

All-Party Parliamentary Group
on the Fourth Industrial Revolution



appg

The Fourth Industrial Revolution

RESPONSE TO COVID-19

With a Foreword from the Secretary of State for
Health and Social Care and contributions from
business, academia and local government

4IRappg.com

Founder and Chairman: Alan Mak MP

This is the third in a series of booklets the 4IR APPG will publish in the coming year to raise awareness of how emerging and enabling technologies are transforming various sectors of the economy, from financial services to energy and manufacturing. They will draw on a range of perspectives from across industry and Parliament, including issues raised at our regular cross-party events, to promote engagement with the Fourth Industrial Revolution.

In this edition, we look at the impact of technology in the on-going fight against COVID-19, including contributions from the Secretary of State for Health and Social Care and the Economic Secretary to the Treasury. Our sponsors – all leading players in the development and implementation of technology in their sectors – also share their insights alongside leading figures from academia, local government and beyond.

This report provides valuable information to Ministers, MPs, Peers, advisors and others working in Westminster, Whitehall and beyond who want to understand the powerful influence of technology in tackling the greatest challenge to public health for generations. We are grateful to the APPG's members, supporters and sponsors for their continued backing.



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The views of the contributors listed above are their own, and are not necessarily shared by the 4IR APPG or the MPs and Peers who are its members.

Foreword

The coronavirus pandemic is the most serious public health emergency that our nation has faced for a generation.

As we respond, we are fortunate to be able to call upon a force that previous generations did not have access to: the power of digital technology.

Critics of emerging technologies say that they can blur the line between the physical and digital worlds, and make us less connected with one another.

However, during this crisis, in the midst of seismic changes to how we work and live, our digital dynamos have done so much to keep our country going.

It is hard to imagine the past few months without the technology that has been keeping businesses running, helping families to remain connected and allowing our democratic institutions to perform their vital role.

I have always been optimistic about the potential of digital adoption; and as soon as I arrived as Secretary of State, I made technology one of my three major priorities for our health and care sector.

I also wanted technology to be at the heart of our response to this pandemic, and it has been one of the integral pillars of our battleplan, helping us to stay one step ahead of the virus.

We have seen some real successes as a result. Around 75% of GP practices in England are now running video consultations, compared to under 10% prior to coronavirus, whilst the NHS 111 online service has completed over 2 million coronavirus assessments.

This means that even though face-to-face GP appointments have halved, we have been able to keep services going in a way that doesn't further the spread of the virus.

We are also using the latest digital technologies to drive our efforts to test, track and trace.

Our groundbreaking NHS Covid-19 app, which we are currently trialing in the Isle of Wight, will let people know if they have been in close contact with someone who is transmitting the disease, so they can take the action they need to.

Of course, every new technology presents ethical questions, and agreeing answers to these questions is fundamental if the Fourth Industrial Revolution is to succeed.

As a result, we will be publishing the app's source code for transparency, and we are working with leading names in digital ethics so we can get the ethical foundations right.

This pandemic has confirmed the importance of this tech agenda and its importance for the future success and sustainability of our health and care service.

So we have a programme of work in place to reap the benefits of the Fourth Industrial Revolution, and drive the adoption of biotech, genomics, AI and healthcare innovation.

This will make life easier for NHS colleagues, give people the tools and information they need to manage their own healthcare, and allow for more focused, personalised treatment.

First, we are working to get the systems right; the smartest IT infrastructure, digitised patient records and shared standards, so these technologies can really achieve their potential.

Second, we are putting in place the best tech leadership through the recently created NHSx, and their work has been instrumental during this pandemic.

Third, we need to invest in truly transformative technologies, like our AI Lab, which has been backed by £250 million of investment.

The Lab will use the power of artificial intelligence to pursue new opportunities for our health and care system, including earlier cancer detection, new dementia treatments and more personalised care.

This important work is mission critical to the future of our health system, and the future of our country too.

It will help us create the jobs of the future, and make sure that our businesses, and our NHS, are shaping the technology of tomorrow.

The Rt Hon Matt Hancock MP
Secretary of State for Health and Social Care



Introduction

The speed and scale of the COVID-19 outbreak has caused a global crisis on an unprecedented scale. Entire countries have been placed in lockdown; millions of people have become infected or succumbed to the disease; and our entire way of life has been transformed.

COVID-19 has spread through our interconnected, globalised world in a way that was unimaginable before the outbreak. In response, new and advanced technologies are playing a key role in tackling the pandemic. From the use of AI to develop potential vaccines to the rapid deployment of 3D-printing to counter shortages in medical supply chains, harnessing the full potential of the Fourth Industrial Revolution (4IR) has proven critical to saving hundreds of thousands of lives around the globe. Technology has enabled our NHS and key workers to respond in innovative and unprecedented ways from video-based GP consultations to widespread testing and diagnosis.

Throughout the world, political leaders have recognised that scaling up essential technology, enabling innovation and prioritising a technology-led response has offered them the opportunity to tackle the outbreak more effectively. Technology is no longer just an enabler of our medical, political and social response to COVID-19 – it is the central organising tenet of everything we do to defeat this horrific virus.

As governments around the world, including in the United Kingdom, enforce strict social distancing measures, we have witnessed an unparalleled shift in how we live our lives. Office-based sectors have rapidly adapted to utilising video conferencing and the plethora of web-based applications available to keep their businesses operating remotely. Additionally, multinationals such as Lockheed Martin have used their advanced manufacturing capabilities to support national initiatives like the “Big Print” which has helped to address the global demand for Personal Protection Equipment. Companies of all sizes, and across all sectors, have risen

to the challenge of supporting our national response to COVID-19 and some of this pioneering work is showcased in this booklet, alongside the valuable contributions of academia, policymakers and industry.

Whilst the immediate objective has rightly been to suppress the spread and transmission of the virus, we must also start planning for the changed world beyond COVID-19. We should build upon the innovation, the collaboration and the freethinking that has been demonstrated by companies large and small to reimagine and seize the opportunities presented by the Fourth Industrial Revolution for the benefit of all our communities.

In this booklet, leading technology-focused businesses share insights about the challenges that they have faced and the work they have been doing in response to COVID-19. I am grateful to the Secretary of State for Health and Social Care and the Economic Secretary to the Treasury for their contributions alongside those of senior representatives from academia, business, local government and industry.

By harnessing the full potential of technological change and embracing the opportunities of the Fourth Industrial Revolution, we can support our national effort to tackle COVID-19 and help to shape our country beyond it so we all have a brighter future once the pandemic is over.

Alan Mak MP
Founder & Chairman of the 4IR APPG



Innovating after COVID-19

An Introduction to the Future Fund

Innovative companies are vital to the UK and are the key to our future as an open and dynamic economy. Firms across sectors ranging from fintech to life sciences provide jobs for thousands of people up and down the country. The digital sector alone added £149 billion to the UK economy in 2018, accounting for 7.7% of the UK economy. It also grew 7.9% from 2017 to 2018, nearly six times faster than the economy as a whole. The government is committed to supporting these companies through this crisis and beyond.

Supporting innovative companies also means supporting the wider economy to ensure that these companies' customers and suppliers are here tomorrow.

At the Budget in March, we set out the first stage of the government's economic response with £12 billion of support for businesses, households and public services. Since then, the government has extended the support available to individuals and businesses through business rates holidays, small business grants and £330 billion of guaranteed loans delivered through the Coronavirus Business Interruption Loan Scheme, the Coronavirus Corporate Financing Facility and the Coronavirus Large Business Interruption Loan Scheme. Through the Coronavirus Job Retention Scheme almost 1 million employers have applied for help to pay the wages of 8 million furloughed jobs.

We have also launched the Bounce Back Loan Scheme which allows the smallest businesses in the country to access the finance they need. So far over 460,000 facilities have been approved for a value of just over £14 billion.

While many high-growth, innovative companies will benefit from these schemes, the government recognises they also face unique challenges. They are often pre-profit or pre-revenue, and rely on equity investment, which has dried up as the pandemic has unfolded. Traditional loans may not always be suitable for these firms.

As elsewhere, the government has responded to the challenge with bold action. In April we announced an unprecedented £1.25 billion package of support and funding for our innovative companies.

There are two components to this package.

The first is the Future Fund, which I was pleased to launch this May. The Future Fund is an investment scheme worth £500m designed for high-growth innovative companies who have been impacted by the Coronavirus pandemic. The government has made an initial £250m available for the Fund, which will provide between £125k and £5m in government funding through convertible loans to high-growth companies. Private investors will at least match the government funding on each loan, bringing the total potential investment to £500m. Through the Fund, we will invest in viable high-growth innovative firms on terms which minimise the risk to the UK taxpayer.

The second is £750m of targeted support for R&D intensive SMEs. Innovate UK are accelerating £200m of grant and loan payments for existing customers on an opt-in basis. An extra £550m will also be made available to increase support for existing customers, and £175k will be offered to around 1,200 firms not currently receiving Innovate UK funding.

These steps underline the government's commitment to innovative companies across the UK and the crucial work that they do every day to transform our lives and build the economy of the future.

John Glen MP
The Economic Secretary to the Treasury



The new normal – delivering for customers, keeping people safe

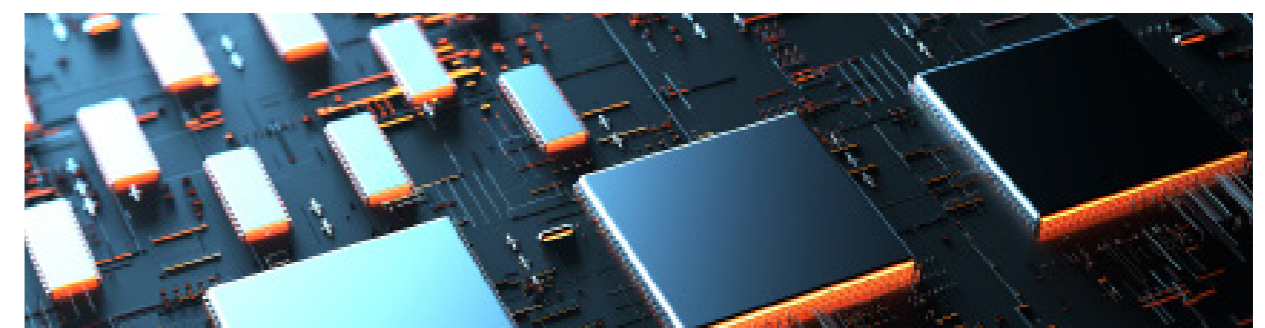
COVID-19 is an unprecedented challenge for the United Kingdom and international community. As a responsible employer, Lockheed Martin UK's priority is the health and safety of its 2,000 staff, whilst ensuring that critical defence and national security capabilities continue to be delivered. Commercially available networking and communications tools have been used to ensure basic business continuity, allowing three quarters of employees to work from home while new, secure communication capabilities to enable remote working and collaboration on highly classified information have been developed.

Lockheed Martin's venture capital (VC) arm is supporting the UK's vibrant technology ecosystem by providing companies with capital, allowing them to continue to operate, develop new technologies and grow the economy.

Lockheed Martin Ventures has been investing in UK start-ups and small businesses since March 2019, through a partner fund, to learn about new technologies and business models and apply these to defence and security challenges. This investment is continuing during COVID-19. And some of the Cambridge-based companies which have received investments are themselves supporting the national response to the pandemic. For example, genomic medicine enabler, Cogenica, is developing a genetic test to detect strains of the Coronavirus. A patient-inspired technology company, Healx, is applying artificial intelligence to the challenge of identifying treatments for the virus. And two companies, Sphere Fluidics and Fluidic Analytics, are accelerating the development of a vaccine, including through rapid screening and characterisation of cells and assessing drug interactions with the virus.



Lockheed Martin UK has used its advanced manufacturing capabilities to support the national response to COVID-19. The 3D printing capability at Lockheed Martin UK's site in Amptill, Bedfordshire is being used to produce face shield bands and chin guards in support of 'The Big Print' campaign for frontline health workers. Usually, the team undertakes 3D printing of metal structures for armoured vehicles and strategic systems using an additive manufacturing process called 'Wire + Arc Additive Manufacturing' (WAAM). 3D printers at RAF Valley in North Wales are also producing face shield parts for local hospitals and care homes. The printers are normally used by a Lockheed Martin UK team to manufacture bespoke parts for the Military Flying Training System.



Keeping the world turning through the crisis... and beyond



Many new working practices have been introduced during the Coronavirus outbreak – many are temporary, but some of the 4IR enabled ones should remain.

Throughout the pandemic many sectors of industry have played a critical role in keeping the country's essential services operating. Whether this is producing PPE, ensuring oxygen supplies to hospitals, keeping the lights on and the taps running, or producing and distributing food; these sectors have had to carry on working and producing. All these key industries have overcome a multitude of challenges to find ways of protecting the health of their employees while keeping the world turning.

Nearly all businesses have had to adapt incredibly quickly, transforming operations overnight in some cases, so that they can continue to do their business safely. Some of the changes are compromises that need to be reversed as quickly as it is safe to do so, but there are many, particularly those enabled by digital technologies, that may have been 'imposed' initially but have proven to be of great benefit. These improvements will remain and be built upon in the 'new normal' way of operating.

Those businesses that had already embraced 4IR technologies have often managed to accommodate the disruption more easily, for most highly automated operations it is much simpler to ensure adequate social distancing for example. Companies that previously had access to remote digital services, but had not fully embraced them for whatever reasons, are now activating these services.

There is increased interest from those businesses that haven't started the 4IR journey to take the first steps.

Remote services come of age

Remote services have been available for many years, but with limited equipment connectivity they have historically been utilised mostly for critical or high cost assets. The Industrial Internet of Things has allowed many more items of equipment to be connected cost effectively, so today even a small electric motor can be cheaply connected to the Internet, allowing its health and performance to be continuously monitored. This increasing connectivity allows almost all key elements of a manufacturing facility to be remotely monitored, diagnosed, optimised and supported.

However, despite the technical feasibility of remote services many companies have continued to rely purely on on-site or visiting specialist technicians to maintain their equipment. In the current situation site visits are not feasible, or at least not preferred as with adequate planning most tasks can be completed safely, so remote services are now often the only option manufacturers have to keep factories running reliably. The full range of remote services is very large and diverse, but to pick just a few of the most popular ones;

Remote condition monitoring and diagnostics services can be applied to almost any production assets, for example factory wide control systems, electrical systems, robots, machine

controllers, safety systems, sensors, motors and variable speed drives. The systems monitor the health and performance of individual pieces of equipment, e.g. a robot, entire fleets of equipment or the total operation. Any faults or potential problems can be quickly detected, and an alert is then sent to an appropriate person, either on site or based remotely, so that they can take prompt action to prevent production stoppages or equipment damage. That alert could be an alarm, an automated text message or phone call. The interventions taken following the timely alerts help to improve productivity and reduce maintenance costs.

Remote maintenance and technical support services are available to help on site teams to carry out essential maintenance tasks themselves, without the need to bring in additional personnel from outside. The services can be delivered in several different ways. Some tasks can be carried out fully remotely without any site involvement via a direct internet connection, for example equipment reconfiguration, software upgrades or recalibration. Routine tasks can be supported by tools such as augmented reality tablets or headsets showing a local technician how to find faults and perform tasks – a mix of AR images, text, videos and sound are used to support the technicians. More complex tasks may involve experts supporting on-site personnel using video and audio tools to guide their activities. Remote domain experts and data scientists use digital technologies to help customers derive insights from their

data. The experts suggest improvement actions and provide critical remote assistance to help customers to keep production running.

Digital Twins are a digital replica of individual items of equipment and can be used by remote experts to diagnose issues and test solutions, before working with on-site teams to implement the solutions. Digital twins of larger systems, or complete facilities, can also be used to see what's going on in a production line remotely. Improvements or new projects can be designed offline, often collaboratively in a virtual 3D environment, without having to visit or disturb an actual production line. The new installation can then be constructed ready for installation when the site is available.

Other travel free ways of working

Other digitally enabled ways of working have become normal practice for the many people working from home or unable to travel. I won't mention the multitude of on-line collaboration tools for meetings that are now part of most people's lives (though many customer

meetings are working very well remotely) but will highlight a couple of the practices my business has adopted. Initially they were adopted in the spirit of being the 'best we can do in the circumstances', but we have learnt that they have many benefits over the traditional methods, and we hope they will become the new normal. Most involve saving a considerable amount of travel, saving both time and carbon.

Remote witnessing of equipment and system tests – normally customers would travel to our factories, often overseas, to witness equipment and system tests. These are now being done remotely by sharing documents and using video calling on systems such as MS Teams, Facetime etc. and everyone is asking why we didn't do this before!

Education & Training – a lot of classroom training has been taken on-line, with breakout group exercises, video streaming and 1:1 discussion on chat. Those working from home are taking the opportunity to get some, often long-delayed, upskilling to better understand the latest developments in technologies.

ABB is a technology leader that is driving the digital transformation of industries. With a history of innovation spanning more than 130 years, ABB has four customer-focused, globally leading businesses: Electrification, Industrial Automation, Motion, and Robotics & Discrete Automation, supported by the ABB Ability™ digital platform. ABB's Power Grids business will be divested to Hitachi in 2020. ABB operates in more than 100 countries with about 147,000 employees.

The industries that are newly taking advantage of these digitally enabled services and ways of working are seeing real benefit from their adoption. Let us hope that these enforced changes remain in place as part of the 'new normal' and help take the UK further along our 4th Industrial Revolution.

My final reflection on positive changes that hopefully become part of the new normal is nothing to do with technology. I won't be alone in valuing the better sense of perspective, the improved collaboration and teamwork that most businesses have shown – truly bringing out the best in people. There are some inspiring examples of people and companies, my own included, united by the common goal of overcoming the effects of the virus. I have seen many of our staff going the extra mile in helping customers in difficult situations, while we help maintain business continuity by offering free remote services to existing customers and hospitals, as well as supporting front line charities.

Dai Richards
External Affairs Director at ABB

Keeping payment Infrastructures working through the pandemic



The global outbreak of Covid-19 continues to evolve and disrupt many aspects of our lives. As an important part of the payments infrastructure in both the UK and across more than 200 countries around the world, we are extremely mindful of our responsibilities towards citizens, businesses and the economy at large.

There are a range of initiatives that Visa has helped lead in the UK to best support consumers and the payments ecosystem during this challenging time, and there are also a number of key issues that remain at the heart of what we do every single day.

On the first aspect, at the end of March, we were pleased to have played our part in increasing the UK contactless payment limit to £45. This will make a real difference to consumers up and down the country by cutting queue times and reducing physical contact with terminals. Cardholders have already begun to see the benefits of this increase, where millions more transactions every week are now contactless that would have previously required a PIN entry, and they will continue to see the benefits as the change is implemented at more retailers over the coming month.

In addition, at the start of April, we were proud to announce that the Visa Foundation has committed to two programmes totalling \$210 million to support small and micro businesses across the world. This addresses an urgent need from local communities following the spread of Covid-19, and aligns with the Foundation's long-term focus on women's economic advancement and inclusive economic development.

It's also worth adding that, given the extreme circumstances facing the wider industry as well as the critical need for ongoing security and stability, Visa has postponed our planned technology changes for April to allow our clients to focus on what matters – supporting consumers.

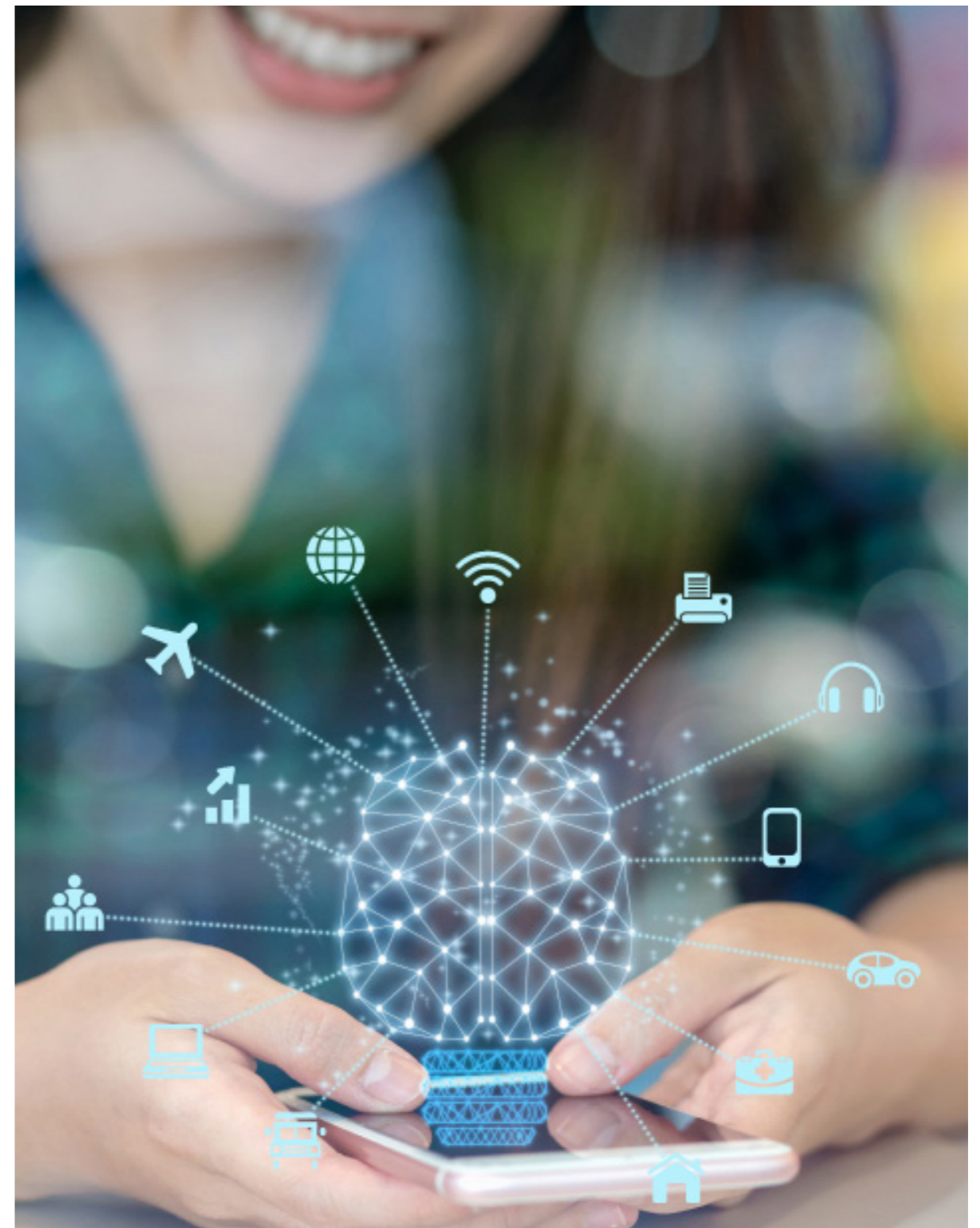
To the degree that the Government continues to assess new questions and challenges within the payments ecosystem, be they enabling disbursements for specified targets and uses, or even new ideas around digital support for small businesses, Visa stands ready to help.

On the second aspect, there are a number of issues that continue to be the bedrock of Visa's business on any given day. For example, while some people may be using digital payments more than they usually would at this time, we

remain absolutely confident in our ability to operate without interruption. Visa's infrastructure in the UK can route to multiple data centres around the world, while instant fail-over capabilities contribute to best-in-class operational resilience. To keep consumer data secure in a connected world, Visa deploys some of the industry's most sophisticated fraud and cybersecurity tools.

We also continue to work tirelessly to protect UK citizens from fraud – both on and offline. Unfortunately, in these times, fraudsters can take advantage of the situation, but we continue to use global data sets to analyse and authorise transactions in milliseconds and our teams continue to work to identify new fraud cases and address them rapidly.

Visa stands ready to play our part in rising to the new challenges that the Covid-19 pandemic presents both here in the UK and around the world, and we continue to prioritise our responsibility towards the integrity and reliability of the UK's world-leading payments system.



Responses to COVID-19 with an integrated technology infrastructure



The effects of the 2019 novel coronavirus on industrialised economies has been striking, drawing into sharp relief the stress lines of our current infrastructure and presenting an opportunity to re-organise our ever decentralising economy and see Britain emerge as a leader in new civic infrastructure, powered by the Fourth Industrial Revolution.

The current infrastructure of road and rail, pipeline and pylon needs a new, intelligent idiom to build sovereign resilience and technologically mediated economic flexibility. This means smarter secondary industries with capacity for import replacement, remotely operated Black Box industry matching diverse working routines and intelligent support for logistically mediated, decentralised and distributed services.

Import Replacement + Secondary Industries

The COVID19 pandemic shows the weakness inherent in just-in-time (JIT) supply chain logistics in rapidly changing supply and demand scenarios. The approach minimises buffers of stock held in manufacturing facilities and relies on the ability of the supply chain to rapidly deliver replacements as stock is utilised.

In Britain, the pressure on JIT supply chains has increased with the provision of more reliable and rapid delivery services creating smaller buffers.¹

The consequence of this however is that in times of wildly changing supply, the buffer proves insufficient and latency enters the manufacturing process, leading even to production halts. With a distributed supply chain, distance proves a factor in acquiring resources with limited advance notice.

As international supply chains are disrupted there is a greater than ever need to develop locally produced substitutes. All goods imported into the UK are recorded by tariff code, volume, value and date of import. If this data was made available, Elastacloud would be able to use the power of the public cloud to quickly join and analyse data sets to spot disrupted supply chains, isolating specific products in short supply to deliver faster insight to manufacturers to develop replacements.

Through the at scale technological horsepower of the public cloud, modern machine learning algorithms can find the correlations between deeply interconnected supply and demand challenges at speeds that would elude manual operators. The adoption of these services in pursuit of analytically based locally achievable thresholds of production, will form the basis of a new Data Science infrastructure.

New logistically mediated, decentralised and distributed services

This Data Science Infrastructure has myriad expressions; with the new enforced isolation, a slew of services that were previously relatively centralised around central business districts are posed with a decentralisation challenge. This is a challenge to be met in days or weeks, not months or years and is unprecedented in terms of its swiftness. Confidential commercial waste disposal was previously a service industry that could operate solely around business districts. With the isolation, there are now thousands of executives generating commercial waste across the UK.

The newly distributed professional workforce needs a new civic infrastructure of computationally optimised logistical supply. This smart delivery routing should take into account constraints based on application; vehicle capacity, pickup weight at each location, maximum duration of worker shifts and vehicle uptime efficiency. It should consolidate purpose, not a new Royal Mail but a new Royal Services function.

Each service needs to be co-optimised, which technically is made possible through creating a global cost function² to take into consideration many expenditures. Accordingly, vehicle routes can be optimised, with reduce vehicle fuel being loaded for certain routes as is common practise in aircraft. This Royal Service function should disrupt and innovate even itself, looking to future vehicles such as autonomous, aero delivery.

The toolset of the Fourth Industrial Revolution has all the necessary components to make this possible, if it is centrally mandated deep in the manufacturing base. The installation of novel sensors is fundamental to IoT in vehicles and is a dependency of self-driving cars which would natively lead to dynamic routing; adjusting vehicle routes based on current traffic conditions or changes to routes.

The interrupted factories in turn provide only precarious work for the workforce, and a burden for society to manage.



Importance of Data in Society

Never before have the general citizenship been interested in data and data visualization. Currently, an estimated 2.6 billion people – one-third of the world's population – is living under some kind of lockdown or quarantine³, directly affected by an invisible threat that can only be conceptualised through data tooling. The majority of these people are following the trend of the curve of number of infections per day, produced by so called Business Intelligence systems that excel at visualizing data points.

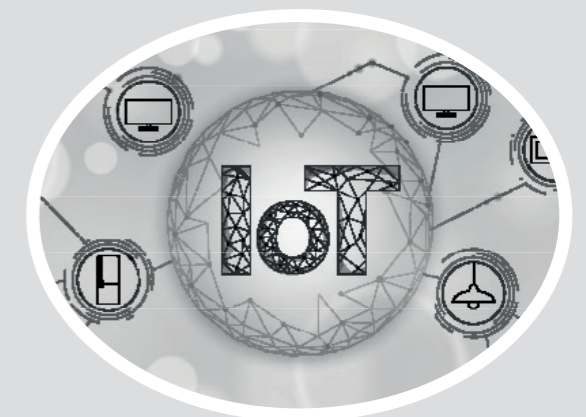
This is an exceptional opportunity to let the general public know about the importance of data, data science and statistics. There should be a broad reassertion of the important of data in mathematics and technology teaching in education policy and in the media, the emergency of a Data Attenborough for public advocacy and evangelism of data services is essential.

Mobile Phone as a sensor

In these unprecedented times, governments need to track if the population is following the rules and guidance that the emergency laws say. With the restriction of liberty, it is extremely important to evaluate and make decisions based on data. As there is not enough data to properly track the degree of compliance, governments are forced to use broad indicators to estimate it (for example, by using the traffic accidents to measure if the population is traveling less by car).

Now that we are in position to make proper use of IoT, we can easily have an accurate picture of how the population is obeying the law by using the data from smartphones. Even with aggregated or anonymized data, we can detect which societal segment are not following the rules or the geographic areas where there are issues with the confinement. Knowing that the government can focus the resources to avoid this in concrete areas or sectors.

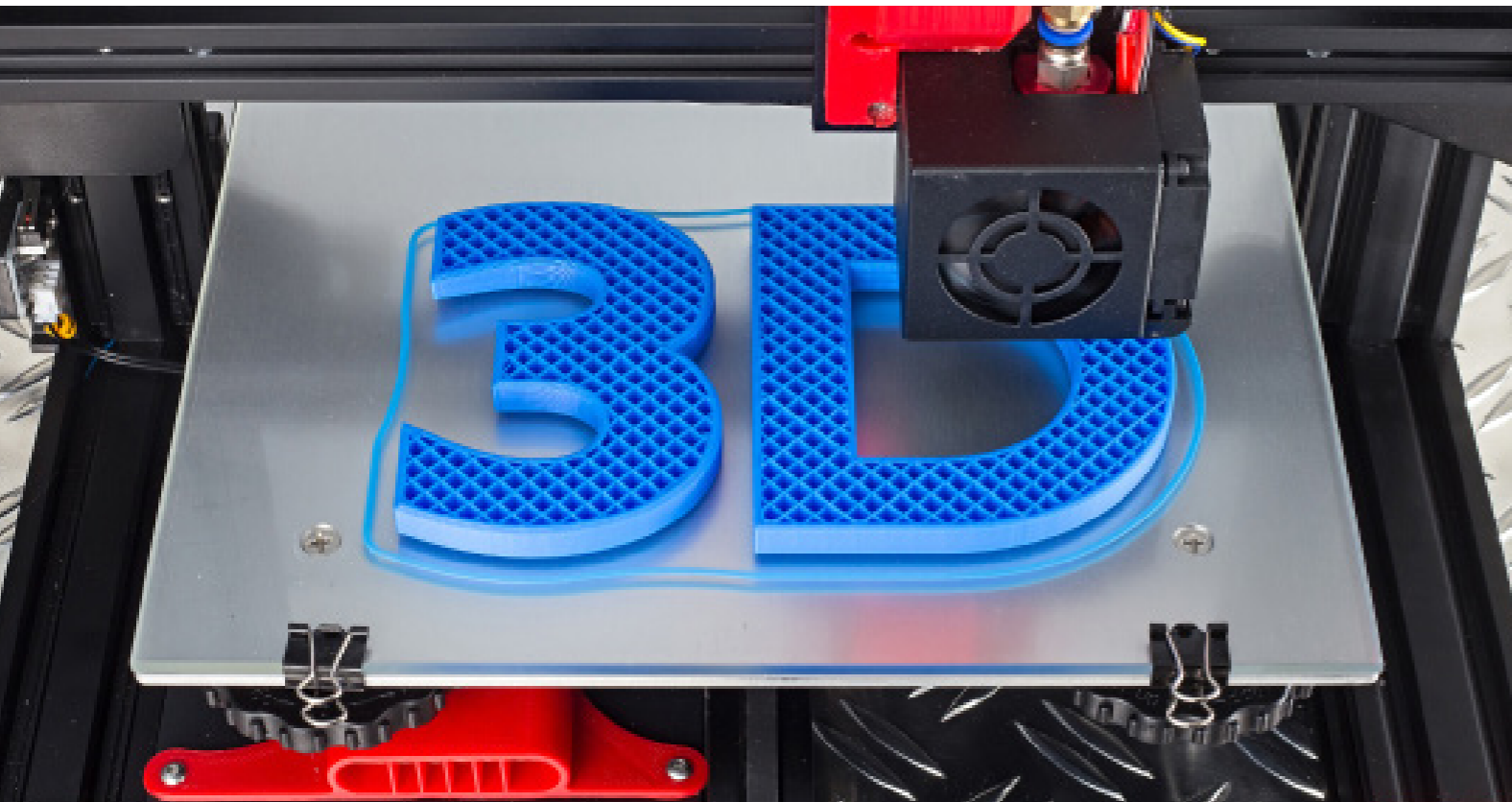
There was a recent study on this by Google in Spain.⁴



1. www.reuters.com/article/us-japan-supplychain-sp/special-report-disasters-show-flaws-in-just-in-time-production-idUSTRE72K5AL20110321

4. www.elmundo.es/tecnologia/2020/04/03/5e86ddc4fc6c841358b45e5.html

Understanding is the key to Economic Flexibility



The absolute basics of the Fourth Industrial Revolution will make possible the stabilization of supply by modelling demand accurately and applying economic flexibility.

By maintaining views on current stocks of necessary basic goods and infrastructure such as sanitizer, in real time through automated monitoring and inventory management and storing this data in a broadly accessible Data Lake, Britain can predict future demand. It can integrate current and future demand with epidemic modelling and movement data to predict where potential shortages will occur and redistribute stock for maximum effectiveness.

The Coronavirus pandemic has seen some enterprising British companies providing outstandingly reactive services to the changing demands. This spirit can be spread by making available data that clearly shows traversable routes through the market that benefit all companies, from SMEs to enterprises. Taking the foresight of Brewdog to produce hand sanitizer broader⁵, Britain should integrate supplier capacity and current production information with demand model and transport modelling to optimise supply chain for reactivity.

5. www.brewdog.com/uk/hand-sanitiser

Following this, we should maintain lists of secondary suppliers that can be pivoted to producing necessary medical good and infrastructure in a short timespan; Breweries and distilleries capable of producing hand sanitizer, clothing manufacturers able to produce face masks and scrubs and machinists and rapid prototyping (3D Printing) to produce replaceable parts for medical equipment like ventilators.

Staffing Levels

The determination of staffing levels in manufacturing and in the service sector has been radically advanced by the adoption of data science techniques, and that advancement has direct utility in the battle against coronavirus. Through the deep integration of disparate systems, a full view of staffing skill levels, availabilities and morale can be projected forwards in time to give predictions of the overall health of a workforce. Further, the provision of PPE can be optimised by combining the projective active work force with their requirements for protective equipment.

Elastacloud have successfully created predictive algorithms that help establish the likely availability of staffing resource into the future, following the educational trends, topics studied and the likely career progression of those students. This was achieved in multiple settings including with student midwives. Taking this approach with shorter time intervals would yield a model able to predict the staffing levels and the emergency drafted workers who are not specialists and who are given basic training.

Curve of Recovery

Machine Learning and Artificial Intelligence is exceptionally strong at pattern recognition and so has great utility in identifying recovery modes and what can affect faster recoveries for a sick workforce, leading to less spreading and fewer deaths. By deducing risk points by including datasets such as shopping habits, movement of people, what can work and also what doesn't work can be reported on to help optimise what people shouldn't do.

The use of IoT sensors to generate real time data and thus power intelligent forecasting of spreading of the virus which can also help identify potential risk locations.

The dashboarding of the data in a common fashion allows for much quicker turnaround and identification of these points, or for rapid change in effort location. This can happen

within hospitals as well, using information from IoT devices within hospitals to identify which machines are more reliable, what methods of treatment are working best, etc. If someone is showing similar traits of recovery, how can these be identified earlier to lessen recovery load for other patients, how can the factors affecting their recovery be isolated, and how can they be planned back into the available workforce?

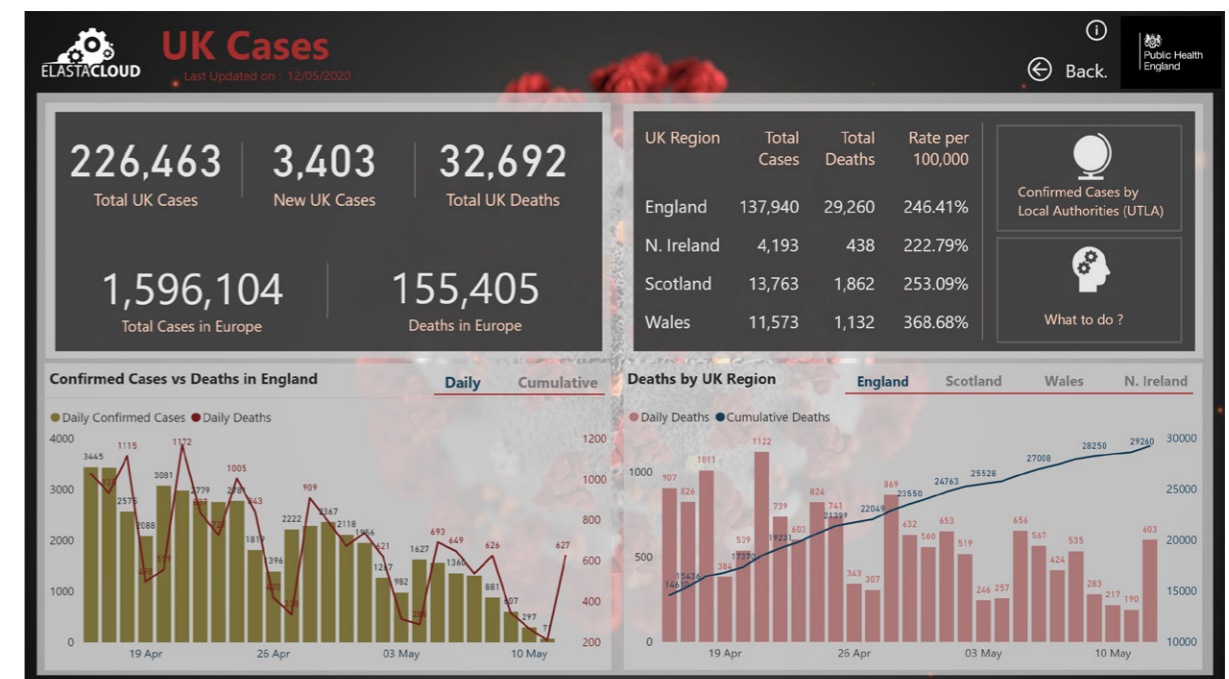
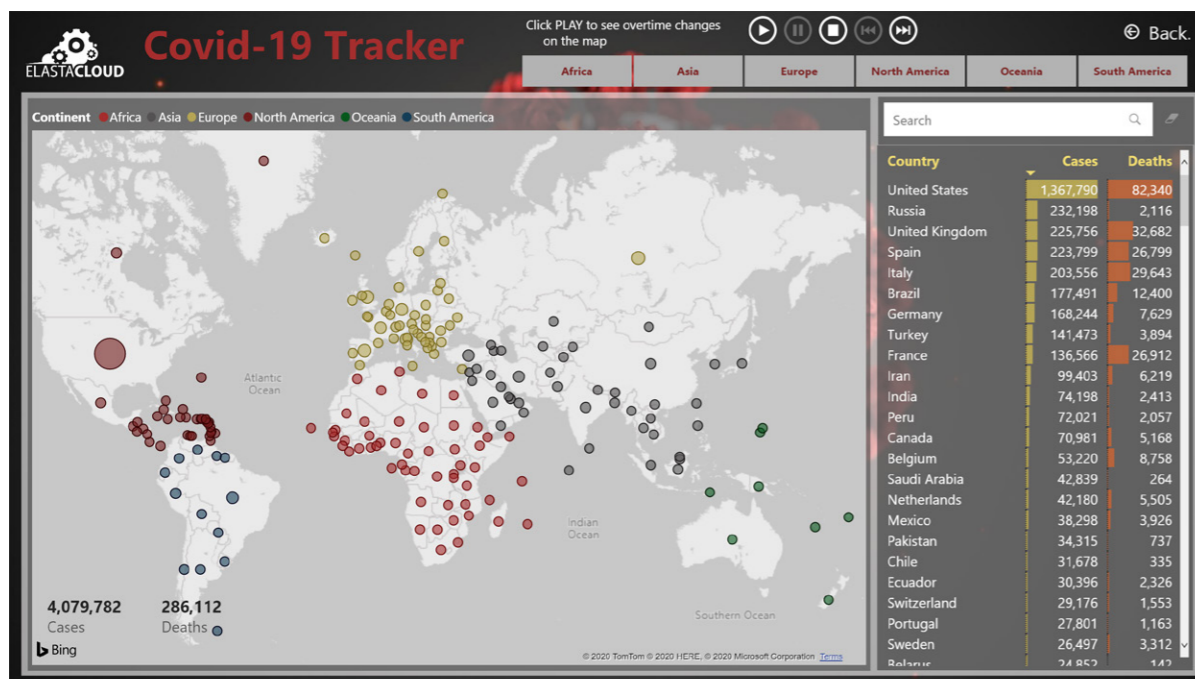
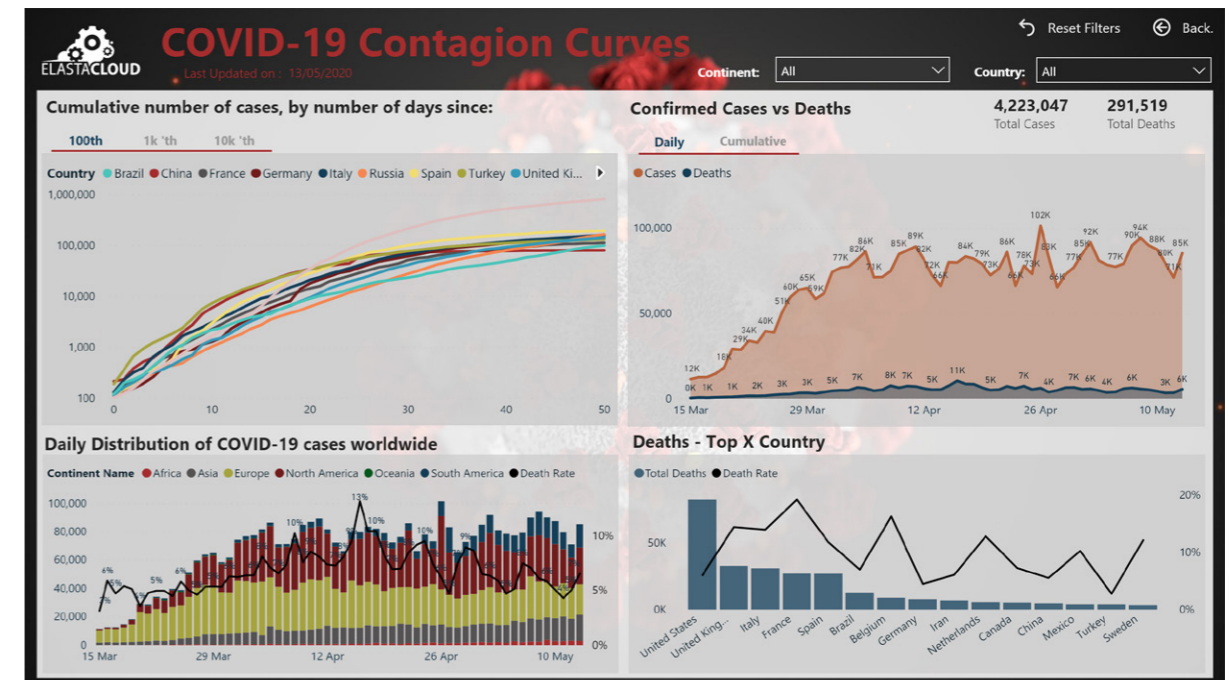
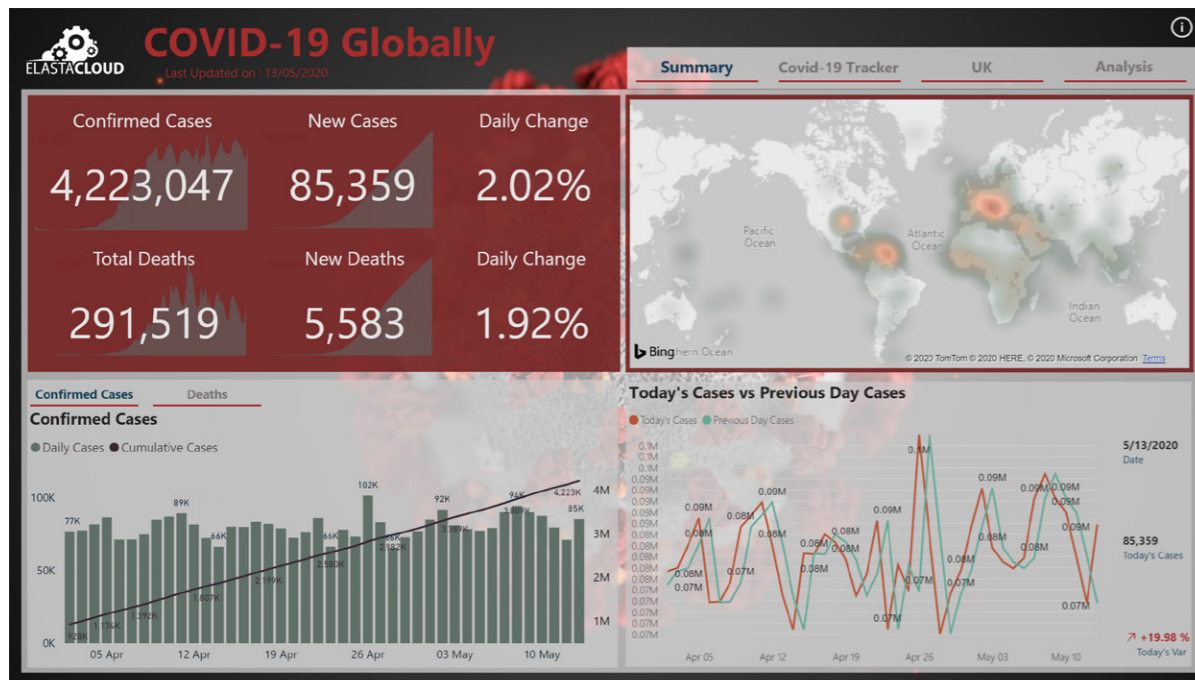
If this methodology is taken on board and used among other medical practices (i.e. all hospitals sharing anonymous data regarding common medical issues), it could potentially be a reusable model to help aid with recovery from other illnesses or identify risks which may inhibit faster recoveries, sooner.

The introduction of digitised patient records within the NHS could mean greater possibilities to use patient data to create deep learning models. However, currently the systems used for digital records vary between trusts and hospitals, making data collection and sharing inefficient. The use of IoT devices for capturing patient notes could increase the speed of innovation through more effective data sharing and management.

This could have a direct impact operationally, leading to more positive health outcomes overall. Recently, access to 40,000 CT lung scans has given data scientists the ability to develop deep learning models which have been able to detect the seriousness of pneumonia to the equivalent accuracy of an expert radiologist. Models like this allow for much quicker analysis and predictive measures, resulting in faster reactions to environments like COVID19 and anticipation of the challenges being faced.

The UK should further develop an advanced and integrated technology infrastructure.

This will improve our resilience to global activity and possible disruptions. It will bring about the flexibility to our economy that we need. Technology has the ability to help us be both global and local, and we should be proud of our highly capable part to play. The importance of data in particular is already at an all-time high, and it has an incredible opportunity to be used not only by technologists but by wider society to help reshape our modern economy. By making use of technological innovations, and particularly within manufacturing, our country can thrive and survive, even in challenging times.



Covid-19 visualisation report (13th May 2020)

Maintaining an essential service during the Covid-19 Lockdown



We are now more than eight weeks into the Covid-19 lockdown, and this is not one of the situations that I ever thought I would be dealing with during my tenure as the CEO of GTR. The rail industry, like every community, has responded with resilience and determination and I have been humbled by the energy and courage shown by my colleagues in supporting our customers.



Impact of the Pandemic at GTR

Like every organisation in the UK, we are reappraising how we operate each aspect of our business during this terrible pandemic. Being key workers ourselves, we have a clear mission during the Covid-19 crisis – to get other key workers to work. For many people, the instruction is not to travel, and this has led to a 97% fall in passenger numbers over the last few weeks.

Train drivers and crew turn up at depots, to maintain and drive trains around the network. You can't do this work from home. Key Workers turn up at stations and rightly – expect the station to be staffed. They want people there to offer customer service and if they have accessibility needs, be on hand to support them.

Over the last few years, everything we have done at GTR has been to increase and improve the quality of face-to-face interaction with customers. Freeing up staff on trains to give more direct customer service and changing how we work at stations.

Now, fewer passengers means fewer services running, with fewer train drivers, on-board crew or station staff required. Those who need to self-isolate can do so without negatively affecting punctuality/reliability and, where possible, other staff can be redeployed. Social distancing in depots, on stations and on trains, although challenging for some roles, becomes possible. All of this only functions if the back-office, more usually based in traditional offices, is still able to operate.

The role of technology

Away from customer-facing roles, we have broadened our use of digital technology to support the safe running of the railways. Whilst the rail sector is not known for taking radical action or quickly adopting new technologies, current circumstances have seen the industry make the best use of the technology available, working differently and virtually at pace to keep employees as safe as possible and ensure key workers can get to their essential place of work.

Technology has played a vital role in connecting people, keeping them informed, and ensuring back office functions continue to adapt and focus on supporting the rest of the business. It is that agility in how we work and in effectively using digital technology and our IT systems, that has secured a smooth transition from an office based back office to one that within days, worked effectively at home.

Over the past couple of years, we have transformed our ways of working by revamping our IT strategy and introducing new digital technologies. We have equipped our people with the right tools including the latest mobile phone devices, introduced new collaboration platforms such as Teams and Yammer, and importantly trained everyone so that the changes were not a one off capital investment but the conduit to more effective and efficient ways of working. Training might be obvious, but it can often be overlooked. Training colleagues to use digital technology is what can make the biggest difference between the success and failure of remote working.

If anything, the last few weeks have cemented this new way of working and allowed my team to remain focused on our purpose.

That's not to forget that something is lost when you are all working remotely, all the time. Building morale and team spirit, ensuring your teams are safe and well, understanding if they are concerned or anxious is more important than ever and whilst it can be done remotely, it is much harder to read the small signals and body language by video call that you naturally and easily pick up on in person.

What next for business?

The impact of remote working will be far reaching and long term. When this crisis is over, will businesses expect their employees to attend meetings in person, when we now know it can also be done via video call? I'm not sure. I think many businesses will be looking at their costs and wondering if they need large office spaces in prime locations. They'll be considering what they have learnt about how they can do things differently and how much they can rely on their people to do the right thing.

As a train operator, any change to how people travel will inevitably impact on us. Whether the shift will be dramatic or slight, only time will tell. But as an industry we will all have to be ready to adapt and continue to use the technology to provide the agility we will continue to need as we slowly create a new normal.

Final Thoughts

Whilst you can't always plan for the unknown or the unexpected, I think we are all much more adaptable than we knew. Our investment in technology and its development is essential because as leaders our role is to empower our people with the tools, learning and information to work effectively. And ultimately, every business is about people. I have never been prouder of ours, as I see the sense of determination, commitment and resilience from all our staff every day as they continue to support our mission to get other key workers to where they are needed.

Patrick Verwer
Chief Executive Officer Govia Thameslink Railway



Case Study: Supporting our customers, passengers and staff through Covid-19

In a fast-moving situation, such as the current pandemic, it was vital to support the front-line delivery of services. Broadly speaking, the challenge and the solutions, can be divided as follows:

- Rapid enabling of online working for all employees where operationally possible
- A coherent, collaborative “single source of truth”
- Online training and support
- Safe delivery of train service

Fortunately, we were already well into a digital upgrade, meaning we were better placed than many in the industry to respond to the digital demands the new restrictions were likely to place on our ways of working. For instance, we had deployed over 4,000 Android smartphones to frontline staff and had refreshed or replaced 1,800 laptops and desktops with Windows 10.

Microsoft 365 had already been deployed to support the business, enabling a secure cloud platform accessible anywhere. Staff were already used to using phones, tablets and laptops to access their emails, intranet and online collaboration tool Yammer as well as for virtual meetings via Microsoft Teams.

When it became obvious the UK, like much of the rest of Europe before it, was heading towards a serious lockdown, the challenge to make the whole business agile was considerable. Needless to say, we found ourselves in a better place than we had been 12 months earlier.

However, we had to urgently deploy an additional 200 Windows 10-ready laptops to GTR staff in five days as well as supporting our parent group by supplying them with 40 additional laptops.

Prior to the current situation the capacity of our legacy VPN solution was geared for around 30% concurrent usage. Clearly this would be inadequate for the new circumstances we now find ourselves. The most cost effective and quickest solution was to deploy within ten days a new redundant Windows 10 Always On VPN based VPN solution enabling 100% of our staff accessing company systems remotely and securely from company laptops. By running in the background, it allows staff to easily access company systems, and gives the company the capacity to manage, update and remote support these staff using these devices.

In times of great uncertainty and with the need to work agilely, we were acutely aware of the need to support staff to collaborate and work effectively. Using our SharePoint intranet, Together Online, we are supporting staff with the most up to date guidance daily.

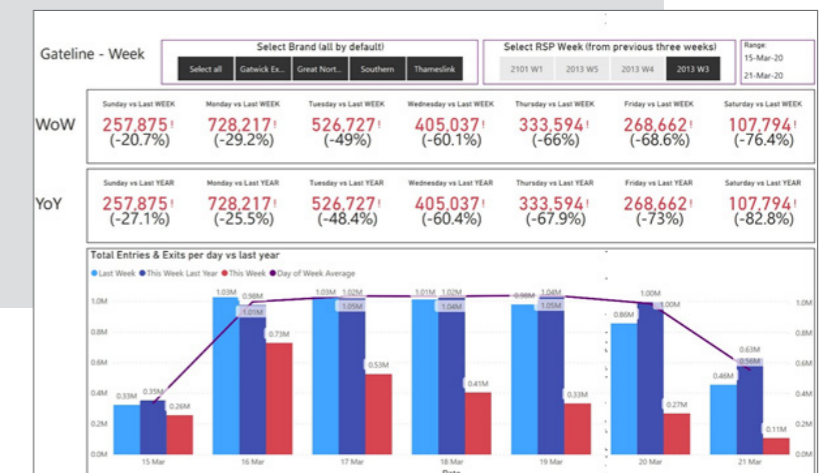
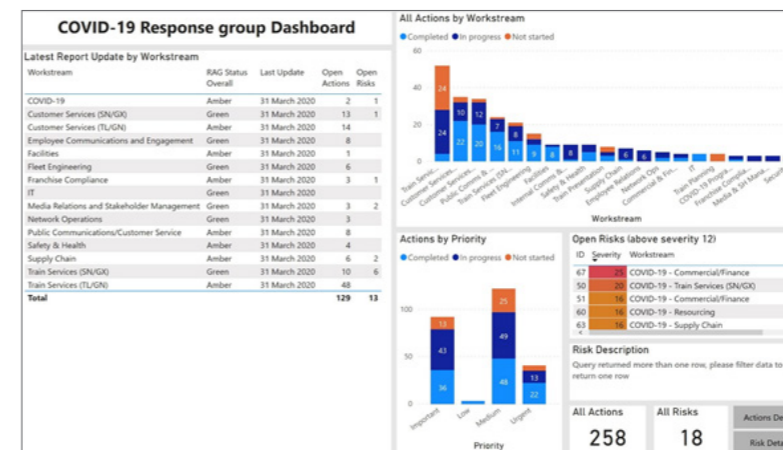
We have also used the Teams function to support our weekly internal COVID-19 Response Group: The software has enabled the team to not just collaborate safely via video and phone, but to share and track actions to enable effective decision making. The technology has also been used to run live briefings as

a weekly call for all managers and union representatives, at which a slide deck can be securely shared.

To support rapid and effective decision making, we had already deployed and built a live data analytics platform hosted in Azure. By automating accurate data capture into a visual report from a single source in our Data Hub we were able, at a glance, to see key areas of concern and issues, across much of the business. Looking at data across key workstreams, combined with the ability to analyse risk and action, the support for strategic and tactical decision making as the situation evolved across the business has been invaluable.

Understanding the number of passengers travelling, loading levels on our trains and the ability to monitor our train performance was essential. By using Siemens remote monitoring, we were able to determine the condition of our trains and loading levels – ensuring the decisions to reduce the timetable did not adversely impact on those who needed to travel. This data, combined with gate line data, ensured our passengers and station staff keep to the social distancing guidelines.

To support the COVID-19 working group and provide them with accurate and timely information around staff availability, we rapidly developed an internal COVID-19 PowerApp for managers to assist in providing guidance for them and their teams, which fed data into new Staff COVID-19 impact dashboards



as well as reporting on staff status to occupational health and safety. The data is then presented to the Executive so they know where they need to focus their support.

The new ways of working inevitably created an anticipated training need. To support employees as they got used to using the new systems, we ran a series of online training sessions which were subsequently added to the self-help portal as short videos, training documentation and tips and tricks. We also added Microsoft Custom Learning Pathways, a pre-packaged training site, to further support employees.

Changing processes, especially technological ones in a traditional industry like rail, is often seen as too difficult. Yet the railway's essential role in getting our vital key workers to their much-needed jobs has proven that we can act rapidly and differently. Of course, much of what we have had to address is back office functions. But ensuring these are efficient is essential to enabling the right operations.

Using visual representations of large volumes of data, often in real time, have enabled dynamic decision making. In turn, we have been able to advise, support and train our frontline staff remotely,

often using new technologies during this incredibly challenging time. They, and all our employees have embraced the changes, just as they have diligently worked throughout, making sure that those who need to still travel can do so – safely and in the knowledge that we are constantly assessing what is happening across our service, to ensure we are doing everything we can to keep everyone safe.

We are seeing the benefits of investment in technology and our people.

Ian McLaren
Chief Financial Officer
Govia Thameslink Railway

But of course, the hardware is only part of our solution for homeworking.

Improving the Earth's ecosystem with Artificial Intelligence (AI)

By Nikolay Gurianov – Founder of Braintree



braintree
nature of intelligence

Despite the COVID-19 pandemic presenting dramatic challenges for all, we should view the current situation as a 'note of warning', which indicates a necessity to change our approach towards our future and our key priorities in it.

The COVID-19 outbreak has illustrated that humankind, as an important part of this planet's biosphere, has already started negatively impacting Earth's ecosystem some time ago. To the extent where the damage we have caused to the environment has changed it critically and violated the very balance of nature.

Several different theories are explaining how COVID-19 has emerged, as well as how 'patient zero' became infected by the virus. However, would it really make a critical difference if we knew where it came from or how it got into the human's organism? The reality is that the COVID-19 pandemic is an interplay between the ecosystem and human civilization. Humanity as a whole and each person individually, along with all the viruses and bacteria are interconnected as parts of that ecosystem. Hence, when one part of that system gets overloaded, it leads to an imbalance and inevitable change in the rest of its parts.

Our civilization has progressed step by step, in a very logical way. Yet, has it occurred to us that inventing the car was one of the conditions for humanity not only to progress but to success in raising the standard of living? Imagine contemporary London, with its current population, where instead of cars everyone is using horses like it used to be. That would

not benefit our current ecological situation, as in this scenario cars are a lot less harmful to the environment than horses. Inventing the first car one didn't only take travelling to the next level (by improving speed and comfort) but this invention contributed to increasing the standard of living and ecosystem of the future humankind. That innovative approach to solve travelling and future ecological issues took place around 120 years ago, not long ago we started considering next step to take in that direction trying to find what could be the next alternative vehicle. The same is applied to all the other areas of technological progress; humans are in a constant process of developing it – step by step. However, a process as such takes time. Up until now, such a process was driven by three priorities:

1. Survival
(supply of required resources)
2. Procreation
(preserving the genome)
3. Domination
(to win an evolutionary competition)

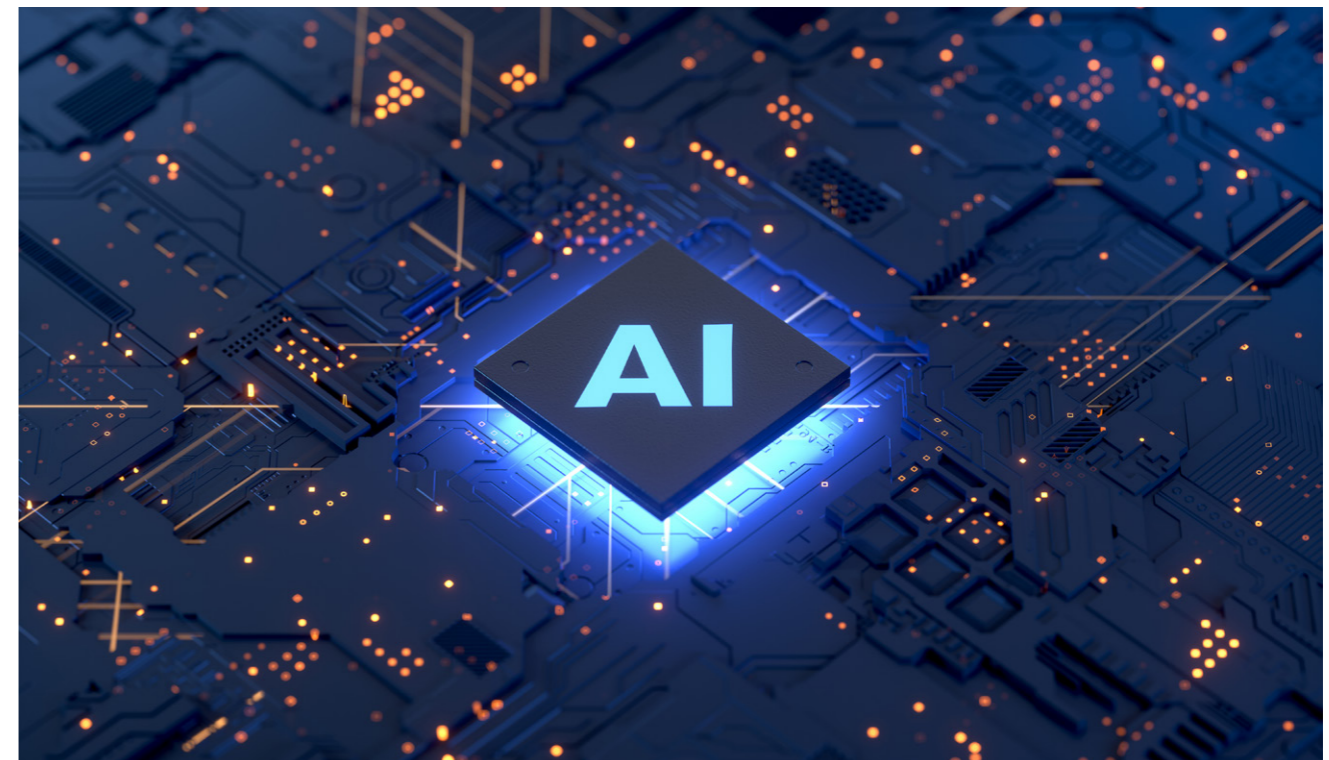
Those principals based on living instincts were balanced out by human intelligence and biosphere. Any historical event can be analysed through the lenses of such prism: which illustrates there has always been a fight between biological instincts and intellectual achievements. While it was happening, another essential process was taking place - an accumulation of knowledge. Before ways to record knowledge through writing or drawing

were invented, it used to be passed on verbally. After years of developing tools through which the information can be passed, society is now mainly using digital technology for that purpose.

In line with someone accumulating and recording knowledge, there was and always is a process of a 'convergence' in information taking place. As one leads to the other. In this context, convergence in information means that different kinds of knowledge are coming closer to each other, therefore making it more effective and efficient to use. Every so-called 'breakthrough' was made at a place where the most amount of knowledge would be concentrated at that time. Such locations would serve as a platform for a living repository of knowledge to emerge (e.g. libraries, data storages).

Let's go back to my initial point related to COVID-19. Regardless of the origins of the virus and where it came from, its 'outbreak' was caused by the humankind. Even though our society is developed enough to be influencing the ecosystem, it's not developed enough to be able to analyse the full process of convergence in information related to our ecosystem and humanity. This is where we have a chance to balance everything through data convergence if we start the process correctly.

There are many different types of knowledge known to us: scientific, statistical, empirical; however, we sometimes fail to understand the 'causal link' between that which we observe. Therefore, we may already have the solution recorded in our



Data Storages, and we are simply unable to 'view' it.

As we are all living in a digitalized world, our next step is developing Artificial Intelligence (AI) and help us to navigate and use data. AI will serve as a tool to analyse data, acquire new knowledge and learn how to create balance in our world.

It's important to understand that AI won't ever replace the humankind, as its' very existence losses purpose without humans to use it. AI should be viewed as a door to the whole new digitalized world, allowing us to link and analyse all kinds of information, as well as find and process the causal links mentioned earlier. There are

more benefits the AI can and will bring us: analysis and interconnection of an endless amount of information, the task a human brain is simply not able to process.

AI is the next step towards solving all sort of issues the society and the world is facing at the moment. A logical step, just like the ones we have made before towards a better future. Only this one won't only help to develop our knowledge and take technological progress to a whole new level – it will also help to restore and maintain the ecological balance in nature. I would call this new tool to access the new reality 'Hybrid Intelligence', the term illustrates the balance between

the natural order of things and technological progress that we, as a society, sick to find the balance.

I express my deepest condolences to all of those, whose life got affected by the pandemic. It's a tragedy and it affects us all on both: communal and personal level. However, I do believe it's a call for us to make 'the next step' towards a brighter future. It is essential to make it now, as the future will depend on the action we take now, and it's important to make the right action at the right time. If we agree on the kind of action we need to make, the next step would be to sit down and consult on how to make it and what would be the next after.

Local Government Leading Digital Transformation

Local government continues to show the nation that councils are there for our communities in our times of greatest need. As leaders of place, councillors and council officers have embraced digital practices to protect the vulnerable, supported our businesses and kept our highly-valued services running. All whilst doing our utmost to minimise the spread of coronavirus.

It hasn't been easy as the pandemic has dramatically reshaped local areas and changed the way our communities live, work and socialise. Councils are working tirelessly to protect lives, livelihoods and the most vulnerable in our communities. They have ensured that our most important public services keep running successfully. In doing this they have found new ways of working, such as meeting remotely to conduct their business and using digital innovations to ensure services continue to be delivered

The Local Government Association (LGA), which represents councils in England and Wales, continues to amplify the voice of local government on the national stage and ensure councils have the support they need. As Leader of Central Bedfordshire Council, I know all too well the spread of challenges we face, but I am reassured by the way local leaders continue to step up and deliver.

Indeed, Communities Secretary Robert Jenrick MP has spoken of the important role local councils are playing, reiterating the Government's commitment that councils will get the resources they need to cope with this pandemic. I was pleased that the Government listened to our warnings about the financial pressures facing local government when they announced a further £1.6 billion funding, taking the total funding local government has received in this crisis to £3.2 billion. This funding is crucial to councils' ability to continue to support local areas and will also go towards some of the digital services that councils are providing for their residents.

Despite the 'new normal' we find ourselves adapting too, councils continue to deliver vital frontline services such as adult and children's social care, waste collections and recycling, fixing potholes, and keeping our parks and cemeteries open to help improve communities mental and physical wellbeing.

With 21 per cent of Britain's population lacking the basic digital skills and capabilities required to benefit from using the internet, we know that giving people the confidence to use digital resources can change their lives for the better. Without access and confidence to the internet, many residents are at risk of loneliness and isolation, especially during these uncertain times. In response to these challenges, councils have been working extra hard to meet the needs of the residents and to ensure that they receive services as close to 'normal' as possible. Never has this been more important than in our response to coronavirus.

All councils have stepped up and are accelerating changes that were already happening, including remote and flexible working, video conferencing, and the digitisation of communications.

In late April I gave evidence virtually, alongside the LGA's Chief Executive, Mark Lloyd, to the Housing, Communities and Local Government inquiry into local government's response to COVID-19. It was good to join MPs in a virtual meeting, I look forward to joining more and I hope it is an innovation Parliament keeps as it will help ensure local leaders and their communities from across the country can contribute to parliamentary discussions.

The Committee session was an opportunity to talk about how councils have been working tirelessly to protect lives, livelihoods and the most vulnerable in our communities. Protecting the economy was central to our discussions and I was proud to highlight how local councils have re-designed how they pay grants and how they administer business rates relief to help businesses who need our support. There are many positive examples of this and to name a few, South Cambridgeshire District Council distributed £5 million worth of grants in four days, and Cornwall County Council have distributed £200 million to around 10,000 businesses.

The LGA for its part continues to offer support to councils. We called for councils to be able to meet virtually to make sure they can still function. Having worked with government to get the Coronavirus Act amended to include the powers around council meetings, we have launched a remote council meetings hub alongside

partners including the Government. The hub brings together the guidance, legislation and peer to peer support for councils to run their meetings remotely. Since the launch, the webpage has received more than 5,000-page views and is the fourth most popular page on our website. This demonstrates the importance of providing a central digital space where all councils can access guidance to help shape decisions.

As part of the LGA's sector-led improvement offer, which works with all councils to bring together examples good practice and innovation, we have also supported councils to deliver projects at pace. For example, an AI bot has been provided to direct queries on Kingston and Richmond's joint children's service, Achieving for Children website. Huntingdonshire District Council is also developing a voice bot in-house to reduce traffic to their contact centre while ensuring customers still receive a high-quality service and providing the ability to get a response out of standard hours.

Adur and Worthing Councils have developed an online community response service using a low code platform that allows digital services to be operated with minimum coding skills. The digital service manages requests for help through to neighbourhood teams who work closely with registered volunteers and the community and voluntary sector, tracking provision of a range of support including food parcels, help with shopping and prescriptions.

For a number of years, the LGA's Digital Inclusion programme has been a local government success story, providing councils with grants of up to £20,000 each to improve access to digital services. The LGA has worked with more than 30 councils, improving service delivery and productivity for thousands of residents. Independent analysis estimated that full digital uptake could add £63 billion to the UK economy – for local economies and for their resident's wellbeing.

As a sector, local government has shown it is exemplary in making best practice common practice. The LGA's Behavioural Insights programme has helped 26 councils to improve a wide variety of service areas, including public health,

adult social care, tackling domestic violence, housing and recycling.

Behavioural insights are based on the idea that interventions aimed at encouraging people to make better choices for themselves and society will be more successful if they are based on improved understanding of how people behave.

We are working closely with North Yorkshire County Council on two COVID-19 behavioural insights projects which will support the wellbeing of their staff as they adjust to working from home and to mobilise citizens living in North Yorkshire to support their local community during this pandemic.

Another example where councils have been providing digital support to residents is through their libraries. In usual times, council libraries provide a vital service for residents, acting as community hubs, providing free access to Wi-Fi, surgery appointments and access to books.

Following the introduction of social distancing measures, council libraries shut their doors. As a result, there has been a boom in new digital users with some councils experiences a 770 per cent increase. Council-owned libraries continue to provide people with access to e-books and audiobooks, alongside running reading clubs for young children.

However, many council-owned libraries are limited in the number of licences and copies of e-books and audiobooks they are able to provide and we therefore called for the Government to provide an extra £5 billion funding so councils can meet the demand. Working alongside partners, it was positive to see Arts Council England offer every library in England £1,000 to help deal with demand pressures.

We have also highlighted the importance of maintaining broadband and mobile networks at this vital time, not only for residents working from home or parents home-schooling their children, but for council staff and other local partners providing services to communities. Councils have been working with broadband and mobile providers to help facilitate access to roads and council-owned sites to conduct essential maintenance and emergency repairs to digital infrastructure where necessary, in a safe way.

I am proud and grateful to every councillor, member of staff and contractor who is going above and beyond right now to support our communities. Nationally, we are now providing support to more than 1.8 million people who are clinically vulnerable and our services ensure that all communities continue to receive vital services. For example, councils and adult social care providers have been using the GoodSam app to allocate NHS Volunteer referrals.

As we look ahead, after we beat the virus together, councils stand ready to pull the necessary levers at their disposal to support local economies, including through using increasingly digital, efficient services. Life will have changed forever and things will be different to how they are now. Whilst it has been a challenging time, the innovation such as remote working, virtual meetings and the huge upsurge in voluntary working and community support is something I would personally like to keep.

Having demonstrated the importance and success of councils delivering for our communities, together we need to ensure local government is at the forefront in the months and years ahead.

I hope our staff will continue to be valued as equal to those in any other public services, our contribution to supporting the wider group of vulnerable people we serve will be recognised, and that we will be funded sustainably now and into the future. With this backing, local government will continue to innovate and embrace digital platforms as our nation moves into the next phase of its fight against coronavirus.

As we look to move into the recovery period and adapt to the 'new normal' councils will look at how they can retain some of the changes we have been adapting to over the last few months. A combination of the increasing digitisation of services, videoconference and remote working, will ensure that councils are able to be more flexible and accessible for their residents. Similarly, as we embrace digitalisation, I hope to see behavioural changes which will help councils meet their environmental targets with less people making unnecessary journeys.

Cllr. James Jamieson
Chairman of the Local Government Association



Cllr. James Jamieson was first elected to Central Bedfordshire Council in 2009 and served as a Chair of Scrutiny. He was elected as Leader following the 2011 elections and currently represents the Westoning Ward having previously represented Flitwick.

Cllr Jamieson has lived in Bedfordshire since the mid-eighties. He is a qualified engineer with a Masters degree from Sheffield University, and worked in industry and banking for over 20 years before setting up his own consultancy providing strategic

advice to companies. He was elected Leader of the LGA Conservative Group in July 2018 and was subsequently elected as LGA Chairman in July 2019.

Uber in Covid-19

Not long ago, Uber was connecting 16 million trips a day globally. But if you opened your Uber app in the last two months, you'll have seen a reminder urging riders to stay home unless their trip is necessary.

Helping to protect public safety and key workers

In this challenging time, we committed over 300,000 free trips and meals for NHS staff. To provide longer-term support, we launched Uber Medics which gives 1.2m NHS staff and care workers 25% discounts until mid-July. We have also been supporting brilliant charities like Hestia who are working hard to move victims of domestic abuse to safe shelter at this difficult time.

"Healthcare staff and everyone serving in care homes are working tirelessly to protect, treat and care for those affected by coronavirus. We have responded to the request of the Government to provide transportation support for those serving on the frontline. We all have to play our part to help respond to the coronavirus crisis."

Jamie Heywood
Regional General Manager for Northern and Eastern Europe, Uber

To help restaurants stay open for delivery to feed the nation during the crisis, Uber Eats rolled out contactless delivery and made a new 'Leave at Door' feature the default, so that couriers could deliver without any physical contact. We also removed the delivery fee for many independent restaurants, waived registration fees for new restaurants and introduced daily payout to support struggling cash flows.

Helping drivers and couriers to continue to work safely

We all have a shared responsibility to help keep our communities safe and healthy: Uber, riders, drivers, couriers and restaurants, all of us. This is why Uber and Unilever are working to distribute hygiene kits to drivers and couriers who use the Uber platform in the UK. We are also distributing 3 million masks to drivers and couriers across the country.

For anyone restricted from working during the COVID-19 outbreak, we put in place a policy to provide drivers and couriers with financial assistance. This is in addition to our pre-existing free AXA insurance protection, which covers sickness, injury, maternity and paternity payments for Uber drivers and couriers in the UK.

Raazma, driver on the Uber app, London, who has been driving her Tesla Model 3 on the Uber app for two years, said: "I have already signed up to the NHS Volunteer Responders, and now I can also help NHS doctors, nurses and hospital staff get to and from work safely and in comfort. It's the least I can do in these challenging times, as we all need to pull together to help one another."



We also worked with our vehicle and insurance partners to find flexible solutions to reduce their vehicle and insurance costs during this period.

Helping cities reopen safely

Since the onset of the pandemic, our tech and safety teams have been hard at work to build a new platform experience that will help protect everyone, every time they use Uber. We have worked with Public Health England, Care England and NHSX, the digital arm of the NHS, to provide transport to healthcare workers during the crisis. Contactless delivery continues to play a key role in supporting restaurants as they reopen safely.

As cities begin to reopen and more people start to move again, we are

proceeding with caution. We are currently carrying out a pilot in the north east of England to help bring about a greater understanding of how to get people from A to B as safely as possible. This involves partnering with the AA to install in-car partitions in 400 cars across Newcastle, Sunderland and Durham. We hope that this pilot will help to better understand how in-car partitions can work.

Looking forward, Uber is committed to working with governments, public health bodies, charities and other businesses to support the country through this crisis.



Mohammed, Uber Eats delivery partner from London said: "During this crisis we all need to play our role in helping those that are fighting the coronavirus, and I am proud to be playing a part in that by helping to make sure NHS workers in London are fed and can keep working."

Subsidised rides for healthcare workers

uber.com/medics



BAE Systems joins the industry-wide fight against Covid-19, using 3D design and print facilities, SME suppliers, games engine technology and innovative ventilator engineering

One of the positive stories to come out of Covid-19 is the readiness of British companies to work together for the common good. One example is VentilatorChallengeUK, a consortium of technology, engineering and medical companies collaborating to ramp up production of medical ventilators.

As well as joining the VentilatorChallengeUK consortium, which we continue to support, a team in our Applied Intelligence business in Guildford, under the leadership of Mark Bennett, Strategy Director, Government, came up with an innovative idea for an entirely new ventilator. This was to be built from readily available parts that could be rapidly manufactured.

The team started work immediately following the Government call to action, joining forces with Intersurgical, already a leading provider of respiratory products to the NHS. Following input from senior NHS clinicians it became apparent that this ventilator design was suited to treat COVID-19, so our Chief Technology Officer, Ben Hudson, stepped in to help bring together the wider engineering and manufacturing skills across BAE Systems.

With Ben's help, our Maritime Services business offered its high-tech electronic manufacturing expertise in Broad Oak, Portsmouth and Hillend, near Edinburgh,

creating a production process that would allow us to build more than 1,000 units per week. Within three weeks, the production line in Portsmouth was ready and our employees were proudly starting to build multiple units of the AirCare ventilator.

As the project progressed it became clear that some additional specialist skills and capabilities were needed. Our Air team based in Lancashire joined the project, providing specialist engineering support while also using their industrial-scale 3D printers – which are also printing PPE for frontline health workers – to print hundreds of new ventilator parts. These parts were flown directly from our site in Warton to the production line in Portsmouth.

In just a few weeks, our team had gone from concept through design and development, and were ready to begin rapidly producing ventilators. By mid-April AirCare had completed initial technical testing

While the AirCare ventilator will not be going into large-scale production for the immediate UK response to COVID-19, it is a clear testament to the ingenuity of our people and the innovation within our business. We are proud to have played our part in responding to the call for help from the Government and stand by to help further in any way we can.

Producing PPE using our 3D Printers

A number of companies in the UK, including ourselves, are also using Industry 4.0 technology to produce PPE for frontline health workers. In late March we were approached by a GP local to our site in Barrow, asking if we could donate face shields. We rapidly prototyped a new design of 3D printed face shield and delivered the first units in just two days, before testing a number of design iterations and settling on a shield we could manufacture in volume from our industrial-scale 3D printers.

To further increase the numbers of face shields we can deliver to health workers, we are using our supply chain to manufacture tens of thousands more units of their own design. Together with our own 3D printed face shields, more than 90,000 face shields have been delivered to date. In total, we expect to deliver more than 150,000 face shields by mid-May.

We are sending face shields directly to the front line where there is the greatest need, including NHS hospitals and trusts, GP surgeries, ambulance services, care homes and hospices. In the spirit of collaboration, we have shared our 3D print design with other organisations, including the National Crime Agency and

Sellafield, to help inform their own PPE production using Industry 4.0 technology.

For our contribution to the VentilatorChallengeUK consortium, our Air training team, which usually develops Typhoon simulation software for the RAF, is developing innovative training content for engineers who will be producing ventilators for the first time. We

are using the 'Unreal Engine' games platform to highlight the key steps in factory acceptance testing of new ventilators. This is designed to increase the effectiveness of training for engineers who are doing this for the first time, allowing new production lines to be opened more quickly.

For both ventilators and PPE, Industry 4.0 technology allows

us to design collaboratively across a number of locations, then quickly test and productionise a solution. Having the ability to 3D print complex parts also makes a huge difference, as the speed at which we can go from CAD file to product – and go through numerous design iterations – is much more rapid than traditional techniques would allow.



Mercifully, and in no small part because of the British public's strict adherence to Government advice on social distancing, ventilators have not been required in the numbers originally estimated.

Techforce19

Now, more than ever, technology is well-placed to tackle the challenges the government is facing. These are incredibly trying times for everyone, whether that's frontline workers or those with elderly relatives who it's no longer safe to visit, and where technology is able to make these times easier, it is paramount we give it the opportunity to do so.

The Covid-19 crisis is rapidly evolving, and as our understanding of the crisis evolves, so too does the guidance of how best we can minimise its impact. That's why now is the time to work with new and innovative technologies at a pace and scale that hasn't been possible in a pre-Covid world. Whether it's helping those self-isolating and in need of remote care, or providing support networks for those struggling with mental health problems exacerbated by social isolation, new technologies in the market are able to (and want to) help. Technology - and people - want to help, so long as they are given avenues to do so. That's why, when the UK's health service, the NHS, launched the GoodSAM initiative to recruit volunteers to help with the crisis, they received 750,000 sign-ups in less than a week - and have a waiting list.

That same sense of enthusiasm led us to launch TechForce19, a project between PUBLIC, the UK health service, and the Ministry of Local Government, to find new technologies to support those vulnerable and self-isolating under Covid-19. The selected companies would be given up to £25K of funding to conduct a two-week test phase, with the possibility of scaling beyond that afterwards. TechForce19 was pitched to the NHS in mid-March, and within a week we had launched applications - having established the key challenge themes to address in tandem with NHSX and having laid out a commercial process which allowed us to move quickly, support SMEs, and leave the opportunity for scaling. The challenge focused on three key areas: remote social care, staffing in the care and voluntary sectors, and mental health. We received over 1600 applications in just 10 days, more than five times what we normally receive for our GovStart accelerator programme.

This project allowed the government to move at a pace necessary under Covid-19 and a pace more suited to the innovative companies needed to tackle this crisis. These companies are more innovative and agile, able to adapt and change their technologies quickly based on feedback and ever-changing circumstances.

From the 1643 applications, 18 companies were selected to take part in pilots with various government agencies. The trials are supporting the elderly, the homeless, new parents, those with severe learning disabilities, cancer patients and many others.

Over the course of just one month, we were able to go from pitching the initial idea to NHS to having 18 selected companies conducting trials across the UK - in England, Wales, Scotland and Northern Ireland. This is a process that would normally take at least several months. By moving quickly, it enabled the project to have a tangible impact during the height of the pandemic rather than only tabling solutions past the point when they were most needed. But it shouldn't take a pandemic for this to happen. Working culture and pace within the public sector needs to match that of the private sector in more ordinary times as well as in times of crisis - how else can we expect to see the same innovation within the public sector that we see outside it?



We developed TechForce19 to tackle a problem we've seen time and time again: government does not move quickly enough to keep up with innovation, and government procurement is designed to favour large incumbents.

Case Studies - selected companies



Vinehealth is a mobile app to support cancer patients and their loved ones during treatment by allowing them to easily track and understand their care, including their symptoms, side effects, appointments and medications.

By completing a 1-minute daily log, cancer patients can develop a clear overview of their progress through treatment and access advice on how to cope and when to access health services.

The Vinehealth app empowers cancer patients who are self-isolating to self-manage and feel more in control.



Birdie provides a digital platform for home care agencies to better manage the care they provide. Through an easy to use app, care workers capture daily visit logs, and a central hub allows staff to track real-time information. Family members receive live and daily safety and well-being updates through the app, including from optional home monitoring sensors. Birdie helps domiciliary care agencies to increase efficiency, and improves the care people receive in their homes through systematic monitoring, prevention of risks, and support to carers.



The RIX Multi Me toolkit provides highly accessible and secure social networking that serves as a Support Network for people with learning disabilities and mental health challenges.

This easy to use multimedia network, with accompanying communication, personal-organiser and goal-setting tools, enables isolated and distanced vulnerable people to build stronger support circles.

It helps them self-manage their care and actively limit the impact and spread of Covid19 infection. Care professionals use the 'Stay Connected' RIX Multi Me Toolkit to remotely monitor and support people's wellbeing in an efficient and friendly way.



Beam is a digital platform that crowdfunds emergency items for homeless people in emergency accommodation or rough sleepers self-isolating in hotels. The organisations supporting homeless people are particularly overstretched during the Covid-19 crisis, and the public has shown a huge desire to be part of the solution. Beam takes referrals from local authorities and homeless charities, then ensures goods are funded, delivered and documented.



Feebris helps carers to identify health risks and deterioration within elderly communities.

The Feebris app guides a carer through a 10min check-up, including capture of vital signs from connected medical-grade sensors (digital stethoscope, pulse oximeter etc.). Powerful AI augments clinical guidelines and personalised monitoring to help decisions on triaging health issues.

The intention is to provide Feebris to care homes to help carers triage the day-to-day health needs of their residents during the COVID-19 pandemic, and also enhance the capabilities of remote clinicians.



Delivering Innovative Technologies to support the National Effort



The COVID-19 Pandemic is unlike anything we have experienced for generations. Possibly since the Spanish Flu in 1919, we have not seen a pandemic on this scale. The response, both political, economic and social, must likewise be unlike anything we have ever experienced. We have already seen from the Government a commitment to protect jobs and shield the vulnerable, as well as doing whatever is needed to protect as many lives as possible through the work of our NHS. We are lucky, in that we have technology and understanding of epidemiology that those in 1919 couldn't dream of. From the ability for many to work remotely in our homes, thus slowing the spread, to the technology we can bring to bear to aid the NHS and our frontline workers. We are better equipped than any generation in history to mitigate the threats which this disease poses to our society.

Government Ministers have regularly compared the current situation to a war-time effort, where the entire might of our economy and society must be brought to bear in service of a common challenge. Old opponents and rivalries put to one side to deal with a bigger threat to us all. As a nation it has been incredible to see how we have answered that call. From people power, with hundreds of thousands of volunteers and medics joining the NHS to increase its capacity, to the inspirational collaboration between companies and academics to think of new ways of making ventilators, testing kits, vaccines and treatments.

Nowhere has that effort been more manifest than with the speed at which the new NHS Nightingale hospitals have been constructed. With support from businesses across the economy, including Capita, one of the largest hospitals in the world was built in just five days. We are

embracing new technologies and using them in new ways, at a speed never before seen.

Technology has sped up the collaboration between government and its partners. The sharing of data between public health and tele-communications firms in South Korea is just one example of how information has been used in ways we never would have thought of to help in a pandemic response, whilst 3D printing is being used to produce new personal protection equipment quickly, cheaply, and efficiently. We're also seeing mass adoption of digital technologies and approaches for education and learning on a scale never seen before.

Capita is a long term partner of the NHS, delivering innovative technologies to help the NHS, designed with clinicians to deliver exactly what they need. If some of the products we have built over the years had not existed before, we would have built them for this exact moment.

Chief among these could be new forms of video sharing, allowing for safe, rapid and remote diagnosis of high volumes of people while limiting medical professionals' exposure to contagious illnesses. By way of one example, we have developed ResponsEye with police forces for emergency control rooms across the UK and the USA. It allows 999 operators to connect to callers phones, providing them with live video, and location tracking technology. Its application, previously had been in assessing the scenes of incidents, to ensure the best and most appropriate

responses are sent out as quickly as possible. It doesn't call on much imagination to work out how it could be used to support the NHS during this crisis.

Supporting control rooms, allowing them to see and get a better, remote grasp on patients conditions, allows for easier, more accurate assessment of patient needs. It frees up time and pressure on Accident and Emergency departments, from both those with COVID-19, and those without who would otherwise be in A&E where that might not be the most appropriate place for them to go, and it is an additional option for the NHS.

Video conferencing is nothing new to the world of business, nor even to the world of medicine. But the scale on which it is needed and used is unprecedented. Video diagnosis could be at the forefront of helping people, and taking pressure off the NHS by enabling GPs, doctors and medical staff to continue seeing as many patients as they can, while mitigating the risk of their own exposure to the disease. Technology has made this possible, and it will save lives.

But our response to the pandemic, as a company and as a society, is about more than just the front line work we do with the NHS. Keeping key services like financial services support online, working with anxious people to help them access mortgage holidays, business loans and other services to ensure their finances remain sound, working for telecommunications customers to ensure that people can stay connected, even as they remain at home – or are even stranded abroad. And doing this while capacity drops as people self-isolate. Technology again, has the power to make a difference. Conversational Artificial Intelligence enables call centres to be run with lower capacity, allowing call centres

to focus on the most complex cases, helping the vulnerable when they need it most.

It is also about staying at home and preventing transmission between households. Working from home has gone from being something that some of us do once in a while, to a patriotic duty to slow the virus. In the post-COVID world it may be the new norm. There is no way around it, it will require a major culture change, and major

technological innovation. Humans are social animals, and we will need to find ways to deliver new virtual water-cooler moments. But if our COVID response has taught us anything, it is that technology has the ability to achieve almost anything. There will be challenges, not least of which is around connectivity in our homes. These will be the challenges of the future.



Technology has fundamentally, and forever changed how we live our lives and how we interact with our work, colleagues and friends. It will change the nature of work, and businesses, governments and individuals must adapt and embrace AI and automation, or risk being swept away. We plan to be at the very front of that wave, offering world leading technologies to Government and our clients.

Technology has fuelled our response to the coronavirus, and it will also accelerate us out of it, rebuilding our businesses and restarting our economy. From helping facilitate social distancing at the start as we begin to ease out, to taking over the easiest and most mundane parts of work, so that humans can focus on the most complex issues. We are using robot process automation to ease the burden on our call centres, for example, and other businesses are doing the same.

AI makes its mark as a powerful ally in the fight against COVID-19

BenevolentAI

Although many scientists and technology leaders including Bill Gates in his now infamous TED talk in 2015 warned of the likelihood of a highly infectious airborne virus potentially leaping species to infect humans on a mass scale, it seems that nearly every country in the world was caught off guard. As a result, a global lockdown of nearly 40% of the world's population became necessary whilst governments dusted off pandemic plans, established emergency supply chains for protective equipment and developed testing protocols in response to the COVID-19 global pandemic.

The sudden appearance and rapid global spread of the novel coronavirus illustrated the need to leverage emerging technologies to hunt down treatments to combat the virus until a vaccine could be developed, tested and available in the global supply chain. Following China's publication on 12 January 2020 of the genetic sequence of COVID-19, the race was on to identify drugs that might have a prophylactic effect of reducing the severity of the virus or that could inhibit the virus and the body's hyper-inflammatory response to it. Several antiviral drugs previously used to treat malaria and HIV were put forward by pharma companies, including an experimental drug developed for Ebola all of which started clinical trials.

In a global pandemic, speed is of the essence – and machine learning models excel in handling data in fast-changing circumstances. Computing power and algorithms can be harnessed to work as tireless and unbiased super-researchers, analysing chemical, biological and medical databases to identify potential drug leads far faster than humans. AI systems save time and the agnostic approach adopted by machine learning means such platforms can process all of the world's available bio information to generate leads that may be overlooked by traditional research.

At BenevolentAI, a technology & drug discovery company based in London and Cambridge UK, we set up a specialist scientific team in late January and launched an investigation using our AI drug discovery platform to identify approved drugs which could potentially treat COVID-19. Using a vast, curated biomedical knowledge graph, we surfaced a number of potential drugs and through a triage process using deep learning models, BenevolentAI scientists identified baricitinib, an approved rheumatoid arthritis drug as a potential treatment. Although many scientists were already studying similar anti-inflammatory drugs, using the AI platform, we discovered that Baricitinib, an IL6 inhibitor known to reduce inflammation in the body, has anti-viral properties that could inhibit endocytosis, the process by which a virus infects cells as well as reducing the body's extreme immune response referred to as a cytokine storm. Baricitinib is a small molecule, readily available in the supply chain, taken orally and renally cleared in twelve hours, meaning it can be rapidly put to work either alone or in combination with other therapies

At the start of February BenevolentAI published research findings in The Lancet, which was followed by a second publication in Lancet Infectious Diseases and by March, small groups of Italian physicians battling the virus on the frontlines became aware of the Lancet publications and commenced treating COVID-19 patients with baricitinib on a compassionate basis. Those investigator-led trials yielded initial successful outcomes. Eli Lilly, which owns the drug baricitinib subsequently validated the hypothesis in vitro and on 10th April, announced it had entered into an agreement with the National Institute of Allergy and Infectious Diseases (NIAID) to test baricitinib in clinical trials and alongside Remdesvir as a treatment protocol.

The incredible speed at which this hypothesis moved from computer to bench to bedside demonstrates the far-reaching potential of AI models and algorithms for identifying existing and new drugs for the treatment of disease. While the urgency of the coronavirus outbreak means it makes sense to hunt through already approved drugs that could be ready for large-scale trials within weeks, the greatest potential lies in uncovering brand-new treatments for complex diseases with poorly understood mechanisms of action that have defied conventional research efforts. Indeed, this is where BenevolentAI's primary effort is focused; working on complex diseases that currently have no effective treatment such as Glioblastoma Multiforme, ALS, Crohn's Disease and Ulcerative Colitis.

Tackling an infectious disease may have been a new avenue for this AI-enabled technology but it may not be the last since evidence suggests the current coronavirus outbreak could represent an increasingly frequent pattern of epidemics, fuelled by our hyper-connected modern world.



New Tech, New Challenges

Data is the lifeblood of AI-powered research. Machine learning models and algorithms can interrogate vast quantities of biomedical data but the quality of that data has a direct impact on the value of hypotheses generated, the molecules designed and the patients identified as potentially benefiting from treatment. COVID-19 is ultimately a novel problem, and therefore the difficulty has been in collecting and applying quality data in a rapid timeframe. Urgency can lead to data being collected haphazardly jeopardizing results and usefulness in decision making. In addition, the pandemic has made clear the importance of collaboration and data sharing between governments, academic researchers and businesses but this must be accomplished in a way that also protects patient anonymity.

Another challenge centres around the issue of trust. This lack of trust is due to the 'black box' problem, whereby machine learning technologies are rarely able to explain the patterns they find. For humans - who demand transparency, evidence and a clear understanding of rationale - this

inability to explain decisions results in a lack of trust in AI, which delays adoption of this transformational technology. Scepticism also arises from the simple fact that because algorithms are created by humans they can occasionally be wrong. In both cases, building trust involves a greater symbiosis between human and machine in the form of sustained efforts to refine predictions and better train models so that scientists and researchers can better understand where predictions have come from.

The success of AI in drug discovery is therefore contingent upon access to large datasets and a collaborative mindset which in the highly competitive traditional biopharma culture is a challenge indeed. A 2018 survey by the Pistoia Alliance, 52% of respondents stated a lack of access to data as one of the main barriers to innovation. Fortunately, recent years have seen a growth in collaborations and the open availability of large numbers of datasets, reflecting a growing awareness of the power of AI and other advanced technologies to transform drug discovery.

COVID-19 has helped accelerate data-sharing agreements and encourage open publication of research results and provided a glimpse of the beginnings of a more open and adaptable R&D model that can accelerate the delivery of innovative and life-changing products to patients. Alongside dozens of other scientific organizations and businesses, BenevolentAI signed the Wellcome Trust Pledge, to ensure that this and other research findings relevant to the coronavirus outbreak are shared rapidly and openly. The UK government followed by launching a new alliance to sequence the genomes of SARS-CoV-2. Backed by a £20 million investment, the COVID-19 Genomics UK Consortium (COG-UK) is comprised of the NHS, Public Health Agencies, the Wellcome Sanger Institute and several academic institutions. And finally, there are, at last count, over 100 vaccine projects in development around the world facilitated by the better understanding of the genetic makeup of the virus and open tracking of its mutations to identify if different strains are emerging.

AI should not be regarded as a silver bullet, be it in pandemic response, healthcare generally, or drug discovery more specifically. In these areas, AI alone is not enough, for once an AI platform or system has made a prediction or recommendation, it requires interpretation by human expertise and capabilities. The fundamental role of technology should be to augment scientists' capabilities, be it in identifying novel targets, designing novel molecules, or repurposing existing drugs.

In the search for potential treatments for COVID-19, AI technology played a significant role in accelerating potential drug candidates, streamlining the triage process and enhancing the ability to query these results. However, it was experienced scientists who evaluated those recommendations and put forward the hypothesis.

In a connected world in which pathogens spread at unprecedented speed, advanced technologies like AI and machine learning can be weapons to fight back. But while AI is proving its worth in the battle against this devastating disease, ultimately it is the fusion of machine intelligence and human ingenuity that holds the key to unleashing the full potential of this new technology to combat disease.

Baroness Shields

CEO of BenevolentAI and
Member of the House of Lords



These are challenging times, but there are many reasons to be hopeful.

Exit through the App Store?



Governments around the world are beginning to look to data-driven technologies as tools to support the transition from emergency lockdown measures in response to COVID-19.

The Government is right to explore non-clinical measures in its attempt to relax controls without an intolerable rise in COVID-19 cases. There are three interlocking technical interventions under consideration in the UK, as well as in other countries: symptom tracking applications, digital contact tracing applications and digital immunity certificates.

It is suggested that these technologies can inform research into the disease, prevent further infections, and support the restoration of system capacity and the opening up of the economy.

Data-driven technologies may be effective tools in any transition strategy, but they are not a replacement for policy. Technologies must form part of holistic public health surveillance strategies and other pandemic response initiatives. Without supporting evidence, they cannot and should not replace other proven methods.

To that end, the Ada Lovelace Institute has published a rapid evidence review examining the potential development and implementation of technical solutions to support symptom tracking, contact tracing and immunity certification. This contribution highlights key findings from this review, which takes into account societal, political, legal and ethical perspectives to provide recommendations for the transition and rebuild phases that follow containment, delay and mitigation.

Digital Contact Tracing

Contact tracing is a standard method in public health surveillance during pandemics. It enables public health authorities to understand who is at risk of catching the disease, put in place

proportionate health measures to help people who may have been infected, and reduce the chance of it spreading further.

Typically, contact tracing is performed manually. Manual contact tracing involves speaking with patients, identifying people with whom they have been in close contact while infectious, and then locating those people and placing them in isolation or quarantine.

Digital contact tracing uses devices carried by people, such as smartphones. It measures these devices' proximity to each other, and uses it as a proxy for contact between two or more people. A risk-scoring algorithm then determines whether a user or public health authorities should be alerted about potential contact, and what action should then be taken.

Different approaches to digital contact tracing are being proposed and implemented around the world. At the time of writing, 28 countries had launched official contact tracing apps, with a further 11 countries – including the UK – known to be developing them.

Based on the current evidence reviewed, there are significant technical limitations, and deep social risks, to implementing digital contact tracing.

At the time of writing, there is still a lack of evidence on the effectiveness of digital contact tracing apps as part of a wider pandemic response strategy, meaning that governments will need to measure and report on effectiveness, while retaining the ability to change direction.

Digital contact tracing uses measurable vectors such as distance and time to ascertain when a contact incident occurs. However, these measurements will necessarily be imprecise, and could lead to high numbers of false positives and false negatives.

Digital contact tracing relies on high

levels of accuracy in data about infection rates, which is problematic given currently low levels of testing in the UK. It also requires widespread uptake of the application by the population – with studies suggesting at least 60% of the population would need to use it.

Digital contact tracing apps will only become an effective tool for transitioning out of the crisis if they enjoy public buy-in. Efforts to increase the ubiquity of digital contact tracing apps, including through mandating their use, could have the opposite effect, undermining public trust and confidence in government, and even provoking civil disobedience.

Government policymaking will also need to consider social considerations of widespread deployment of digital contact tracing, including the potential exclusion of vulnerable groups and exacerbation of health inequalities.

Symptom Tracking

Symptom tracking services take the form of apps and websites that encourage citizens to share some information about themselves (such as their age, gender and medical history), and report their symptoms, usually on a regular basis. This may be useful in helping public health authorities and medical researchers expand understanding of the disease, track its spread and plan healthcare responses.

However, symptom tracking apps suffer from limitations, including the low quality of data obtained through self-reporting of symptoms, imbalances in the representativeness of the data collected, and false reporting risks.

These limitations translate into risks that could exacerbate health inequalities and raise social risks. For example, if made available to a recruitment or insurance service, symptom data might reveal information about an individual that they have the right not to share with those organisations. Symptom tracking

databases may also centralise large amounts of personal data, turning them into ‘honeypots’ prone to adversarial attacks and breaches.

Immunity Certification

There is broad agreement that widespread testing is the only route through which the UK can exit the coronavirus crisis, and the UK has highlighted immunity testing as a key strategy.

If evidence emerges that long- or short-term immunity to COVID-19 can be established through contracting the virus or through a vaccine, and credible immunity tests are established, then a means for certifying immunity may need to be developed.

Immunity certificates need not form part of an immunity testing strategy, but Health Secretary Matt Hancock has suggested there is government interest in developing immunity certificates, while other countries are investigating the potential for immunity passports.

The establishment of a regime for immunity certification will have deep societal implications. It may lead to arbitrary and unfair restrictions on individuals’ access to transport, services, employment, movement and other rights and freedoms, on the basis of their immunity status. Discrimination and stigmatisation may become commonplace if immunity becomes an integral element of an individual’s identity as we transition from the crisis.

Policy Implications

Effective policy interventions using technology are designed with the input and involvement of people across society, and are monitored and evaluated to assess their social impact on individuals and communities.

Government must broaden the range of actors involved in decision making around the COVID-19 crisis beyond scientific advisory bodies.

An independent Group of Advisors on Technology in Emergencies (GATE) should be established to stand alongside the Scientific Advisory Group for Emergencies (SAGE), with a remit to examine the evidence base for technical interventions during the crisis, make recommendations for their deployment and oversee their impact.

The Group of Advisors should be diverse and representative, and include experts in data and technology, the social sciences and humanities, and representatives of vulnerable groups, civil society and local authorities. Its deliberations and findings should be made public.

Ensuring effective regulation of data processing

There is a real risk that the expansion of state intrusion into individuals’ lives that occurs during emergencies endures

beyond the originating crisis. Technical and legal infrastructure built during this pandemic may be difficult to dismantle once it is over, unless proper safeguards are in place. Legal and technical sunset clauses must be built into the design of new powers and technologies.

To achieve this, Government should advance – and Parliament should adopt – primary legislation regulating the processing of data by both public and private sector actors in the use of technology to transition from the crisis. Government must encourage privacy-by-design in technical implementations, and must choose privacy-preserving protocols to underscore technical measures.

Gaining and maintaining public trust

Effective deployment of technology to support the transition from the crisis will be dependent on widespread public trust and confidence in those interventions.

Government must be transparent about the technical measures under consideration in advance of their deployment. Technical interventions should not be deployed until the Group of Advisors on Technology in Emergencies has examined the evidence base for their use, assessed their likely impact, and recommended their deployment. Open debate and scrutiny must be encouraged, to increase trust and raise public awareness of the complexity of the issues.

Enabling real-time scrutiny, evaluation and independent oversight

As we move into the transition phase, the government should be thinking about how decision making at pace can be underscored with real-time scrutiny, evaluation and independent oversight.

An independent oversight mechanism should be

established to lead scrutiny of the Government’s policy formulation and decision making in real-time during the crisis.

There is a real-time scrutiny initiative underway in Scotland, where the Scottish Police have appointed John Scott QC to lead

scrutiny of how the police are using their powers. This type of model could be applied in other domains, and may be particularly critical to bring accountability and oversight to the use of data and technology to support transition measures.

Overview of the uses of technology to transition from the COVID-19 crisis

Contain phase	Delay phase	Mitigation phase	Transition phase	Rebuild phase
			Technical solutions under consideration Understand the disease Prevent new infections Restore system capacity	
			<ul style="list-style-type: none"> • Testing • Clinical research • Surveys and symptoms tracking 	Symptom tracking apps
			<ul style="list-style-type: none"> • Testing • Social distancing • Contact tracing • Isolation of suspected or confirmed cases 	Digital contact tracing apps
			<ul style="list-style-type: none"> • Testing • Establishing prevalence of immunity 	Immunity certification
		Research phase		
2019	2020 January	March	May	Widespread vaccine deployment

Exit through the App Store? Read the full rapid evidence review: adalovaceinstitute.org/covid-19-exitthrough-the-app-store

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Defining the role of immunity certification during transition and beyond

Until a robust and credible means of immunity testing is developed, Government should focus on developing a comprehensive strategy to establish how immunity testing will be conducted, how immunity will be certified, and how immunity certification will be integrated into policy and processes including those pertaining to travel,

movement, work and schooling. The strategy should be made public and open to public scrutiny. It must be clear to the public what values are being prioritised and traded-off in a transition strategy that centres on immunity certification.

Should an immunity certification regime be determined necessary,

a secure digital system based on open standards may be an effective way of maximising benefits while minimising fraud and abuse. However, it would need to be bolstered by non-digital methods in order to account for digital exclusion and prevent further harm to vulnerable groups.

Coronavirus: How UCL, UCLH & Mercedes F1 Fast-Track a Lifesaving Breathing Aid

The Need

The UCL-Ventura project resulted from the needs raised by the Government and the NHS in the context of the Covid-19 pandemic.

In response to the spread of coronavirus in the UK, the Prime Minister announced a call for more ventilators to increase the respiratory support capacity of hospitals around the UK. This included asking leading manufacturing businesses to join a 'national effort' through sharing skills and expertise as well as manufacturing components (www.gov.uk/government/news/pm-call-with-uks-leading-manufacturers-16-march-2020). Although production was ramped-up by medical companies, manufacturing of such complex machines by other industries was a challenge.

Alongside this, a consortium spanning UCLH clinicians, UCL engineers and Mercedes AMG High Performance Powertrains focused their combined expertise on large-scale manufacture of non-invasive respiratory support technology: continuous positive airway pressure (CPAP) devices.

CPAP had been used extensively in hospitals in Italy and China to help Covid-19 patients with serious respiratory problems breathe more easily. Their data clearly indicated that their intensive care unit (ICU) capacity was quickly overwhelmed when mechanically ventilating patients needed more than facemask oxygen. They moved to using CPAP and this prevented ~50-60% of patients from progressing to invasive, mechanical ventilation (IMV).

This enables vital and scarce IMV resources to be prioritized to those who need it the most, and limits the number of patients who need sedation and associated risk factors. Unlike mechanical ventilators, CPAP does not require patient sedation and intubation. This reduces both the need

for specialised ventilation healthcare workers and the possible recovery time at home.

With backing from the National Emergency Committee for Critical Care, the NHS Guidance for treatment of COVID-19 patients was amended to include CPAP on 26 March 2020.

As with all coronavirus related innovations, time was crucial. The team reverse engineered an off-patent device, evolved its design to minimise oxygen utilisation, tested it, got regulatory approval and moved to full-scale production in less than 2 weeks.

The Academic-Clinical-Industrial Partnership

This project was only possible by the rapid alignment of established academic, industrial and clinical collaborations.

Around mid-March, after discussions with colleagues in Italy and China, UCLH doctors realised that the UK needed more CPAP devices in hospitals.

UCL engineers and UCLH intensivists have a long-standing collaboration through the UCL Institute of Healthcare Engineering. They met to discuss the problem and decided to reverse-engineer an off-patent high-flow CPAP device. The team also iterated the design of the device and accompanying breathing circuits, reducing oxygen utilisation by up to 70% and improving patient comfort.

The Mercedes-AMG HPP team has a longstanding relationship with UCL's Mechanical Engineering department and was brought on board on the 18th of March. They met at MechSpace, a recently opened facility in central London for mechanical engineering students and started to work on the design. Just 100 hours after the first meeting, the first prototype was made!

The Device: From Design to Manufacturing

Engineers at UCL and Mercedes F1 came together to reverse engineer an existing off-patent CPAP system.

This system works by pushing an air-oxygen mix into the mouth and nose at a continuous pressure through a face mask, keeping airways open and providing the patient oxygen-enriched air.

Over two days, the UCL MechSpace became the pit lane of the project with engineers from the Mercedes team using expertise acquired from the F1 industry to fast track design and prototype manufacture.

The initial design was based on meticulous measurements of every dimension of the old device from the UCLH anaesthetic Museum, and their translation into a 3D computer model. Improved designs based on CT scans and computer flow simulations would then underpin the production process.

The UCL-Ventura underwent healthy volunteer evaluations and received approval from the MHRA on 27th of March; modifications of the design to minimise oxygen utilisation were approved by the regulator on 2nd April, and the devices progressed to patient assessments at UCLH and across sister hospitals in London.

Manufacturing the UCL-Ventura CPAP devices relies on 40 machines that would normally produce F1 pistons and turbochargers. The CPAP devices were produced at a rate of up to 1,000 a day at the HPP technology centre in Brixworth (Northamptonshire) where the entire facility was repurposed to meet the demand.

Regulatory Approval

The first prototype of CPAP was achieved within just 100 hours and received UK regulatory approval in 10 days.

Despite the fact that medical device regulatory approvals take years under normal conditions, the UK's Medicines and Healthcare Products Regulatory Agency (MHRA) approved the UCL-Ventura CPAP device within only 36 hours. This was only possible due to the collaborative approach of the MHRA, who provided support to the UCL-Ventura team throughout the process.

The team purposely focused on reverse-engineering an off-patent device, that has been used in the NHS for decades, so that demonstrating like-for-like in terms of performance would facilitate MHRA approval. This also enabled quick follow up with incremental changes in the design to reduce oxygen utilisation, and redesign of the patient breathing circuit to improve patient comfort. The UCL-Ventura was approved under special conditions. The device is a non-CE marked device, given approval for use in the NHS for the interest of public health protection under the Covid-19 pandemic emergency.

Impact on the NHS

The Department of Health and Social Care ordered 10,000 UCL-Ventura devices.

By 15th of April, 10,000 UCL-Ventura CPAP devices had been manufactured ready for use in the NHS. The devices were allocated and distributed by the Oxygen and Ventilator programme, jointly run by NHS England, NHS Improvement and the Department of Health and Social Care.

To-date, UCL-Ventura CPAP devices have been distributed to over 60 hospitals, working with logistics company G-TEM and their army of volunteers, who have expertly coordinated next-day delivery of devices and resupply of breathing circuits to hospitals across England, the devolved nations, crown dependencies and overseas territories. Hospitals across London, Belfast, Glasgow, Prescot, Blackburn, Manchester, Norwich, Northampton, Birmingham, Bedford, north Devon, Jersey, and Montserrat are now using the devices.

International Impact

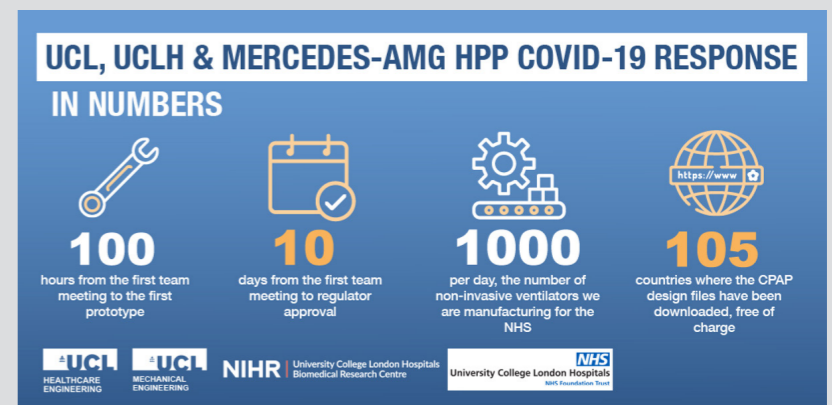
The technical specifications for the UCL-Ventura CPAP device were made freely available for humanitarian purposes to support the international community addressing the demand of the Covid-19 pandemic.

The UCL-Ventura team made the designs and manufacturing instructions of the CPAP devices available on the 6th of April to support public health efforts worldwide, through a licensing platform developed by UCL Business. The designs and manufacturing instructions were made available, at no cost, to governments, industry manufacturers, academics and health experts across the globe.

Within a month the designs were shared with more than 1800 teams across over 100 countries spanning Europe, Asia, Africa, Americas and Australasia. Numerous countries are now developing their own prototypes, including Kenya, Bulgaria, Canada, Russia and Mexico.

Lessons Learned

1. It was only possible to deliver vital healthcare technology to the NHS frontline because of the pre-existing relationships across the university, hospitals and industry.
2. The pace at which this problem evolved was unprecedented, and only enabled by the rapid mobilisation of an interdisciplinary team to focus on a clearly defined, immediate need.
3. The UCL Institute of Healthcare Engineering interfaces engineers with clinicians, which enabled a common understanding of the unmet clinical need, and opportunity for continuous iteration and testing of the technology in hospitals.
4. The strong links between UCL Mechanical Engineering and Mercedes-AMG HPP provided unprecedented manufacturing capability, whilst maintaining high precision and an ability to respond at pace.
5. The team worked collaboratively with the regulatory body, staying in daily communication to facilitate the approvals process.
6. The UCL-Ventura CPAP has successfully been used in over 60 hospitals to treat COVID-19 patients and decrease the requirement for mechanical ventilation.
7. In the UK, initial findings show that approximately 50% of patients treated with CPAP do not progress to mechanical ventilation, which is consistent with data from Italy.



Remote Industry: Working from home, the new norm

In times of crisis, being able to maintain business continuity is a challenge for any organisation, whether big or small. Even large technology companies, which usually have the infrastructure in place to support remote working, have been struggling to ensure business as usual. The more traditional companies in the manufacturing and industrial engineering domain have been hit the hardest in light of the COVID-19 situation.

A recent survey by Leesman of over 700,000 employees worldwide revealed that of the 52,240 employees working in the manufacturing and engineering space, 53% have no home working experience. Remote working in such sectors has never been the cultural norm but importantly, there's been a technological void that made it almost impossible.

Smartia, a UK based Industrial AI technology company, is shaping the future of industrial operations by bridging some of those gaps. We have worked with a number of companies of various sizes, yielding business outcomes across use-cases such as predictive maintenance, anomaly detection, inventory optimisation, process monitoring and energy usage optimisation. Our industrial intelligence platform, MAIO, provides the machine connectivity and analytics infrastructure that makes all that possible.

A lot of those use-cases require data collection from machines before it is possible to unleash the intelligent applications. However, once connectivity to physical machine interfaces has been established, the data is accumulated in the cloud or on a remote server, and therefore remotely accessible. As a consequence, we can build digital twins of both

the machine(s) and the associated processes, laying the foundation for remote process monitoring and many other digital applications.

Therein lies the game changer

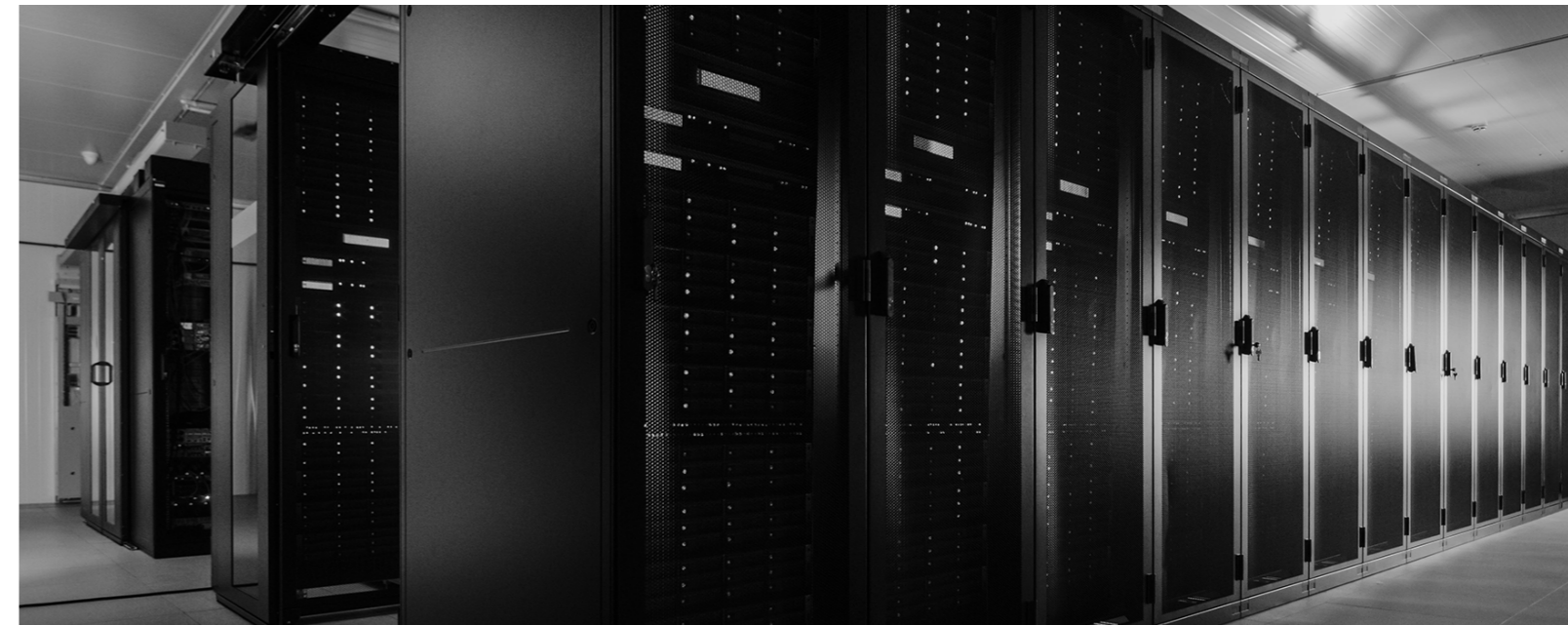
If we can remotely collect data and monitor processes, we can also use the same infrastructure to remotely control industrial assets (e.g. robots) and manufacturing lines. Complete automation might not be the need of the hour but employees being able to continue their day to day operations from their homes is. Closing the loop was always part of our core vision for Industry 4.0. The manufacturing and engineering sector had only just started adopting Industry 4.0 technologies. However, the recent developments and operational challenges highlight the need to accelerate the development of such closing-the-loop technologies, which would make remote working a reality for these sectors.

The next frontier is really the use of novel technologies such as Artificial Intelligence to make the existing facilities and infrastructure smarter. To set it into context, remote monitoring and intelligent alerting applications provide an avenue for operators to react to anticipated issues in good time. The same technology can also be used to provide remote control of industrial assets. Based on insights from intelligent applications, operators could remotely adjust system parameters either to

sustain a manufacturing operation or perform a maintenance task. Remote working becomes a reality even for manufacturing and engineering employees as MAIO provides the technology that makes it possible.

Eventually, as technologies evolve, we might move towards automated control in factories and other facilities to a reasonable extent. However, the domain knowledge that humans have accumulated over the years remains irreplaceable. In fact, such smart technologies are most beneficial when they either assist humans in decision making or help them bridge physical boundaries as in the remote working use-case. Undoubtedly, traditional sectors in the UK such as manufacturing and engineering will see a paradigm shift in their work culture and practices as we start to recover from the COVID-19 situation. Technology would build new bridges and show us a way forward. Moreover, companies across other verticals such as healthcare, retail, and finance, also stand to reap benefits from use of such technologies.

As the world watches, it's an opportunity for the UK to lead by example and strive for the adoption of technologies that change how we work in a world after COVID-19.



Partnering with customers to drive innovation

Airedale, who are a leading UK based manufacturer of precision air conditioning systems, are developing such disruptive services through remote management and autonomous optimisation of their products. Industrial cooling equipment has multiple use-cases and can be found across facilities such as data centres, hospitals, commercial buildings and even remote sites supporting critical national telecom infrastructure. Surprisingly, a typical maintenance routine would involve engineer(s) visiting the site in person before they can access any information from the equipment. This becomes a bottleneck when trying to service remote sites as well as more accessible sites, particularly, in

the current climate. Our platform MAIO is being used to help overcome such challenges and in fact, provides a platform where maintenance engineers can remotely monitor assets and plan maintenance operations based on available information. In today's world where internet connectivity is easily accessible and information flows freely, there's no reason why the industrial sectors shouldn't benefit from the same. At Airedale, we are looking at remote management of critical sites such as data centres as well as national telecom infrastructure. Collecting data is nothing new; analysing that data and gaining insights that we can act upon is the key.

Regarding the data centre use-case, building on top of remote monitoring, we are using the available data to develop AI applications around energy usage optimisation. Currently, optimising energy usage involves physically making changes to the live infrastructure. However, our application will provide a medium to simulate the effect of any parameter changes before deployment, allowing operators to model energy usage improvements and select optimised operating conditions. Again, given the connectivity infrastructure provided by MAIO, such changes can be initiated by operators in a remote manner.



About the APPG

As technologies like artificial intelligence, the internet of things, robotics and process automation, additive manufacturing, augmented and virtual reality, social media, and other emerging innovations continue to converge, our economy and society will become highly networked and increasingly dependent on data.

The All-Party Parliamentary Group on the Fourth Industrial Revolution was launched to encourage proactive engagement with the policy implications of new and emerging technologies, and to raise awareness of the corresponding challenges and opportunities for Britain's economy and society.

Founded in 2017 by Alan Mak MP, it is now one of the fastest growing and most active All-Party Groups in Parliament. The group exists to bring together Government, parliamentarians, academia, the private sector, and other stakeholders to consider how technological advancement is changing our economy and society, and how political and business leaders can and should respond.

The group also seeks to build a large non-parliamentary community of business leaders, academics, and other individuals interested in technology policy, to connect politicians and advisors in Westminster with industry and academic expertise around the country.

The APPG will continue to reinforce the message that Britain has a once-in-a-generation opportunity to harness emerging technologies to boost economic growth and raise living standards, and that this should be a priority for policymakers.

Officers

Alan Mak MP (Founder & Chairman)

Peter Kyle MP (Vice Chairman)

Wes Streeting MP (Vice Chairman)

Kevin Hollinrake MP

Stephen Kinnock MP

James Cartlidge MP

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Anthony Browne MP

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We can only exist thanks to the sponsorship partners that support our work.

All Party Parliamentary Group on the Fourth Industrial Revolution
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