town. “Milton Keynes has a lot of housing estates around the city centre, so people travel from those estates to the centre and park their cars. A lot of the time, it’s only a short walk away, but walking and cycling are not possibilities for everyone, especially the older population. We want to prevent cars sitting around in a car park for eight hours, and to change the way people think about mobility.”

Geoff Snelson, Director of Strategy at Milton Keynes Council, says that the town is an urban laboratory well suited to this kind of disruptor. But he adds that the technology is no novelty. “Milton Keynes has both a track record for innovation and a risk appetite which has seen us invest in the development of many technologies.”

Beyond Milton Keynes, the UK has a strong track record when it comes to both the history and the technology of the automotive vehicle and is similarly well placed in the development of driverless vehicle technology. The fact that the UK did not ratify the 1968 Vienna Convention on Road Traffic — which requires that ‘every moving vehicle or combination of vehicles shall have a driver’ — is widely seen as an advantage to the country’s willingness to invest in autonomous vehicle trials without the need for new legislation.

Further proof of the country’s willingness to invest in autonomous vehicles can be seen in the projects that are already set to follow. UK Autodrive, for example, is just one of three separate consortia exploring these technologies as part of the UK government’s ‘Introducing Driverless Cars to UK Roads’ competition. Taken together, these three programmes already represent a public-private investment of nearly £40m, and in March the government announced the creation of a £200m investment fund (half-financed by the state and half by industry) to enhance the development of driverless car technology and the systems required to implement and adopt the technology.

In the UK alone the scope is significant. A study from KPMG commissioned by The Society of MotorManufacturers and Traders, found the development of connected and autonomous vehicles could help ‘create an additional 115,000 jobs in the UK by 2030, 25,000 of which would be in automotive manufacturing’, and deliver social and economic benefits of around £83bn per year. One institution that has already benefited is Oxford University. Professor Paul Newman heads up the university’s Mobile Robotics Group, which supplies the pods’ sensor and navigation technology. ‘The pod has got a memory of what the city should look like, but that’s not enough – it’s got to have its eyes open’, says Newman. He adds that the beauty of the technology is that it can be used across myriad sectors and capabilities.

His team are inputting data from pedestrianised areas into the autonomy control system (ACS). This involves mapping using stereo cameras and laser scanners so that the ACS can ‘learn’ how Milton Keynes looks in varying light conditions and weather.

And, says Newman, the science has ramifications beyond transport and mobility. ‘The 3D scan of Milton Keynes has gone on to be used by all the other pods. All the lessons learned are shared across projects. This is exciting because it means that the pods are not just vehicles, but a whole ecosystem that can share data, share intelligence.’

The plan is for the driverless pods to run as an on-demand service that will integrate with other modes of transport. The vehicles will drop the passenger at their destination of choice, then move autonomously to pick up another passenger from elsewhere. “We believe this responsiveness to the needs of users will help reduce the reliance on the car for bespoke journeys to city-centre destinations.”

RDM Group was selected after an open European tender to find a manufacturer that could build the LUTZ Pathfinder pods. CEO David Keene (pictured) explains how winning the contract bestowed interest in the small, Scottish firm.

“RDM has made products and provided engineering services for the automotive sector for 22 years. We have about 100 customers, the largest of whom include Jaguar Land Rover and Aston Martin. ‘For this particular prototype, which is predominantly made to operate on pathways, we’ve had a lot of interest from eco-towns around the world. All these pods communicate with each other, so they know where each other are: in time, they’ll be like lawnmowers that operate on their own – when they run out of power, they park themselves on a charger. It’s a steep learning curve and we’re leading the field, which is exciting for us as an SME.’

“There’s been huge interest and many conversations with some of the world’s largest companies. It has led to other projects, such as our becoming partners in the UK Autodrive consortium, that will see us producing another 40 pods. It’s put us on the world map. The NYT and Washington Post both wrote articles mentioning us in the same breath as Google Cars and Uber. You can’t buy that type of press.”

The 3D scan of Milton Keynes has gone on to be used by all the other pods. All the lessons learned are shared across projects. This is exciting because it means that the pods are not just vehicles, but a whole ecosystem that can share data, share intelligence.”

**SME on the World Map**

**RDM Group**
maps we’re using to build these vehicles’ memories have massive implications for companies that look after road infrastructure, people who are inspecting nuclear plants, building surveys that figure out where all the ducting is in a building.”

In the meantime, the advent of autonomous vehicles is expected to change how we perceive car ownership. Instead of seeing the car as a status symbol, people are likely to regard it as an on-demand service, which must accommodate our schedules in an efficient, safe, and eco-friendly manner.

This flexibility could extend to delivering goods as well as people. “If the car isn’t being used to carry people around at night,” Fulton says, “why not reallocate it to the movement of goods? For example, you could have a pod making deliveries to small shops – you don’t need trucks arriving in London to do that.”

Connected cars also take away the element of human fallibility, which is estimated to be at least partly responsible for more than 90 per cent of road traffic accidents. The KPMG/SMMT report predicted that connected and autonomous vehicles would save over 2,500 lives annually and prevent more than 25,000 serious accidents in the UK alone.

Back at Milton Keynes Council, Geoff Snelson predicts that once people become comfortable with giving away control to their car, they will start to view autonomous vehicles as a service. “Even the motor manufacturers understand that in the long-term, they won’t necessarily be just manufacturers of cars – what they will be is transportation services. I might have a subscription that could provide me with a seat on a shared minibus to work, or a van to move my daughter into her university halls. The benefits to a car being driverless – as well as safety and ease – are that they will sit as part of an on-demand and bookable transportation system.”

As we progress closer to full automation, the benefits will become increasingly clear.

Reduced congestion, fewer car-related deaths, an ease of pressure on our natural resources, more flexible mobility, and a myriad of opportunities that pioneering small businesses can grasp before bigger companies get involved. All that’s needed now is for technology and society to catch up.
For years the railway system has been challenged to improve on customer satisfaction. Now, thanks to a healthy dose of investment in innovation and revamped contractual guidelines, that’s finally about to change.

You’re at the railway station and your smartphone has just sent you a notification. Your train is about to arrive. You don’t have to crane your neck towards a sign to discover which platform you should sprint towards. Way-finding across the station is digital, easy-to-read and abundant. No need to sift through your pockets to find your ticket – ticketless technology put an end to all of that. There are no feisty barriers to battle, you do not have to touch in or touch out. All that’s required is that you meander towards the train.

As you walk by the carriages, your phone will tell you which seats are free. You don’t have to haul your elbow-knocking baggage through a narrow aisle. Bulky luggage is transported separately now. You can collect it when you alight or choose to have it delivered to your front door.

After you take your seat, you want to continue reading that article on your tablet. Thankfully, Wi-Fi is free and reliable – and will remain so during the entire journey.

For the millions of Britons who use trains, this sounds like an excellent but unlikely scenario. Their complaints of the current rail system are well known: it’s too expensive, crowded, and plagued by delays. For years, they would say, prices have increased quicker than their salaries and they are yet to feel any positive changes. From booking a ticket to getting a refund if a train is late, the system is sluggish. It’s a service, unlike aviation and automotive, not particularly associated with innovation, whether fairly or not. A perceived lack of investment, coupled with an unsupportive contractual framework, has resulted in dissatisfied passengers.

“One of the barriers the industry has had is a lack of funding in innovation. Despite what’s in the media, train-operating companies (TOCs) are not terribly profitable businesses compared to other sectors,” says Andrew Payne of the Transport Systems Catapult, which is spearheading a push for greater modernisation through the Innovation in Rail Franchising programme. “They have pretty limited cash and make about 3% profit. They are lean and thinly capitalised companies operating in a challenging environment. They operate a franchise for a relatively short period of time, and investing in long-term innovation is really not on the radar for people, especially when that innovation might only pay back beyond their particular franchise life. It’s not really in their commercial interests, because they may not win the next round.”

Opposite: The rail sector is crying out for innovation.

Innovation on track

Customer Experience

Impact
On average UK industries invest about 1.7% of turnover in research and development, compared with estimated 5% in the transport and rail operators. Where manufacturers of train carriages might invest up to 6% of their turnover, aeronautics and airlines devote 9%, while high-tech companies spend around 15%. With greater investment, Payne says, innovation could flourish and bring that perfect train journey far closer. “We’re embarking into the heart of rail franchising to deliver better customer outcomes and for the whole end-to-end journey experience.”

Efficient connections between rail services and other modes of transport, better technology, and smarter digital systems for both operators and customers are just some of the benefits of investment. While updating the system sounds expensive, investment in innovation is proving to reduce costs in the long-term. Consider this: currently, traditional paper tickets cost the rail industry £350m, an amount that could be greatly reduced with smart technology.

The number of people travelling by train is close to record. In 2013-14, 1.59bn passenger journeys were made in Great Britain on franchised passenger operators, the highest recorded figure since the series began in 2002-03. This was an increase of 5.7% on the 1.5bn passenger journeys recorded in 2002-03.

But Transport Focus, an independent passenger watchdog, reported that nationally the percentage of passengers satisfied with their journey overall was 81% in its Autumn 2016 report. That might sound high, but it’s down 2% from 83% from a year earlier – a small but significant drop. Customer satisfaction, according to this report, is at its lowest in four years.

So what do the people want? Open to the public, a consultation in February with train passengers in East Anglia raised some ideas. Over a series of workshops organised by the Transport Systems Catapult with the support of the Department for Transport (DTT), the consultation aimed to elicit feedback from stakeholders and transport operators. It included questions about the rail experience, such as accumulator points. If your train is late by about five minutes, your minutes accumulate over time and you will be refunded accordingly. All of the minutes you’re made late compensate for delays such as accumulator points. If your train is late by about five minutes, five minutes goes into your little pot. All of the minutes you’re made late accumulate over time and you will be refunded accordingly.

One British company, DeltaRail, launched in March, the Innovation Fund went live with three major franchises: East Coast, Northern and Trans-Pennine. It is valued at £48m.

Another way to improve services is to harness big data, an increasingly available resource, as a monitoring tool. Sentiment mapping is high on the agenda at the Transport Systems Catapult and the number of transport-related apps is set to increase. This spin-off benefits from innovation investment, in terms of new companies and small businesses, include the combining of data. “This opens new opportunities for not just those who use it in this country, but those who are potentially exporting it too,” says Payne. “At a global level, there’s a massive export market on Intelligent Mobility.”

Indeed, the Catapult has already had visits from companies and organisations from Spain to Saudi, and Malaysia to Taiwan. One British company, DeltaRail, is already on the case using real-time data. Its app, Commutelab, scans tens of thousands of tweets a week about London’s trains and lets passengers know where the problems are. And it’s quicker at doing so than National Rail. “Our solutions gather consumer feedback by monitoring social media channels,” explains Daren Wood, Solutions Development Director at DeltaRail. “Not only are we using this to monitor the consequences of the decisions we support, but we are also responding with tailored consumer information to inform and empower travellers and nudging them onto services that better fit their whole-journey needs.”

It is initiatives such as these that will bring rail in line with other transport industries. “The UK is in a position where productivity, innovation and growth just can’t stagnate,” says Payne. “Unless rail improves its game, it’s going to find itself supplanted by driverless cars and autonomous vehicles. Rail will be under huge pressure as passengers experience profoundly better journeys on other modes.”

Fostering smart technology, however, comes with challenges.

In the new rail franchise competitions, TOCs need to have an innovation strategy. “Some companies struggle to adopt a new mind-set. They haven’t had a Research and Development Manager, they haven’t had an Innovation Director, they haven’t really had an innovation programme. The industry is making positive signs from leading companies is very encouraging,” says Payne.

As well as enabling new ways of thinking, progress will require TOCs to communicate more with one another. High levels of commercial rivalry, a symptom of a challenging contractual framework, had previously hindered such openness.

The UK rail market is split into a number of separate franchises, which are awarded by the Government for set time periods of eight to 10 years. TOCs bid to operate on the basis of new, improved, more responsive, safer and more efficient services.

The Transport Systems Catapult hosts a workshop on Transforming the rail passenger experience in July 2014.

Opposite: The transport systems Catapult hosts a workshop on Residual Value in July 2014.
A Transport Systems Catapult project has helped develop a major fund as part of the franchising process that aims to stimulate new investments in innovation. The three elements of improved procurement process, funding for innovation, and building industry capability both in people and organisations are essential to help meet the UK’s ambition of securing a world-class railway.

Launched in March 2015, the scheme went live with three major franchises: East Coast, Northern and Trans-Pennine – and is valued at £68m. In the pilot rail franchises, 1% of turnover is ring-fenced towards innovation, helping to create demonstrators and offset risk. The target for the pilot is a 4:1 return on investment as a portfolio, to encourage taking and innovation.

“Who would doubt that the future of this railway lies in the Passenger-Centric future?” says Payne. “The ability to innovate is perceived as risky. The Transport Systems Catapult aims to de-risk innovation.”

To promote long-term investment, a group has emerged to cultivate a better environment founded on trust and collaboration. Rail Executive, the Transport Systems Catapult and Future Railway have all worked to create a refreshed residual value mechanism worth £75m for each newly bid franchise and open for negotiation each franchise that’s newly bid franchise and open for negotiation each franchise that’s

One solution is to transfer assets between operators. For example, if there were a case for rebuilding a car park towards the end of current X operator’s cycle, incoming Y operator would be obliged to take it on at an agreed cost. To make things fair, X operator would recoup the value beyond its franchise time – thus providing some incentive.

It is passengers who would essentially pay for such innovation, says Peter Wilkinson, Rail Executive’s Managing Director, and therefore industry must take heed of their demands. “Innovation isn’t a choice or a fad,” he says. “It’s about consistently re-doubling our efforts to centre all of our thinking on exceeding ever-changing expectations. Transport Catapult is an essential ingredient in the quest and I commend the team for their success in helping us create a Passenger-Centric future.”

Managing Director, Rail Executive, Peter Wilkinson
The Transport Systems Catapult is working hand-in-hand with 14 universities nationwide.

- University of Nottingham
- University of Leicester
- University of Sheffield
- University of Leeds
- University of Aberdeen
- University of Cambridge
- University of Southampton
- Cranfield University
- Coventry University
- Sheffield Hallam University
- Loughborough University
- University of Heriot-Watt
- De Montfort University, Leicester

"The partnership with the Catapult enhances our links with industry and policy-makers, and we are confident it will lead to future collaborative research and development activities with clear impact to the UK as a whole." - Sharples

Elsewhere, the Catapult is developing a Traffic Control Test Bed with the universities of Southampton, Bristol, and York. The idea is to build on a prototype simulation test bed built by Dr Simon Box at Southampton to host an international facility for the benchmarking of alternative algorithms for traffic control. - North
MAXIMISING THE EFFICIENCY OF UK AIRSPACE AND REDUCING DELAYS IS ESSENTIAL TO ENSURE THE UK MAINTAINS ITS COMPETITIVE EDGE IN AN AGE OF INCREASING GLOBAL TRAVEL. THE TRANSPORT SYSTEMS CATAPULT IS USING AN INVESTMENT OF £750,000 TO INCREASE THE SOPHISTICATION OF AIR TRAFFIC CONTROL SYSTEMS AT AIRPORTS ACROSS THE COUNTRY – WITH A LIKELY BENEFIT OF UP TO £10M OVER FIVE YEARS

Air travel is key to the UK economy to the tune of about £18bn a year, but maintaining and improving the efficiency of our airspace is a continuous challenge. Furthermore, passengers hate it when their plane is late – and with delays costing over £33 a minute, airlines hate it too. But with more than 6,000 planes a day travelling through UK controlled airspace, keeping everything on time is a significant challenge.

Maximising the safe, efficient and reliable use of UK airspace is a priority for the Future Airspace Strategy (FAS). Working in partnership with NATS (which provides air traffic navigation services within the UK) and the CAA (the UK’s specialist aviation regulator), Transport Systems Catapult is leading the Departure Planning Information (DPI) Project, in which they have invested £750,000. The project is expected to cut delays and lead to benefits of up to £10m over the next five years, based on fuel savings and delay savings.

DPI provides real-time information to air traffic network managers about what aircraft are doing at key stages while they are on the ground just prior to take off (from when the plane is cleared to move off stand, to when it is taxiing, and has taken off). With this real-time picture, air traffic network managers have more accurate predictions of the departure time. Sharing this data with the European network helps reduce pan-European air traffic flow restrictions, and, crucially for passengers, helps improve departure times.

DPI was already in operation at Heathrow and Gatwick, as part of a wider suite of systems and tools that help manage aircraft movements on the ground at the UK’s largest airports.

The challenge was to find a cost-effective way of providing DPI to other UK airports. To do this, the Catapult first worked closely with NATS and EuroControl (the European organisation for the safety of air navigation) to upgrade air traffic control systems at seven airports with electronic flight progress strips: London City, Stansted, Manchester, Edinburgh, Glasgow, Aberdeen and Luton. As of January 2015, DPI had been successfully deployed for trial across these airports. Offline trials showed a 60% improvement in the accuracy of real-time on-the-ground aircraft activity.
AIR TRAFFIC EFFICIENCIES

Developing dynamic information packages (DPI) for national and regional airports, provides substantial improvement of around 60% in the accuracy of predicted flight take-off times. The systems is now fully operational at London City, Manchester and Aberdeen, and will be live at the remaining four airports by July 2015. Taken together with the information already provided by Heathrow and Gatwick, DPI now covers around 70% of the UK’s commercial flights, with initial offshore tests showing an improvement of around 60% in predicting actual take-off times of aircraft,” says Steve Yianni, CEO of the Transport Systems Catapult. The scale of the DPI roll-out means the UK is sitting the bar for provision of such information into the European network manager, while also helping airlines reduce fuel costs and cut pollution.

The next step for the Catapult was to find a cost-effective scalable solution for regional airports that use paper flight strip systems. This March, the Transport Systems Catapult signed an agreement with Lockheed Martin (after a public procurement process) to develop and deploy a DPI solution to four regional airports, and is working with Future Airspace Strategy to secure funding to deploy the system to up to a further 20 UK regional airports.

To fully understand the benefits of DPI, it helps to know more about how aircraft are managed. After an aircraft takes off, real-time information provides air traffic network managers with details of its location at any given moment. But it is a different story while the plane is still on the ground, where air traffic network managers are reliant on accurate updates being passed from the airport ATC (air traffic control) towers, and this is not always possible. Air traffic network managers in the UK and Europe have the task of managing hundreds of traffic flows; without DPI, they are missing crucial information about when departing aircraft are going to take-off and enter the airspace. The cost to a regional airport of installing DPI was seen as prohibitively high as it was an investment that would in many cases be of more benefit to network managers and the airlines (through fuel savings) rather than airports themselves. To complicate matters, airport ownership is diverse and the technology used at each one differs.

The Catapult was uniquely placed to act as a third-party broker between the CAA, NATS and the various airports. To secure funding from the Department for Transport to accelerate the programme, the full costs of developing the DPI capabilities were no longer the responsibility of regional airports.

The DPI project was rolled out by the CAA on behalf of lots of stakeholders to bring together a group of airports to go through a project together, rather than trying to do it piecemeal. The CAA’s Director Safety & Airspace Regulation Mark Swan is clear about the benefits of this approach: “The Transport Systems Catapult has been fabulous. We set out a really difficult problem and they have come in with highly motivated people, with a very clear project plan and they showed the industry you could do this – all in the space of about 12 months.”

“The second key area takes into account delays and inaccuracies in departure times by about 60% from ten minutes down to four minutes.

“When you multiply that up by the number of aircraft flying about in the UK airspace, saving three/four minutes per aircraft will have a huge effect.”

STANSTED SUCCESS STORY

Stansted was among the airports chosen for the Transport Systems Catapult’s DPI project. The airport uses a software product known as EFPS (Electronic Flight Progress Strips), to which DPI was added before going live. The additional information provided by DPI has helped to pinpoint exactly when a flight will become airborne. Duncan Smith, Operations Manager at Stansted Airports, has been pleased with the results: “The benefits are increased on-time performance, a cut down in runway occupancy times and less holding times for aircraft,” he says.

“The subsequent benefit of that is less fuel burn, and less aircraft emissions, which is a win for everybody.”

The Transport Systems Catapult’s Krishna Ramcharan, Programme Manager for DPI, hopes the improvements seen at Stansted will be replicated as DPI is rolled out across the UK. “Based on the trials we have done at Stansted, we are reducing the inaccuracy in departure times by about 60%, from ten minutes down to about four minutes.”

“In the past a flight strip was a paper document, which could be a little inaccurate. Now, we can see accurate times, which is very helpful.”

Air traffic network managers in the UK and Europe have the task of managing hundreds of traffic flows; without DPI, they are missing crucial information about when departing aircraft are going to take-off and enter the airspace. The cost to a regional airport of installing DPI was seen as prohibitively high as it was an investment that would in many cases be of more benefit to network managers and the airlines (through fuel savings) rather than airports themselves. To complicate matters, airport ownership is diverse and the technology used at each one differs.

The Catapult’s work is reducing inaccuracies in departure times by about 60% from ten minutes down to four minutes.

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The delays that the Transport Systems Catapult hoped to target with its project are divided into three key areas. The first are the so-called start-up delays. These occur before an aircraft receives clearance to push back from its stand. Clearance may be delayed for various reasons, including capacity limitations in the network due to lack of accurate information. At this point, it may be burning fuel, albeit less than if it was flying; a delay here will cost an airline in the region of £62 a minute. In the 12 months to January 2013, UK airports recorded over 700,000 minutes of start-up delay, so reducing this figure has a clear financial benefit. The DPI project hopes to achieve a 3% reduction, equivalent to around £20,000 per year.

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4 THE ADVANTAGE OF THE TRANSPORT SYSTEMS CATAPULT IS THAT IT ACTED ON BEHALF OF LOTS OF STAKEHOLDERS TO BRING TOGETHER A GROUP OF AIRPORTS TO GO THROUGH A PROJECT TOGETHER, RATHER THAN TRYING TO DO IT PIECEMEAL. NATS’ GENERAL MANAGER OF CUSTOMER AFFAIRS ANDY SHAND says: “The delays that the Transport Systems Catapult hoped to target with its project are divided into three key areas. The first are the so-called start-up delays. These occur before an aircraft receives clearance to push back from its stand. Clearance may be delayed for various reasons, including capacity limitations in the network due to lack of accurate information. At this point, it may be burning fuel, albeit less than if it was flying; a delay here will cost an airline in the region of £62 a minute. In the 12 months to January 2013, UK airports recorded over 700,000 minutes of start-up delay, so reducing this figure has a clear financial benefit. The DPI project hopes to achieve a 3% reduction, equivalent to around £20,000 per year. The second key area takes into account delays and inaccuracies in departure times by about 60% from ten minutes down to four minutes.

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With many large airports within a reasonably small area, a problem at one airport can easily lead to crowding at pinch points in the network. If this happens, in order to maintain safety, air traffic control will direct aircraft to slow down, re-route or fly at a less efficient altitude. It is estimated that the total level of UK en-route ATFM delay is 200,000 minutes a year, at least 5% of which is generated by a lack of accurate departure information. In financial terms, each minute of ATFM delay is estimated to cost £54. A 5% reduction in ATFM is equivalent to over £540,000 in direct financial savings.

The third key area identified is during arrivals. It is 90% more fuel efficient for an aircraft to slow down while cruising or descending than to be held in a stack. NATS, in partnership with other industry stakeholders, has implemented an arrival management capability for flights inbound to London Heathrow, so that delay is absorbed prior to the holding stacks, thereby reducing the time spent in the stack, thus saving on fuel and CO2 emissions.

This capability is enhanced by the provision of DPI messages, which feed more accurate information into the arrival management system, enabling further reductions in stack holding. The Transport Systems Catapult estimates its contribution will be worth up to £750,000 per year, including the broader societal benefits associated with reductions in CO2 emissions and passenger delays.

Arrival Management for Heathrow aims to reduce stack holding by up to two minutes for many flights. This is being achieved by slowing Heathrow arrivals down while in the cruise and descent phases. “It doesn’t sound like a lot, but two minutes if applied to all flights would be worth in excess of 5,000 tonnes of fuel a year, over 15,000 tonnes of CO2, and that’s just at Heathrow,” says Andy Shand, NATS General Manager of Customer Affairs. “In time, as we see queue management techniques applied more widely, that benefit will increase.”

But DPI is not only a great way to improve efficiency now – it will also help future-proof the UK’s regional airports traffic management capacity. It could act as a building block for other technologies, such as the arrivals management capability, and systems for maximising runway use. In the longer term, the data can be made available more widely. “DPI is about making the operation as efficient as possible,” says Shand. “The advantage of the Transport Systems Catapult is that it was able to act on behalf of lots of stakeholders, to bring together a group of airports to go through a project together, rather than doing it piecemeal. That is the strength of Transport Systems Catapult.”

Efficiencies will result in significant carbon savings.
You may have read all about it—the transport system is going through dramatic change. From driverless pods and a seamless, modernised rail network, to an aviation sector so efficient that it will benefit the economy, environment and passenger waiting times, the future is promising. But for customers, operators and companies, it can be difficult to envisage how these modes would work, separately or together. How will an autonomous vehicle react to people, and vice versa? If a Crossrail station closes because of large crowds, what are the pedestrianised options? How would a fleet of hybrid or electric buses in cities help reduce pollution? And should a greater number of pioneering companies such as Uber emerge, how would they affect traffic, or taxi firms?

“We’re answering those ‘what if?’ questions,” says Robin North, Principal Technologist at the Transport Systems Catapult. As a member of the nine-person strong Modelling and Visualisation technical capability team, North is focused on gauging risk and opportunities. Their priorities are to understand and communicate the performance of transport systems innovations before they are built or deployed, to target development and accelerate adoption.

“We are enabling integration of transport models and datasets in ways that permit rapid testing and development of innovative approaches,” says North. The Transport Systems Catapult also collects its own surveys, including mobile phone data, which is useful in accessing people’s habits and needs. And the team has invested in deploying
The Modelling and Visualisation Unit was created to allow companies to build on its cutting-edge facilities. “We have also acquired industry-leading tools to model emissions from road vehicles, and are collaborating with university partners to implement models for aviation and maritime sectors,” says North. “These allow improvements in system efficiency, for example managing freight transfer from ships to trucks and on to distribution centres, to be assessed in terms of how they affect pollutant emissions and air quality.”

“Gaming is an area we want to tap into,” says North. “We are witnessing a switch in focus from building infrastructure with 50-year lifespan to evolving market-driven services and solutions.”

The Catapult gives us a chance to showcase our work to an audience that we would not have had access to such technology. It allows our designs to evolve towards the future, knowing that we have partners with us on that journey. As we push the boundaries of modelling and visualisation, the Catapult too is pushing the boundaries of hardware.

TravelAi is a good example of a nimble company with innovative technology and a bottom-up approach, where one is tactically connected to large-scale projects. “Gaming is an area we want to tap into,” says North. “We are witnessing a switch in focus from building infrastructure with 50-year lifespan to evolving market-driven services and solutions.”

The Catapult provides a hub, helping large companies navigate the changing landscape and new entrants overcome hurdles to market. The journey planner provides a consortium with TravelAi to create Catch!, a nimble company with innovative technology and a bottom-up approach, TravelAi is an unusual match for the travel sector, knowing that we have partners with us on that journey. As we push the boundaries of modelling and visualisation, the Catapult too is pushing the boundaries of hardware.
For SMEs working in the Intelligent Mobility space, the Transport Systems Catapult is creating a new lifeline. To bridge the gap between academia, big industry and SMEs, the Catapult develops a range of collaborative R&D programmes, while facilitating pilots and demonstrator projects that help small businesses showcase their work.

And, to ease problems around early-stage financing, it has launched a £50-£100m SME Fund. This will help develop pioneering technologies that transform the movement of goods and people.

“We are on the cusp of a revolution in transport that will see IT innovations used to create hyper-efficient, seamless movement of goods and people based on real-time data,” says Paul Zanelli, Chief Technical Officer at the Catapult.

“This has spurred innovation across the private sector, giving Britain a major advantage in a future transport system fuelled by data.”

This year, the Catapult has partnered with 40 SMEs and engaged with 265. Among them is PIE Mapping, which is building the first real-time roadmap of Britain, pooling live data from highway agencies, transport operators and local authorities to build personalised route maps.

Scottish business Route Monkey has developed the world’s first electric-vehicle ‘scheduling and modelling’ system, which is helping BMW and TfL carry out virtual trials to predict the impact of electric cars across cities.

Mole Solutions, meanwhile, is trialling the world’s first automated freight pipelines that transport consignments through tunnels on driverless capsules. Zipabout, a London-based enterprise, has built technology that scours social media traffic and commuter movements to chart the mood of consumers across every location and even predict future transport events.

“A perfect storm of circumstances, from the rise of taxi-pooling to the introduction of smart cards and declining car ownership among young city dwellers, is ushering in a new kind of shared transport delivered as an on-demand package service,” says Zanelli. “This will see chaos and congestion replaced with a single, responsive, harmonised system bound together by intelligent data.”

Championing small business

The Transport Systems Catapult is giving some of the UK’s most promising small businesses a leg-up through collaboration, promotion, and early-stage finance.
In new funds available for residual value and innovation in rail

£359 MILLION will be invested in Intelligent Mobility in the UK economy thanks to the work of the Catapult

£900 BILLION PER ANNUM BY 2025

£81 BILLION market size

£98 BILLION market size

Transport Systems Catapult’s four business units directly address £334 BILLION market size

£125 BILLION market size

Automated Transport Systems is linked to a

Information Exploitation is linked to a

Customer Service is linked to a

Modelling & Visualisation is linked to a

The estimated worth of the global market for Intelligent Mobility is

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By improving real-time data accuracy by 71%, the air network will save £10 MILLION

£123 MILLION

£638 BILLION

£10 MILLION

or 70% of the total global market for Intelligent Mobility

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Transport Systems Catapult is collaborating with 137 organisations including

40 SMEs

75 LARGE BUSINESSES

22 ACADEMIC INSTITUTIONS

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4,397 people have visited the Catapult

104 staff members including technologists and innovators work at the Catapult

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