The Sandy Gunn Aerospace Careers Programme Newsletter #1

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Winter 2020

CONTENTS

1
INTRODUCTION

As stated in the Preface to the first Sandy Gunn Aerospace Careers Programme Annual Review the purpose of these Newsletters, which are published three times per year, is to keep our readers up-to-date on how pertinent matters are developing between each Annual Review. As we are all well aware, 2020 has been a particularly demanding year for the Nation, and especially so for the aviation industry in all its aspects and, therefore, the commercial as opposed to military and space, elements of the aerospace industry.

Nevertheless, as we write this Introduction and the Summary that follows so as to finalise the document for our design team prior to publication, a significant moment has been reached with the announcement that the 95% effective Pfizer/ BioNTech Covid-19 vaccine inoculations will commence in the UK next week following months of rigorous clinical trials. This will provide a significant boost to the UK's returning economic performance through 2021 and potentially place the UK ahead of its major western economic competitors in terms of recovery because they have yet to approve such inoculations.

But to return to 2020. To provide continuity, this first issue of our Newsletter rehearses some of the concluding remarks of the last Annual Review and then, with appropriate additional references, proceeds in chronological order to provide a flavour of what has been happening within the ACP's areas of interest from then until early December. It should be read using the Foundation Year (2019/20) Annual Review as background. Two more triannual Newsletters will be produced (March and June 2021) before the second Annual Review is published in September 2021.

Finally, when reading this Newsletter please note there are many new entries in the Useful Connections (especially Annex F) and Further Reading sections.

From Sir Michael, Sir Peter, the ACP Trustees and Management Team and, of course, Tony Hoskins and myself, we wish all our readers, supporters, advisers and suppliers, a fabulous Christmas & New Year Holiday and a most successful 2021.

Michael Smith
6 December 2020

2
SUMMARY

Despite Covid-19, Project AA810 overall has had a most productive Summer and Autumn. Starting with the aircraft herself, restoration progress has been highly satisfactory and original systems parts continue to be sourced. The complete structural back-end of AA810 is now finished and much internal equipment installed. Furthermore, 15 of the 19 fuselage frames have either been constructed or held in stock for us, including the most complex, and the majority of the associated equipment gathered. Additionally, a primary engine is being stripped for inspection and new engine mountings have been manufactured.

Work on all systems is well advanced, including those concerning control, hydraulics, pneumatic, electrical, fuel, and photographic including cameras, and instrumentation is now complete. Finally, a propeller and hub have been sourced, and the search continues for a spare Merlin engine. For all of this we are particularly grateful to Airframe Assemblies, Sigma Components, Rolls-Royce, GE (Aviation), Meggitt, private financial sponsors, and numerous individuals and supporting organisations such as museums.

Turning to the ACP, progress has been equally satisfying. For example, the Programme has been accepted as a registered charity and an initial Board of six Trustees established who, between them, bring a wealth of aerospace, engineering, finance and senior business management expertise to the ACP. They are supported by REN Legal, and Wheeler & Co, Accountants. In addition, although the roll-out of the ACP Presentations has had to be delayed until 2021 because of Covid-19, all aspects are ready including supporting audio-visual aids and exhibits such as a Merlin XX engine, a full-scale GRP Spitfire fuselage and a complete 1940 fighter pilot's flying kit.

Furthermore, discussions are well advanced with eight 'host' schools who will be the venues for our 2021 presentations with the first one taking place on 10 March at Warwick School. And we are especially grateful to Colfe's School for making their facilities available for our 2021 rehearsal. All together we anticipate circa 70 schools attending presentations throughout the year, a mix of independent and state. Additionally, we may be able to bring forward from 2022 a presentation in Scotland courtesy of Aerospace Kinross, and talks should soon commence concerning the involvement of schools and companies in Northern Ireland. A programme of presentations will be announced as early as possible in the new year.

Also early next year, probably in February, we will announce the first annual ACP Engineering Workshops. These will take pace at Shuttleworth College in October and be supported by Shuttleworth and RAF Museum personnel. In addition, planning is now underway for the launch of the AA810 Network next Autumn. Moreover, during 2020 both the Exercise Challenge and Tiger Moth Draw were most successful, and the ACP is particularly grateful to all those that took part, especially Cambridge Flying Group that provided the Tiger Moth flights for the two winners of the Draw. Medals for completing the Exercise Challenge are now being distributed.

Regarding finance, our fund raising campaign continues apace, and we take this opportunity to remind readers that as the ACP is now a registered charity (#1190721) all donations, however large or small, will be most gratefully received. Further details in respect of funding will be released next year including the outcome of our submission to the Royal Academy of Engineering Ingenious Awards scheme.

Substantial updates on the Fourth Industrial Revolution (4IR), the UK Economy, the Aerospace & Aviation Industries and associated Careers information are included in this issue. Particularly of note are, respectively: the major advances now being made in 4IR which are being accelerated, not held back, by Covid-19 and the impact these may have on all aspects of our lives; the fact that following the announcement of the roll-out of the Pfizer/BioNTech vaccine economists are urgently readjusting upwards their projections for the UK's recovery; the emphasis now being given to the UK space sector and the impact the extra funding for UK defence will have, especially in relation to 4IR; and Annex F to this Newsletter containing a very substantial list of Royal Aeronautical Society accredited company training schemes, apprenticeships and academic programmes.

To conclude, 2020 has had both a devastating, but also potentially less longer-lasting, deleterious impact on the UK and the industries we are concerned with, albeit that both are going to look very different in a few years' time; and a potentially highly positive effect in the not so distant future on those industries via 4IR. Whilst the aerospace and aviation industries may look bleak and confused at the moment, we direct the reader to the words of the 2020 joint PwC/ADS report on 'Harnessing Innovation in Aerospace & Defence':

> *"What are we to make of an industry sector that has unambiguous confidence in its status as a global innovation leader but, at the same time, acknowledges major barriers preventing it from fully flexing its innovation muscles? Are those two positions – expressed in our survey – at odds with each other, or simply an expression of an industry in flux, coping with wide-ranging volatility? The answer, as we make clear in this report, lies much closer to the latter position. The story our survey tells is of a vibrant industry facing a series of live economic, political, and social events, complicated by existing sector-specific barriers and challenges."*

Finally, we highlight Gitanjali Rao, an outstanding example of the generation of people the ACP is reaching out to. A teenager whose inventions include an app capable of detecting and discouraging cyberbullying. She has been named TIME magazine's 'Kid of the Year' and is a superb role model for the young people of the ACP.

See https://www.telegraph.co.uk/news/2020/12/04/teenage-inventor-named-time-magazines-kid-year/

3

SPITFIRE PR.IV AA810

Simon Burr, Director of Engineering & Technology, Rolls-Royce, discussing a display Merlin 35, the mark of engine used to power Spitfire PR.IV AA810, with Air Marshal Sir Richard Garwood DFC KBE who wrote the Foreword to 'Sandy's Spitfire' and was an armed reconnaissance pilot in Gulf War I.

RECAP

The 2019/2020 Annual Review concluded in August with the following (abbreviated) summary:

Tail

The fin unit assembly was commenced in March 2019 and completed in early June 2020 despite the Covid restrictions. In addition, the tailplanes are largely completed and will be finished by the end of September 2020.

Fuselage

Despite only starting construction at the end of April 2020 the most complex frames in the fuselage – numbers 5, 8 and 11 - are nearing completion. A considerable number of original fittings from AA810 have been incorporated, and every frame under work with Airframe Assemblies contains original parts. Furthermore, Airframe Assemblies hold frames 12 to 19 in stock for us, and longerons, datums and the dorsal spine are on order. Thereafter, once frames 6, 7, 9 and 10 have been manufactured, the skeletal frame structure can be finalised.

Wings

A very substantial amount of material from the wings of AA810 was recovered from the wreckage. The wings are complex items which do take time, but we could utilise existing stock items held at Airframe Assemblies to speed up the process. To complete the main spars and D box structure will take five months. That said, once built, they are simpler to fit-out than the fuselage.

Propulsion

The engine bearer for the Merlin 35 is most complicated, but courtesy of Sigma Components new machine fittings are currently in manufacture and expected to be ready during Q4 2020. In addition, a primary flight engine has been identified which will shortly be stripped for assessment, and the initial survey of a back-up engine will occur late in September to establish its suitability. Finally, we have obtained an original propeller unit, and are in early discussions for a second, the possible overhaul of which is also under discussion with another major aerospace company.

Instrumentation

The instrumentation for AA810 is now complete, including locating five items that were specific to the Spitfire PR.IV. Currently, the drawings for the PR.IV panel are being converted to CAD, and a trial production of the main instrument panel blank will be carried out with the instruments fitted to ensure correct clearances. Once this is confirmed the final airworthy panel will be cut, anodised and screen printed with the correct labels; the instruments will then be overhauled by GE (Aviation).

Hydraulic system

The only hydraulics on the Spitfire relate to the operation of the main undercarriage and the system is relatively straight-forward, although the component parts are not easy to find. The system for AA810 is getting there, with the project having secured a large number of specific parts. The hydraulic tank will need to be made new as the original from AA810 is too badly damaged. The project has recently located the hydraulic undercarriage selector, a very rare item, and this unit is being assessed. Likewise a pair of the correct early undercarriage legs have been secured. Finally, a pair of retract actuators have been located which will need to be rebuilt. It is hoped to acquire these in autumn 2020 and then, subject to the last fittings and new pipe work, the hydraulic system will be complete.

Pneumatic system

The Spitfire pneumatic system relates to the flaps and brakes driven by an engine compressor. The project has acquired a compressor, and has secured the assistance of Meggitt plc who have offered to overhaul/manufacture the required parts to complete the elements of the system made originally by Dunlop Aerospace. Work on the pneumatic system will begin in earnest late in 2020.

Electrical system

The gathering of equipment for the electrical systems is largely complete with the exception of the voltage regulator which was specific to this early mark of Spitfire. Only one is known to exist outside of national collections and it is quite likely that a voltage regulator will need to be newly made or adapted from a later instrument.

Control system

Work has only just commenced on the control system for AA810 and currently the only items held by the project are an original set of tail control levers, and a set of new-manufacture rudder pedals sponsored by relatives of Sandy Gunn.

Fuel system

Fuel tank fittings have been identified along with various control valves and filter units, and the priming system has been acquired, along with the tank pressurisation controls.

Original camera equipment

AA810 will be unique in that it will carry original camera equipment. We currently have a complete oblique camera set-up with mount, 8” camera, camera motor with cable and fuselage mountings. Of the two vertical 14” cameras we are still short of one lens, another mount, and a final motor and cable. We do, however, have the original wooden vertical camera unit. An original camera controller has been sourced and, once a full set of equipment has been acquired, all items will go to the RAF Medmenham Archive for restoration to working condition.

TO CONTINUE...

This Summer and Autumn could have been far worse for the project and, on reflection, whilst the pandemic has hampered some of our activities, progress on the restoration has been particularly good. Original systems parts have continued to be sourced with the help of various individuals, and progress in the workshops has been especially swift. Major advances have been as follows.

With the fin unit completed early this Summer we were awaiting some of the complex steel inserts for the tailplane spars, and are now pleased to report that these arrived early in September. The tailplane assembly process then began, utilising the kit of frames and skins that we constructed in 2019 together with the machined fittings supplied by Apollo Aerospace in early 2020. Work continued on these through October with the intention of finishing during November; this has resulted in a structurally complete back-end section of the aircraft. Concurrently, we are sourcing the internal equipment to install in the tail, most of which we now have. The next tail areas to source are the rudder, elevator and trim jack units.

Fuselage restoration has progressed extremely well over the Summer with the major assemblies having progressed almost to completion by the time of writing. Frame 5, the main firewall and heart of AA810, was finished in late September following Frame 11 at the rear of the cockpit which was complete in August. Frame 8, which is the other major cockpit frame, has taken slightly longer as there are particular modifications to this frame that are specific to the PR.IV. Airframe Assemblies held some of these required details and, combined with our own archive collection, we were close to having all the information we needed - but not quite. Consequently, Tony reached out to his contacts in Norway and we managed to locate the missing information from a surviving PR.XI Spitfire in Oslo which has now allowed us to recreate these important historical details for the first time since the last PR.IVs left service in late WW2.

At the same time Tony has been gathering important equipment for these frames: priming and tank pressurisation equipment for Frame 8; gear warning horn and electrical fittings for Frame 11; and many tanks, fittings, valves and filters for the Firewall. There isn't much more to go with these systems, but we are still missing the major Type B Voltage Regulator that fits to the rear of Frame 11. These are extremely rare and we may have to make a new one from scratch - a serious undertaking.

Tony located a complete stick assembly on the island of Malta and, with some considerable negotiation, has managed to secure this entire assembly along with some very valuable wing parts which will help supplement those parts recovered from AA810 back in 2018 . The stick assembly, the purchase of which was funded by the proceeds of the keep fit challenge we conducted during the Summer, is now undergoing strip and inspection to assess the cost required to restore it to an airworthy condition; and Tony has located a very early throttle unit that might be available to the project.

To conclude, with seat fittings also in progress, the last major system we need to acquire parts for is the rudder pedal system, and efforts are on-going to locate surviving elements of this.

The primary flight engine remains with the overhaul facility for inspection and assessment, and whilst the paperwork phase is now complete, the contractor is currently gathering the specific tooling to correctly strip the engine.

With the busy schedule we expect to have with AA810 once operational, the project continues to search for a suitable reserve engine for operations starting in 2023. Over the last 18 months numerous Merlin 35 engines have surfaced across the UK, one of which was already overhauled but was prohibitively expensive with the commitments we had at the time. Three others were located in private collections which were rapidly narrowed down to two preferred ones. Of those, sadly, the owner of one has decided he would rather see it on public display rather than go into a rebuild which means, therefore, we currently have just one to assess. This engine is stored in a secure compound in London's Docklands and Tony undertook a borescope inspection of the engine during the first week of November 2020. We have made an offer to purchase the engine but, as yet, have been unsuccessful; consequently, the search for a reserve engine continues.

On the subject of engines, with thanks to Sigma Components, the machine fittings for our engine mount are now finished. These should be delivered in January 2021 straight to Airframe Assemblies on the Isle of Wight for QA checking and booking in. This highly generous input from Sigma reduces the cost of the whole engine bearer assembly by almost 50% and we look forward to starting its construction in early 2021.

In the Summer of 2019 we acquired a de Havilland 3-blade bracket propeller which, whilst having been retrieved from a Battle of Britain crash, had been recovered some considerable time ago and, therefore, was in very reasonable condition. This unit is still undergoing strip and should yield a considerable number of parts, but we will need more.

At around the same time Tony followed up a lead that led to finding a complete hub assembly on static display in a museum in the UK. Unfortunately it had been modified by the museum to take the wrong type of propeller blades. Nevertheless, the elements it contains that are missing from our propeller are complete and unaltered on this unit, so we are confident we can make one complete propeller hub and pitch control assembly from combining both propellers. After 14 months of negotiations we were set to take ownership of the assembly in November but then some last-minute changes to Covid protocols at the museum were adopted resulting in further internal discussions which put a temporary hold on its collection. It is hoped to collect the assembly in December.

For some time now Airframe Assemblies have been very generous in forward-preparing items for us to hold in stock whilst they work similar items for other clients. To this end all the rear frames from 12 to 19 were made earlier this year and, more recently, the materials for the longerons, datums and spine have arrived on the Isle of Wight. Together with the remaining frames 6, 7, 9 and 10, these items remain the last sections we need to place the fuselage into the build jig and so progress through the next stage.

Perhaps our only casualty of the Covid crisis was our intention to begin the construction of the wings for AA810. At the start of the year we had planned to begin these in August of 2020, but with the rapid changes in the world just a few months later work was focussed on the fuselage and its systems - these being particularly time consuming to acquire. Going forward we still intend to start the wings as soon as possible, but this will require some heavy investment. The principal structural elements are the main spars and the leading edge D boxes. These give the wings all their strength, and are standalone pieces that, once completed, can be added to later. Thereafter, we should be able to break down the wings into frames to the point where we have built up both as kits which can then go back into the jig to head to completion.

4

THE SANDY GUNN AEROSPACE CAREERS PROGRAMME

The 2019/2020 Annual Review concluded with the news that the ACP had successfully been registered as a charity (#1190721) and, therefore, could boost monetary donations to the Programme by 25% in accordance with HMRC Gift Aid regulations. Since then, whilst we have had to delay commencing presentations until the Spring of 2021 because of the Covid-19 pandemic, work behind the scenes has continued apace. For example, a timetable is now being developed with - social distancing restrictions permitting - the first presentation booked to take place at Warwick School on 10 March. Warwick will be the host to several surrounding and associated schools, both private and state, and can accommodate an audience of 500. In addition, with our colleagues Aerospace Kinross, we are now pursuing the possibility of presenting to a number of schools in Scotland during 2021, one year earlier than planned; and discussions will commence early next year to extend the ACP's footprint into Northern Ireland.

In addition, our first Board of Trustees has now been appointed and, on 5 October at Brooklands, the birthplace of British aviation and motor racing, they held their first Trustees' meeting. Initial Trustees are: Adrian Jones MA FCA; Christopher Smith BA(Hons); John McGregor OBE; Mark Johnson BSc(Hons) FRAeS; Tony Hoskins; and Dr Michael Smith FRAeS as Chairman. Between them they bring a wealth of aerospace, engineering, finance and senior business management expertise to the ACP. They are supported by Norman Fraser, the Project's legal counsel, and Kevin Wheeler, the Project's financial accountant.

Turning to finance, our submission to the Royal Aeronautical Society for an award from their Centennial Scholarship Fund was, unfortunately, unsuccessful; however, we are delighted to announce that Ros Azouzi, Head of Skills & Careers at the Society, will be joining us at our Presentations and during Network events. Ros and her team will be a most valuable addition to the ACP. Furthermore, in September we submitted an application to the Royal Academy of Engineering Ingenious Public Engagement Awards and await the outcome. That award involves four sixth-form pupils from our education partner, Colfe's School.

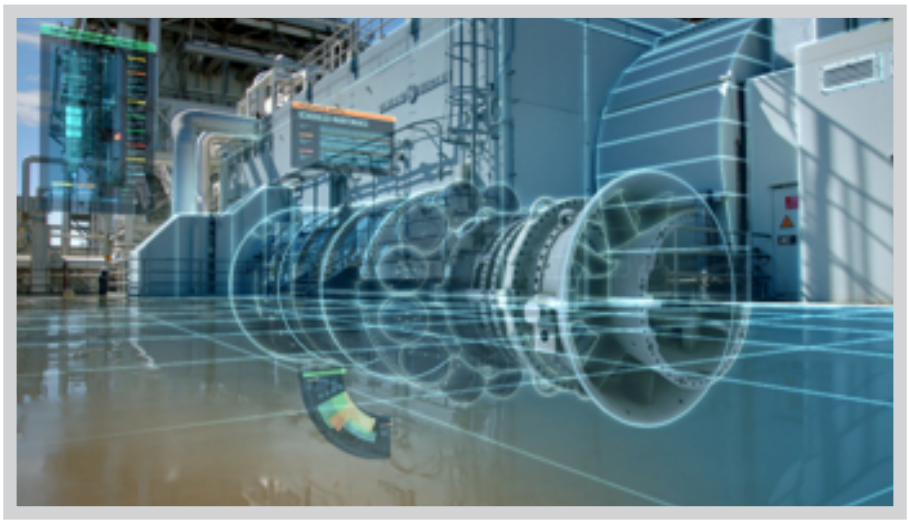
And with Colfe's in mind, we can advise that, successful in gaining the Award or not, each year up to four sixth-form pupils from the School will join the ACP team as active members for 12 months taking full advantage of all events and personnel involved including mentoring, speaking at one ACP Presentation each, and spending time in a hands-on capacity with Spitfire PR.IV AA810 herself. Then, when they reach 18, they will become members of the AA810 Network in their own right.

In late August, with the support of Cambridge Flying Group, the ACP launched a Sandy Gunn Tiger Moth Prize Draw for 14 to 22 year-olds. The two winners, Joshua Anthony and Ella Hewlett, were announced on 3 September, 80 years to the day that Sandy Gunn took his first solo flight in a Tiger Moth. Subsequently, Joshua's flight took place in September and Ella's will take place next Spring. Furthermore, Leading Edge Aviation, an ACP supporter, will very kindly hold two Open Days in 2021 at their HQ at Oxford Airport for those entrants to the Tiger Moth Prize Draw that have indicated a wish to attend.

Finally, as the Newsletter goes to Press we can advise that, following discussions with the Shuttleworth Trust and the RAF Museum, the first ACP Engineering Workshops will take place at Shuttleworth College the week commencing 25 October 2021. All details will be promulgated in February 2021.

5

THE FOURTH INDUSTRIAL REVOLUTION



A General Electric Digital Twin

In the 2019/2020 ACP Annual Review, and quoting from Klaus Schwab, the Executive Chairman of the World Economic Forum (WEF), we described the Fourth Industrial Revolution as the advent of cyber-physical systems involving entirely new capabilities for people and machines. While these capabilities are reliant on the technologies and infrastructure of the Third Industrial Revolution, the Fourth Industrial Revolution represents entirely new ways in which technology becomes embedded within societies and even human bodies. Examples include genome editing, new forms of machine intelligence, breakthrough materials, and approaches to governance that rely on cryptographic methods such as the blockchain.

In this first Newsletter we build on that description, and our introduction of the new technologies involved, by going a little deeper into the potential consequences of the revolution. To do so we quote from an article by the WEF published in 2020:

> *"As the novelist William Gibson famously said: "The future is already here – it's just not very evenly distributed." Indeed, in many parts of the world aspects of the Second and Third Industrial Revolutions have yet to be experienced, complicated by the fact that new technologies are in some cases able to "leapfrog" older ones. As the United Nations pointed out in 2013, more people in the world have access to a mobile phone than basic sanitation. In the same way, the Fourth Industrial Revolution is beginning to emerge at the same time that the third, digital revolution is spreading and maturing across countries and organizations.*
>
> *The complexity of these technologies and their emergent nature makes many aspects of the Fourth Industrial Revolution feel unfamiliar and, to many, threatening. We should therefore remember that all industrial revolutions are ultimately driven by the individual and collective choices of people. And it is not just the choices of the researchers, inventors and designers developing the underlying technologies that matter, but even more importantly those of investors, consumers, regulators and citizens who adopt and employ these technologies in daily life.*
>
> *The Fourth Industrial Revolution may look and feel like an exogenous force with the power of a tsunami, but in reality it is a reflection of our desires and choices. At the heart of discussions around emerging technologies there is a critical and central question: what do we want these technologies to deliver for us?*

WHAT IS THE POTENTIAL IMPACT?

Every period of upheaval has winners and losers. And the technologies and systems involved in this latest revolution mean that individuals and groups could win – or lose – a lot. As Schwab says: "There has never been a time of greater promise, or one of greater potential peril."

While the fact that we are still at the beginning of this revolution means that it is impossible to know the precise impact on different groups, there are three big areas of concern: inequality, security and identity.

Inequality

The richest 1% of the population now owns half of all household wealth, according to Credit Suisse's Global Wealth Report 2015. Oxfam's new report presents an even more dramatic concentration of assets, finding that 62 individuals controlled more assets than the poorer 3.6 billion people combined, half the world's population. This is a stunning gap – particularly given that researchers such as Richard Wilkinson and Kate Pickett have found that unequal societies tend to be more violent, have higher numbers of people in prison, experience greater levels of mental illness, have lower life expectancies and lower levels of trust.

History indicates that consumers tend to gain a lot from industrial revolutions as the cost of goods falls while quality increases, and it seems this is holding true for the latest. Both the Third and Fourth Industrial Revolutions are making possible products and services that increase the efficiency and enjoyability of our lives, while also reducing costs. Organizing transport, booking restaurants, buying groceries and other goods, making payments, listening to music, reading books or watching films – these tasks can now be done instantly, at any time and in almost any place. As Schwab puts it: "The benefits of technology for all of us who consume are incontrovertible."

But what if these benefits fail to contribute materially to broad-based economic growth? Will everyone truly be able to access, afford and enjoy these innovations?

An important potential driver of increased inequality is our reliance on digital markets. As Erik Brynjolfsson and Andrew McAfee point out in The Second Machine Age, globally connected digital platforms tend to grant outsized rewards to a small number of star products and services, which are in turn able to be delivered at almost zero marginal cost. In addition, the dominance of digital platforms themselves, given their power, influence and profitability, is concerning to many, including the European Commission. Research shows that in 2013, 14 of the top 30 brands were platform-oriented companies.

Perhaps the most discussed driver of inequality is the potential for the Fourth Industrial Revolution to increase unemployment. All industrial revolutions create and destroy jobs, but unfortunately there is evidence that new industries are creating relatively fewer positions than in the past. According to calculations by Carl Benedict Frey from the Oxford Martin Programme on Technology and Employment, only 0.5% of the US workforce is employed today in industries that did not exist at the turn of the 21st century, a far lower percentage than the approximately 8.2% of new jobs created in new industries during the 1980s and the 4.4% of new jobs created during the 1990s.

Furthermore, the type of jobs being created in these industries tend to require higher levels of education and specialized study, while those being destroyed involve physical or routine tasks. The Forum's Future of Jobs Report surveyed leading human resources executives and presents evidence that future jobs will increasingly require complex problem-solving, social and systems skills. An upward bias to skill requirements disproportionally affects older and lower-income cohorts and those working in industries most prone to automation by new technologies.

Most Prone to Automation

Probability	Occupation
0.99	Telemarketers
0.99	Tax preparers
0.98	Insurance Appraisers, Auto Damage
0.98	Umpires, Referees, and Other Sports Officials
0.98	Legal Secretaries
0.97	Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop
0.97	Real Estate Brokers
0.97	Farm Labour Contractors
0.96	Secretaries and Administrative Assistants, Except Legal, Medical & Executive
0.94	Couriers and Messengers

Least Prone to Automation

Probability	Occupation
0.0031	Mental Health and Substance Abuse Social Workers
0.0040	Choreographers
0.0042	Physicians and Surgeons
0.0043	Psychologists
0.0055	Human Resources Managers
0.0065	Computer Systems Analysts
0.0077	Anthropologists and Archeologists
0.0100	Marine Engineers and Naval Architects
0.0130	Sales Managers
0.0150	Chief Executives

Source: Carl Benedikt Frey and Michael Osborne, University of Oxford, 2013

Source: The Future of Jobs Report

Shifts in employment and skills may also increase gender inequality. Unemployment due to automation has in the past concentrated in sectors that mostly employ men, such as manufacturing and construction. But the ability to use artificial intelligence and other technologies to automate tasks in service industries puts many more job categories at risk in the future. These include jobs that are the source of livelihood for many young female workers and lower-middle-class women around the world, including call centre, retail and administrative roles.

The Fourth Industrial Revolution may affect inequality across economies as well as within them. In particular, the increasing flexibility of capital in the form of robots and other advanced manufacturing systems may erode the comparative advantage currently enjoyed by many emerging and developing countries, which are focused on labour-intensive goods and services. The phenomenon of "re-shoring" could have a particularly negative effect on those least developed economies just beginning to industrialize as they integrate into the global economy.

Security

Increasing inequality doesn't just affect productivity, mental health and trust – it also creates security concerns for both citizens and states. The Forum's Global Risks Report 2016 highlights that a hyper-connected world, when combined with rising inequality, could lead to fragmentation, segregation and social unrest. This mix of factors creates the conditions for violent extremism and other security threats enabled by power shifting to non-state actors.

Furthermore, the strategic space for conflict is changing. The combination of the digital world with emerging technologies is creating new "battlespaces", expanding access to lethal technologies and making it harder to govern and negotiate among states to ensure peace.

The rapid spread of digital infrastructure thanks to the Third Industrial Revolution means that during the Fourth Industrial Revolution, cyberspace is now as strategic a theatre of engagement as land, sea and air. As Schwab puts it, "while any future conflict between reasonably advanced actors may or may not play out in the physical world, it will most likely include a cyber-dimension simply because no modern opponent would resist the temptation to disrupt, confuse or destroy their enemy's sensors, communications and decision-making capability."

The technologies of the Fourth Industrial Revolution also offer expanded capabilities for waging war which are increasingly accessible to both state and non-state actors, such as drones, autonomous weapons, nanomaterials, biological and biochemical weapons, wearable devices and distributed energy sources. On the frontier of emerging military technologies are those that interact directly with the human brain to augment or even control soldiers. Even these are not limited to government military programmes. "It's not a question of if non-state actors will use some form of neuroscientific techniques or technologies, but when, and which ones they'll use," argues James Giordano, from Georgetown University Medical Center. "The brain is the next battlespace."

Such security fears are further augmented by the fact that a proliferation of dual-use technologies available to a wider range of actors makes it much harder to put into place international agreements and norms to support the peaceful resolution of conflicts. The security challenge of the Fourth Industrial Revolution will be one of coordinating large numbers of potentially lethal private and public sector actors in multiple strategic and cultural contexts. A difficult task indeed.

Identity, voice and community

In addition to concerns around rising inequality and threatened security, the Fourth Industrial Revolution will also affect us as individuals and members of communities. Already, digital media is increasingly becoming the primary driver of our individual and collective framing of society and community, connecting people to individuals and groups in new ways, fostering friendships and creating new interest groups. Furthermore, such connections transcend many traditional boundaries of interaction. Unfortunately, expanded connectivity does not necessarily lead to expanded or more diverse worldviews. Paradoxically, the dynamics of social media use can serve to narrow available news sources. In addition, controversial or anti-establishment views can be further undermined by states and other actors willing to use new technologies and platforms to restrict speech and harass citizens, as detailed in the Forum's Global Risks Report 2016. It is important that the emerging technologies of the Fourth Industrial Revolution increase diversity and the potential for collaboration rather than driving polarisation.

Emerging technologies, particularly in the biological realm, are also raising new questions about what it means to be human. The Fourth Industrial Revolution is the first where the tools of technology can become literally embedded within us and even purposefully change who we are at the level of our genetic makeup. It is completely conceivable that forms of radical human improvement will be available within a generation, innovations that risk creating entirely new forms of inequality and class conflict.

CONCLUSION

Martin Nowak, a professor of mathematics and biology at Harvard University, stated that cooperation is "the only thing that will redeem mankind". If we have the courage to take collective responsibility for the changes underway, and the ability to work together to raise awareness and shape new narratives, we can embark on restructuring our economic, social and political systems to take full advantage of emerging technologies.

The complexity of the technologies driving the Fourth Industrial Revolution, and the breadth of their impact, mean that all stakeholder groups need to work together on innovative governance approaches. As Andrew Maynard from the Risk Innovation Lab points out, we should learn from, implement and extend, thoughtful approaches to dealing with the intersection of technology and society such as anticipatory governance and responsible innovation, supporting widespread reflection on the development, commercialisation and diffusion of current and emerging technologies.

The goal of this reflection is naturally to ensure that emerging technologies and the Fourth Industrial Revolution improve lives in as broad-based and meaningful a way possible. However, even greater possibilities could emerge from bringing stakeholders together in new ways to discuss the future of technology and society.

As Schwab writes: "The new technology age, if shaped in a responsive and responsible way, could catalyse a new cultural renaissance that will enable us to feel part of something much larger than ourselves – a true global civilization… We can use the Fourth Industrial Revolution to lift humanity into a new collective and moral consciousness based on a shared sense of destiny."

AND NOW TO CONTINUE THROUGH 2020...

➤ **2 September:**

Britain's first commercial quantum computer will be built in Abingdon as part of a £10M project aiming to make the UK a leader in this technology. US quantum start-up Rigetti will develop the computer alongside manufacturing firm Oxford Instruments, financial services company Standard Chartered, software start-up Phasecraft, and the University of Edinburgh. The consortium plans to have the computer operational in the second half of 2021. The UK Government has also opened a new National Computing Centre at the Harwell Campus in Oxfordshire.

➤ **8 September:**

Vacancies in the technology sector have risen by more than a third over the past two months as restrictions on hiring begin to ease. By 9 August technology job advertisements had increased by 36% since June. This sector is now second-only to healthcare in terms of advertised vacancies. Outside of London, Glasgow, Edinburgh, Belfast, Cardiff, Newcastle and Leeds have more than one-fifth of their workforce employed in the technology sector.

Furthermore, jobs in this sector have increased by 40% overall in the last two years with 2.93M people employed accounting for 9%, and rising, of the UK's total workforce. Tech Nation has advised that the UK is the "undisputed leader" of this sector in Europe with total venture capital invested in start-ups of £7.5B this year to date, compared with £3.6B in Germany and £2.8B in France. There are already 120 UK tech companies valued between $250M and $1B.

➤ **10 September:**

The Prime Minister's chief adviser, Dominic Cummings, has told civil servants that he is examining ways to help the UK build $1T technology giants. In particular, he believes a no-deal Brexit would allow the Government to provide state aid to British technology business helping them grow though incentives as well as taxpayer funding.

➤ **14 September:**

Nvidia and the Cambridge based computer processor company's Japanese owner, SoftBank, have agreed a cash and shares deal worth more than $40B in one of the largest acquisitions involving a British technology company. Amid fears that the sale could lead to a hollowing-out of Arm's Cambridge base Nvidia's chief executive, Jensen Huang, pledged that not only would Arm's headquarters stay in Britain, but the company would build an AI centre that would become a hub for research and make Britain an AI leader.

➤ **8 October:**

In a report on the security of 5G by the House of Commons Defence Select Committee MPs have warned that there would be *"a greater surface for illicit actions as more devices are connected to the internet with the new wireless technology"*. Continuing, the report stated: *"We share the Government's objective that the UK remains at the forefront of the 5G roll-out as we move into the next technological era. However, 5G will increase our reliance on mobile connectivity and this represents a security risk whether from espionage, sabotage or system failure."*

➤ **15 October:**

Alan Tovey, Industry Editor of The Telegraph, writes about the UK Tempest fighter project suggesting it could bring a boost of £25B to the UK economy, create valuable technology spin-offs, and support 20,000 skilled jobs per year between 2026 and 2050; and these economic benefits do not include export sales. Because the project is a classic example of fourth industrial revolution technologies and their fusion we refer you to the article at Futuristic Tempest fighter jet could bring £25bn economic boost (telegraph.co.uk) - *https://www.telegraph.co.uk/business/2020/10/15/futuristic-tempest-fighter-jet-could-bring-25bn-economic-boost/*

➤ **16 October:**

According to *The Manufacturer* the business world is witnessing a powerful shift. In the past the primary purpose of a commercial organisation's existence was to generate profits for shareholders. Today, companies are being judged against a wider set of environmental, social and governance measures in addition to their financial performance. Deloitte has highlighted the following four major trends and insights: when strategy leads, success follows; recognition of business' social responsibility; commitment to training and development; a retreat from disruption.

➤ **28 October:**

Having already signed a contract with Nokia to provide 5G base stations and antennas across the UK, BT has now signed a contract with Ericson to supply equipment that will manage circa 50% of the company's total 5G traffic and its main mobile brand, EE.

➤ **2 November:**

Massachusetts Institute of Technology has developed a new AI system which they claim can detect coronavirus by analysing the sound of people coughing, even if the individual is asymptomatic. Tests performed on 4,000 recordings indicate a 98.5% reliability. The technology was adapted from the original research using AI to examine coughs and speech to detect Alzheimer's disease which causes weakened vocal cords.

➤ **6 November:**

The UK has launched its largest industry-led project to commercialise the use of quantum computing as part of a £1B push to remain at the forefront of the sector. The £10M *'Discovery'* initiative, which has been partly funded by the Government, will bring nine organisations together led by M Squared, a Glasgow-headquartered supplier of quantum systems, and include Oxford Ionics, Orca Computing, Kelvin Nanotechnologies and TMD Technologies. Graeme Malcolm, the CEO of M Squared, said: *"Breakthroughs in laser technology and semiconductor manufacturing have allowed quantum to become more of a reality than ever before."*

The project will focus on so-called 'photonic quantum computing' which differs from the superconductor technology deployed in most other projects, including those of Google and IBM. Under the superconductor methods tech companies have tried to create artificial atoms that behave in a quantum manner. The *Discovery* project will use natural atoms, ions, or photons in the hope that to do so will improve the scalability of quantum computing.

➤ **9 November:**

After more than 400 unmanned tests Virgin Hyperloop, the high-speed transport company, has carried it first passengers in a world first across the Nevada desert. Instead of running on rails the pods, which will hold 28 passengers each when in production, use magnetic levitation to 'float' through near-vacuum tubes travelling at more than 600 mph. This trial, which used the two-seat XP-2 vehicle, covered 398 metres and reached a top speed of 107.5 mph proving that passengers can travel safely. Virgin Hyperloop aims to be safety certified by 2025 and begin commercial operations by 2030.

Virgin Hyperloop XP-2

➤ **10 November:**

The Telegraph commences hosting a two-day virtual technology conference entitled 'Technology Intelligence Live' where some of the most significant names in British technology discuss the positive role technology is playing in rebuilding a responsible post-pandemic society.

➤ **22 November:**

Long considered a 'pipe dream', nuclear fusion which could produce low-risk, cheap, green energy could now be a reality by 2040 due to the Government's programme for the UK to become carbon net zero by 2050. Scientists at Tokamak Energy Laboratory in Abingdon, Oxfordshire, believe they are just years away from making nuclear fusion – which works by merging at extremely high temperatures the nuclei of atoms to form a heavier element (the internal process of a star) rather than fission which splits them to create a chain reaction that emits a large amount of energy – a key technology of a decarbonised world with the UK as a global pioneer.

➤ **24 November:**

Insect brains, the size of a pin head, are being used as an inspiration to develop the next generation of self-driving cars. Opteran, a spin-out of the University of Sheffield, has received £2.1M in funding to create computer chips modelled on a bee brain. These insects have a brain 0.0002% of a human and yet they can travel for up to five miles and still find their way home. They do this by measuring distance by optic flow, or how objects move across our visual field. Opteran is working to reverse engineer this technique in a bid to replicate it in 'silicon brains' that can be implanted in autonomous vehicles.

➤ **27 November:**

Adrian Weller writes in The Telegraph that *"humans can't escape accountability for decisions made by artificial intelligence"* because, although *"algorithms are in theory a useful tool, their 'black box' decisions shouldn't be accepted without question"*. See article.

➤ **30 November:**

UK Digital Secretary, Oliver Dowden, has announced Government plans for a £250M scheme to develop new secure internet technology in Britain which includes building a new research facility. The scheme will bring together security experts, businesses and leading academics to pioneer ways to create a more open 5G network that will allow smaller British companies to develop this vital technology. In addition, as part of the initiative it was announced that a new Open RAN 5G network will be trialled in Wales from 2021 with the Japanese telecoms company, NEC.

Additionally, a *"50 year-old biological challenge"* concerning protein folding has been solved by AI researchers at Google owned Deep Mind with their AlphaFold program which could *"significantly accelerate"* drug development for cancer and other medical conditions.
See:
https://www.telegraph.co.uk/news/2020/11/30/google-ai-researchers-crack-50-year-old-protein-folding-problem/

➤ **4 December:**

China claims to have built a quantum computer that is able to perform certain computations nearly 100 trillion times faster than the world's most advanced supercomputer which, says Chinese state media, is 10 billion times faster

6
THE UK ECONOMY

On 6 August, when we drew to a close the 2019/2020 Annual Review, Andrew Bailey, the Governor of the Bank of England, advised that the UK economy was bouncing back from Covid-19 as businesses re-opened and shoppers started spending, but that big risks remained over the recovery. The Bank would hold interest rates at 0.1% - the record low reached last March – and make no further expansion of its £745B money printing programme, at least for the moment. Furthermore, he advised that there were no current plans to move towards controversial negative interest rates.

Continuing he said that, following moves such as the £30B stimulus package unveiled by the Chancellor of the Exchequer in July, the Bank now expected the economy to shrink by 9.5% this year, not 14% as forecast in May. The peak in unemployment, at 7.5%, was also expected to be shallower that the 9% suggested in May, but it would take until 2023 to return to the pre-Covid level of 4%. Also, that the UK would remain 5% below pre-Covid GDP by the end of this year and would not recover until the end of next year.

With the above in mind, and now moving on through late August to the beginning of December, we commence this first Newsletter with HMG's August forecasts for the UK in 2020 and 2021. These can be found at Annex A. Thereafter, we continue to follow the chronological structure we commenced in the 2019/2020 Annual Review.

➤ **20 August:**

Tim Wallace, writing in The Telegraph, states that *"almost every industry in Britain is growing faster than its competitors around the world, further raising hopes of a 'V-shaped' recovery according to a Lloyds Bank analysis of IHS Markit's business surveys of 12 of the 14 industries tracked across different countries led by metals, mining and chemicals. However, technology equipment is struggling, as are the embattled tourism and recreation industries."*

Furthermore, a NatWest study of small businesses found that more than one-third of SMEs reported growth in July, up from one-in-ten at the height of the lockdown; and at the same time the number shrinking was down from more than three-quarters to below three-in-ten. This came after the economy grew by more than 8% in June even before such industries as hospitality were allowed to re-open.

➤ **28 August:**

Andrew Bailey, the Governor of the Bank of England when speaking at the Jackson Hole central banking symposium, advises *"we have the firepower to go 'big and fast' with vast stimulus to tackle future downturns in the wake of Covid-19."* Continuing he said that *"Threadneedle Street is reviewing its arsenal of policy tools, including the possibility of using controversial negative interest rates for the first time."* Interest rates have already been reduced to a record low of 0.1% and £300B has entered the economy through quantitative easing since March.

➤ **3 September:**

IHS Markit states that *"UK service providers reported another rise in business activity during August with the rate of expansion accelerating to its fastest for over five years."* Meanwhile combined PMI activity for both services and manufacturing were well ahead of the 50% growth threshold with a composite figure of 59.1%. Nonetheless, steep job cuts continue, job postings remain depressed, and 11% of the workforce remain on furlough. As the Institute of Directors have said, *"We're just starting to see a few green shoots, but firms are still in a great deal of difficulty…..With the furlough scheme drawing to a close, firms are being forced to make difficult decisions."*

➤ **9 September:**

Julian Jessop of The Telegraph writes that *"The seemingly relentless bias towards misery means that even good economic news is often accompanied by warnings of a renewed crisis lurking just around the corner. For a bit of balance, here are nine reasons to be more positive:*

1. *The UK is leading a global recovery.*
2. *GDP is on track to return to pre-Covid levels.*
3. *The retail sector has already completed its V-shaped recovery.*
4. *The re-opening of schools and universities will provide another boost.*
5. *Borrowing is better than expected.*
6. *The labour market is holding up.*
7. *Most people have already come off furlough*
8. *Unemployment is a lagging indicator.*
9. *The economy tends to be pretty good at replacing lost jobs."*

Also, vacancies in the technology sector have begun to rise again: by more than a third over the past two months as restrictions on hiring began to ease.

➤ **11 September:**

The economy grew for the third month running in July as lockdown measures continued to ease, but was still only halfway back to pre-pandemic levels. In particular, GDP added 6.6%. Growth was driven partly by education, which added 21.1% as children started to return to school, as well as the re-opening of restaurants, pubs and hairdressers. Accommodation and food services grew 140.8% across the month, manufacturing added 6.3%, construction gained 17.6% and industrial production 5.2%. Nevertheless, Capital Economics said that a full recovery was unlikely until early 2022.

Also this day Liz Truss, the UK Trade Secretary, announced a trade deal in principle with Japan with the aim of it coming into force in January 2021.

➤ **16 September:**

HMG issues the UK Treasury's September forecasts for the economy in 2020 and 2021 (Annex B).

➤ **22 September:**

Andrew Bailey, Governor of the Bank of England, says that the Chancellor's furlough scheme has been *"extremely successful"* but we are now *"living in a fast-evolving world"* so he suggests the scheme needs a re-think as Ministers prepare to curb the spread of Covid-19 with new restrictions.

➤ **30 September:**

Andy Haldane, the Bank of England's Chief Economist, warns that excessive pessimism over the state of the economy risks undermining the recovery and making a tough situation worse. He said that Britain had recovered far faster than anyone expected but was beset by fear. Such concerns, he said, could be self-fulfilling if households cut back on spending or nervous businesses hold off hiring and investing. Mr Haldane warned against a propensity to dismiss good news and dwell on bad. Continuing he said: *"As best we can tell consumer spending now stands at around pre-Covid levels. In other words, consumption has fully recovered more than a year earlier than the Bank expected as recently as August. Large ticket purchases, such as cars and houses are also back to around pre-Covid levels."*

➤ **8 October:**

The Bank of England's Governor warns that the economy is at risk of stalling as he vows to ramp up stimulus to limit any damage caused by another Covid-19 wave, and advises that the Bank has enough firepower to tackle a second or third wave of the virus if necessary. He urges banks to use their capital buffers to inject more cash into the economy despite a *"natural unease"* following the financial crisis of 2008/9.

➤ **9 October:**

PwC issues its September 2020 UK Economic Update. See UK Economic Update - PwC UK - *https://www.pwc.co.uk/services/economics/insights/uk-economic-update-covid-19.html*

Additionally, in the light of forthcoming stricter lockdown restrictions as a response to an increase in Covid-19 Rishi Sunak, the UK Chancellor, unveils a new furlough-style scheme whereby, from 1 November, the taxpayer will cover two-thirds of staff wages up to a maximum of £2,100 per month at firms that have no alternative but to close for up to six months. Employers will not be required to contribute towards wages but must cover National Insurance and pension contributions; in reality, however, the Government expects only half of firms will need to pay these costs.

Furthermore, on hopes of a US relief package the S&P 500 and Nasdaq Composite move sharply upwards on track for their best performances since July leading to the FTSE 100 rising as well. Amongst the companies to gain the most is Rolls-Royce plc which sees its shares climb for a fifth day in a row more than doubling its Monday opening price. This comes after the company unveils a £5B rescue to shore up its balance sheet. That said, despite the recent gains, Rolls-Royce remains down 66% this year.

Finally, an article by Marianna Hunt in The Telegraph based on a number of new forecasts suggests that Britain's job market will have recovered by January 2021 but that it will not return to the pre-Covid distribution. In particular *"a very substantial movement is expected between jobs as workers look to migrate from fading sectors to flourishing ones."* Improvements have been led by sectors that have been boosted by the pandemic, such as logistics, manufacturing and healthcare.

➤ **10 October:**

The Bank of England asks UK lenders if they are ready for the introduction of negative or zero interest rates, and the steps they would take to prepare for implementation of these.

➤ **11 October:**

Roger Bootle, Chairman of Capital Economics, writes an article in The Telegraph *"looking beyond the immediate future into the decades ahead"* and posits that *"despite the employment crisis the right balance of tech [including AI] and social trends [including changing demographics] provides optimism beyond the Covid gloom."* This article is considered to be of considerable importance and relevance so see AI and shifting demographics offer bright future beyond Covid gloom (telegraph.co.uk) - *https://www.telegraph.co.uk/business/2020/10/11/ai-shifting-demographics-offer-bright-future-beyond-covid-gloom/*

➤ **16 October:**

Boris Johnson, the UK Prime Minister, states that: *"It is time for the UK to get ready for January 1st with arrangements that are more like Australia's"* as he signals the end of Brexit talks. The Prime Minister said that although he had only ever sought a Canada-style deal *"to judge from the latest summit in Brussels that won't work for our EU partners who wanted the continued power over the UK's laws and fisheries."*

Continuing he said: *"I have to make a judgement about the likely outcome and get us all ready. Given that they have refused to negotiate seriously for much of the last few months, and given that this summit appears explicitly to rule out a Canada-style deal, I have concluded that we should get ready for January 1st with arrangements that are more like Australia's based on simple principles of global free trade."* Mr Johnson did not rule out reopening talks if there was *"a change of heart"*, although he stressed: *"Unless there is a fundamental change of approach we are going to go for the Australian solution."*

➤ **21 October:**

Rishi Sunak, UK Chancellor of the Exchequer, launches a one-year spending review which aims to set out financial plans for 2021-22. A three-year review had been expected, but the Chancellor explained the uncertainty around Covid dictated a shorter horizon. The review will not include tax increases. The Government borrowed £208.5B in the first six months of 2020, with the national debt now standing at 103.5% of GDP. Nevertheless, borrowing has been 20% lower than forecast by the Office for Budget Responsibility (OBR). However, with more public spending pledged due to a possible second wave of the pandemic that OBR forecast could still be exceeded.

HMG issues the UK Treasury's October forecasts for the economy in 2020 and 2021 (Annex C).

➤ **22 October:**

Brexit trade negotiations restart today against Michel Barnier, the EU's chief negotiator, stating that *"the EU, as well as the UK, would have to compromise on its red lines and that British sovereignty would be respected."* His call for intensive, daily talks on all subjects, rather than just the three major sticking points, and on the basis of legal texts, satisfied UK pre-conditions for a return to the negotiating table. Both sides have agreed a schedule of daily, intensive talks up to the EU's deadline at the end of this month. UK sources have said *"a deal could be struck in two to three weeks."*

In addition, the Chancellor of the Exchequer announces a revised and more generous Job Support Scheme that reduces employer contributions, doubles support for the self-employed, and pledges cash grants of up to £2,100 per month for businesses in the hospitality, accommodation and leisure sectors which can be backdated to August. For the Scheme, which replaces furlough, employer contributions have been cut by 5% and the minimum hours requirements reduced from a third to 20%. UKHospitality (the British Hospitality Association) described the latest set of measures as *"a hugely generous package of support and very welcome news"*.

➤ **23 October:**

Retail sales grew for the fifth month running, up 1.5% between August and September. This was well above economists' expectations and marked a 4.7% rise year-on-year according to the Office for National Statistics. For the quarter to September, sales climbed 17.4% compared to the three months before, a record quarterly rise. Purchases on-line accounted for 27.5% of sales, up from 20.1% in February.

Nevertheless, whilst business overall still grew in October, growth was at a slower pace with IHS Markit's PMI index survey slipping to 52.9 from September's 56.5. This was caused by the services industry which suffered a more severe deceleration than manufacturing because of restrictions on social contact. Pent-up demand for manufactured goods remains strong, while property sales are also boosting related services. It is hospitality and travel businesses that are struggling. Goldman Sachs estimate the survey is consistent with GDP remaining 7.5% below its pre-pandemic peak, thereby continuing its rebound from the low of more than 25%.

➤ **25 October:**

Heathrow Airport's bid two weeks ago to increase airport charges by £1.7B has been rejected by the CAA. Heathrow Airport Holdings is one of the most indebted companies in the UK; it owes an array of banks and bondholders more than £17B, 90% of whom are from overseas. Passenger numbers in September were down 82%, and it is estimated that 43M travellers need to flow through Heathrow's doors each year just to cover its debt interest bill of circa £500M. So far this year there have only been 19M. If the airport cannot gain a reversal in the CAA decision (which is subject to consultation) then it could be at risk of breaching its banking covenants which require it to keep debt below 95% of the regulated value of its assets. Consequently the airport is not ruling out a legal challenge against the CAA.

➤ **29 October:**

The Telegraph reports that, following the publication of Tech Hot 100: Winners and losers from the year of Covid, the British tech sectors most likely to spawn $1T companies are: Fintech, such as Revolut; Cybersecurity, such as Darktrace; Chip design, such as ARM; and Health tech, such as Babylon Health.

➤ **2 November:**

The method of estimating economic growth in the UK has long been regarded as inappropriate in the age of the Internet. A trial of a more relevant method by the Office for National Statistics has revealed that the economy grew by an average 2.1% every year between 1997 and 2018, not 2.0% as thought under the previous system.

➤ **5 November:**

The Bank of England has injected another £150B (via Quantitative Easing) into the UK economy. Andrew Bailey, the Governor, said: *"Since the Monetary Policy Committee's previous meeting there has been a rapid rise in rates of Covid infection. The outlook for the economy remains unusually uncertain. It depends upon the evolution of the pandemic and the measures taken to protect public health, as well as the nature of, and transition to, the new trading arrangements between the EU and the UK. As a result a further easing of monetary policy is warranted."*

Policy makers decided against cutting interest rates into negative territory for now, instead keeping the base rate at 0.1%. The Bank thinks GDP will fall by 11% in 2020, predicting a fall of 2% in the final quarter which is significantly smaller than the falls of up to 12% predicted by some other economists. Furthermore, this will not become a full-blown double dip recession as output should start rising gain in the opening months of 2021 avoiding the usual definition of a recession as two consecutive quarters of contraction.

And the Chancellor of the Exchequer has extended the furlough scheme until the end of March 2021 stressing that: "all economic and monetary institutions are playing their part with responses that have been *"carefully designed to complement each other"*. He goes on to say that *"the Government's intention is for the restrictions to remain for just one month, but the economic effects are much longer lasting and recovery has slowed while risks are skewed to the downside."*

➤ **9 November:**

The Bank of England has predicted that, following the announcement of the 95% effective Pfizer Covid-19 vaccine, *"business confidence and spending could pick-up well ahead of roll-out as companies lift their horizons to a brighter future, and investors rein in expectations of an unprecedented move to negative interest rates to battle a downturn in 2021"*. In addition, the Centre for Economics and Business Research said that *"GDP growth could reach double digits next year as the collapse in output suffered during the pandemic is reversed."*

➤ **13 November:**

The UK Chancellor of the Exchequer announced earlier this week that Treasury and Bank of England officials would be considering the idea of launching a central bank digital currency which individuals can hold instead of the money they keep in their normal current accounts. Central banks issue two types of currency. Everyone is familiar with one form: banknotes. The other is known as central bank reserves, and only financial institutions have access to this electronic money. Nevertheless, it affects us all because banks hold reserves with the central bank, transactions between banks can be settled in them, and when the Bank of England launches quantitative easing to stimulate the economy it creates reserves.

But the money in our bank accounts is private money, not run by the central bank, and these payments run through infrastructure largely in the hands of the private sector, though its use is facilitated by central banks. So the Bank of England, among other central banks, is looking at digital currency that the public can use in day-to-day digital payments thereby opening up the reserves to all of us. It would still be denominated in pounds and pence, but would be the direct liability of the central bank rather than a commercial bank. But there are pros and cons, so now read Why the Bank of England is considering a digital currency (telegraph.co.uk) by Tim Wallace - *https://www.telegraph.co.uk/business/2020/11/13/bank-england-considering-digital-currency/*

➤ **14 November:**

The Chancellor of the Exchequer has announced in Parliament that he wants finance to be *"a critical enabler"* in the UK's efforts to achieve its net zero carbon target by 2050. He believes that the UK can be *"a world leader in carbon capture, storage and offshore wind"* and advises that this will be his blueprint for the future of the UK's financial services sector.

➤ **16 November:**

Shares surged on both sides of the Atlantic after US biotech company Moderna said its experimental Covid vaccine had shown impressive results in late-stage trials in a repeat of last Monday when rival pharmaceutical company Pfizer announced equally promising results from its own vaccine trial. The FTSE 100 rose nearly 2%; and Rolls-Royce ended the day 10% higher, with a similar increase for British Airways' owner, IAG

➤ **18 November:**

The UK Office of National Statistics has advised that its Consumer Price Index rose from 0.5% in September 2020 to 0.7% in October.

And for the budding economists among our readers, Andy Haldane, the Bank of England's Chief Economist, says negative interest rates could have significant benefits if families were to use digital currency, assuming they were widely available. Mr Haldane also hailed a *"materially brighter"* outlook for the economy in 2021, despite the second wave of the pandemic because of the emergence of two successful vaccines which could bring a quicker [than expected] end to the Covid crisis.

HMG issues the UK Treasury's November forecasts for the economy in 2020 and 2021 (Annex D).

➤ **20 November:**

Jeremy Warner of The Telegraph writes that *"No, Brexit has not been a disaster for the City, the dynamo of economic activity and tax revenue in the UK. Finance was the major cause of the last big economic crisis, but this time it has found itself – unusually for an industry used to being demonised – part of the solution rather than the problem."*

Also, The Telegraph advises that the UK Chancellor of the Exchequer will, next week, announce a major funding exercise to *"insulate the UK from the double economic shock of coronavirus and the Brexit transition period"* including a *"massive down-payment"* on the £600B of investment promised by the Prime Minister to 'level up' the UK.

➤ **21 November:**

The UK and Canada have agreed a post-Brexit trade deal which is a 'roll-over' of the current EU-Canada trading arrangements and leads to negotiations commencing next year on a bespoke UK-Canada trade agreement. Today's announcement means that in under two years the UK government has agreed trade deals with 53 countries accounting for £164bn of UK bilateral trade. It also takes the UK one step closer to accession to the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) of which Canada is a member. CPTPP is a key part of the UK's trade negotiations programme, helping businesses secure more opportunities in 11 key Pacific markets.

➤ **24 November:**

The UK government has launched a new website warning technology firms about the risks of operating in China and accepting Chinese investment. The site, called Digital and Tech China, and carries the slogan *"China. See the potential. Know the Challenge"*, says it is designed to help digital and tech companies *"navigate the country's unique marketplace in ways that reflect the UK's values and take account of national security concerns."*

In a statement, Digital and Culture Minister Caroline Dinenage said: *"We recognise the ethical, legal and commercial questions businesses face when they work in China or with Chinese businesses."* But she also highlighted the opportunities of working with the country. Bilateral trade now exceeds £76 billion while British AI unicorns – Improbable and Blue Prism – have launched in China, with more companies expected to follow.

The Digital and Tech China site includes resources such as a list of FAQs companies might ask themselves before setting-up in China, *"things to consider"* for firms looking to export to China, and links to specialist sites. In the Due Diligence section for firms looking to receive investment from China, the website says: *"Ask a Chinese-speaking colleague or contact to spend some time on Baidu or Google researching the company. This will help to detect any issues of concern such as court cases, bribery allegations, or unexpected commercial or political ties."*

Elsewhere, the website reads: *"While there are many opportunities, there is a risk that your company's technology could be used to violate human rights, posing a significant risk to your business's reputation."* The Government highlights China's use of facial recognition and predictive computer algorithms for mass surveillance, profiling, and repression of ethnic minorities in the northern Xinjiang region such as Uyghur Muslims.

"I think this is really a hardening of the attitudes towards China," said Emily Taylor, CEO of Oxford Information Labs, a company which monitors global technology policy. She linked this new attitude to the new technology standards China has been campaigning for at the United Nations, which include a different way of naming and addressing internet sites and a system that could permanently link individuals or devices to online identifiers. *"I think that this has really crystallised a lot of concerns about China and technology over the past few months,"* Taylor added.

And PwC issues its October 2020 UK Economic Update, the Summary and Projections of which are included as Annex E.

➤ **25 November:**

The UK Chancellor of the Exchequer has unveiled his Spending Review. See Rishi Sunak unveils Spending Review: key points at a glance (telegraph.co.uk) - *https://www.telegraph.co.uk/business/2020/11/27/rishi-sunak-unveils-comprehensive-spending-review-key-points/*

In addition, Goldman Sachs expects the FTSE 100 to rise 14% by the end of 2021 as a widespread recovery and strong monetary support boost stocks.

➤ **2 December:**

The UK becomes the first country to approve the Pfizer/BioNTech coronavirus vaccine after *"rigorous trials"*. A staged programme of inoculations will begin next week and continue throughout 2021. In addition, the AstraZeneca/Oxford University vaccine is expected to be available shortly. Both vaccines will be available on a 'not-for-profit' basis.

➤ 3 December:

Almost a fifth of UK exporters have shifted trade away from the EU since the Brexit referendum as they forge new opportunities around the world. An estimated £50B of exports have been diverted since June 2016, primarily to Brazil, Russia, India, China and South Africa, and to countries with which the UK has strong ties, including such Commonwealth members as Australia and New Zealand. Gwynne Master, global head of trade for Lloyds Bank said: *"While the clock is counting down to the end of the UK's post-EU transition period, British businesses are building towards the future and forging new opportunities around the world. These findings are the start of a new chapter in the story of global British business and trade."*

Also, The Telegraph reports that *"Economists are scrambling to upgrade their growth forecasts for 2021 as the rapid approval and roll-out of the Pfizer vaccine promises to boost the Nation's health and finances in a bumper year of recovery. GDP could climb as much as 10% reversing much of the devastation of 2020 as the vaccine lets workers, shoppers and holidaymakers return to business as usual, unleashing a wave of pent-up demand as the lockdown-weary populace spends with a vengeance."*

➤ 4 December:

UK interest rates can be cut below zero if needed to ward off the scars of Covid-19 or an economic hit from a no-deal Brexit, the Bank of England's Michael Saunders has said. Rates are currently at a record low of 0.1% but the Bank has embarked on a review of negative rates in the event that its Monetary Policy Committee decides to reduce them further. Mr Saunders has said that his own view is that the lower boundary for interest rates is *"probably a little below zero"* and that rate setters should be ready to act quickly if threats to the economy mount.

He continued to say that *"positive news on vaccines had reduced some downside risks but we are not out of the wood yet, and there are some headwinds that could leave the economy stuck with persistently high unemployment and below-target inflation."* He added that cuts below zero may be needed to increase the effectiveness of quantitative easing which works through lowering long-term borrowing costs via bond purchases.

7

AEROSPACE & AVIATION 2020/2021

Rolls-Royce eyes hypersonic commercial flight as it partners with Reaction Engines to pave the way for 2,500 mph aircraft and hybrid-electric engines

To recap on the final comments of this section in the 2019/2020 Annual Review, Oliver Wyman of the global management consulting firm said:

"This is a challenging time for all participants in the [aerospace and aviation] industry – an abrupt and brutal stall in what looked to be, before COVID-19, a decade of growth. But even before the coronavirus, global economies were showing signs of fatigue, and most players were already executing on strategies to blunt any negative impact from an anticipated slowdown at least in the early years of the decade. Now, preparations must be made for a reversal and a consolidation of players. By mid-decade, assuming an eventual containment of the virus, the industry will be back on its way to building a 35,000-aircraft fleet by 2030. It may not be the 39,000 originally forecast, but it will still represent for the remaining companies a decade of growth, despite its horrific beginning."

And Matthew Ward, Partner and Aerospace Leader with Ernst & Young, one of the 'Big Four' global accountancy & consulting firms concluded:

"Despite short-term volatility, the longer-term outlook for the aerospace sector remains positive. Sector growth estimates pre-epidemic were higher than global GDP growth rates with the emerging markets, particularly Asia, driving much of this demand. The sector, while not immune, has survived many recent crises, e.g. financial crash and SARS outbreak, and it is expected that growth for the sector will continue on a similar upward trajectory post Covid-19 crisis, albeit the downturn may last longer.

With long-term order books for OEMs, and a heritage of resilience and innovation, the flight path towards the future looks brighter than one might expect and the sector has a history of rejuvenating itself in a post-crisis world."

TO CONTINUE...

However, before that longer-term recovery the industry must handle the devastating effects of the Covid-19 pandemic on the commercial airline industry, albeit that military aerospace is unlikely to be adversely affected, and the pandemic will most certainly accelerate positive advances as well as initial financial and employment losses.

➤ **20 July:**

The days of the fighter pilot are numbered, Ben Wallace the UK Defence Secretary has suggested at the virtual Farnborough Air Show (FIA Connect), saying that only 10% of [military] aircraft will be manned by 2040. Mr Wallace highlighted Team Tempest, the £2B programme launched two years ago to create a new generation of fighter jets. The new aircraft, due to enter service in 2035, will use AI to enable the plane to fly without a pilot on board, will be surrounded by swarms of computer controlled drone wingmen, and employ laser weapons. Mr Wallace added: *"Those who work on this programme will become the pioneers of high value, digital design; they will be the ones who go higher, further and faster."*

➤ **21 July:**

The next day, the Electric Aviation Group unveiled the first hybrid electric 70-seat aircraft; it will have a range of 800 miles and is expected to be in service by 2028.

In addition, The Telegraph reveals that 23 airlines globally have collapsed so far during the Covid-19 pandemic. And Boris Johnson, the UK Prime Minister, convenes the first meeting of the UK's Jet Zero Council which will work to tackle aviation emissions and enable the first net zero emission long-haul passenger flights.

➤ **29 July:**

Grant Shapps, the UK Secretary of State for Transport, announces that a public consultation on the regulations for the UK's spaceflight programme will commence today paving the way for the UK's first space launch. A total of seven spaceports have been proposed in South West England, Scotland and Wales.

Additionally, Boeing records a 2020 first half-year loss of $28.7B, and further reduces its pace of production, as the collapse in air travel adds to the company's problems caused by the grounding of the 737 Max.

➤ **30 July:**

And the following day NASA's Perseverance, a nuclear powered rover weighing 1,050 kg blasts off on an Atlas 5 rocket bound for the planet Mars with the purpose of trying to find evidence of ancient life on another world. The rover carries a four-pound helicopter named Ingenuity which, pre-programmed, will fly independent of direct instruction. See below.

➤ **7 August:**

The UK's second-largest airport, Gatwick, tells staff that one of its two terminals may not re-open for a year as British Airways embarks on a further programme of redundancies due to the pandemic induced travel restrictions. More than 6,000 staff at the carrier have applied for voluntary redundancy and a further 6,000 could face compulsory lay-offs.

➤ **22 August:**

BAE Systems begins supersonic wind tunnel tests, the data from which will be used in the final design of the Generation 6 Tempest aircraft. Furthermore, the work overall is proceeding much faster than previous aircraft development due to 'digital twin' technology.

➤ **23 August:**

EasyJet offers pilots 'seasonal' contracts that would mean flying for a six-month period with the rest of the year off unpaid. In addition, it warns that almost one-third of pilot jobs may have to be made compulsorily redundant. Other options include pilots working for two weeks on and then having two weeks off, dropping four days from their normal pattern of 13 fixed days, working for three weeks and then having a week off unpaid, or unpaid leave lasting from six to 18 months. These new contracts are hoped to limit those redundancies

On a very different but optimistic note, on this day The Telegraph publishes an article on how the UK, going head-to-head with France, is a leader in airship revival in an escalating global race. The prize is to capture part of the $129B air freight market, and displace a portion of the vastly greater truck haulage business in congested zones or regions with poor infrastructure. In the UK, Hybrid Air Vehicles has already completed seven flights of its Airlander 10 prototype which carries ten tonnes of freight or 90 passengers and can take off and land almost anywhere 'flatish' with a 600 meter expanse, including water, without the need for airports or buildings.

The craft cruises at 130 kph using the vectored thrust of helicopter technology, can fly on one of its four engines, uses ten times less fuel, and is an order a magnitude more environmentally friendly. The first diesel engines will cut emissions by 75%; then by 90% when electric engines are added, and 100% once hydrogen fuel cells come of age.

➤ 27 August:

Rolls-Royce records a 2020 first half-year loss of £5.4B and states it is reviewing its options to strengthen its balance sheet. These include reducing its foreign exchange trading book, eliminating 9,000 jobs, shutting two factories in the UK, potentially selling its engine parts business (ITP) in Spain, and fundraising. The UK Government has a 'golden share' in Rolls-Royce plc which prevents a foreign power gaining control over the company's sensitive work on such item as jet engines for military aircraft and nuclear power plants for submarines.

On a brighter note, following the commencement of recertification test flights by the US Federal Aviation Administration, the European Aviation Safety Agency (EASA) has approved the commencement of its own test flights of the Boeing 737 Max. EASA flight tests will take place in Vancouver during the week starting 7 September, with simulator test runs at Gatwick Airport the week before.

➤ 3 September:

Simon Foy writing in The Telegraph advises that Melrose Industries has warned of significant job losses at GKN Aerospace as the turn-round investor swings deep into the red during second-half 2020. The FTSE 100 firm that bought GKN two years ago after a major takeover battle said sales in its aerospace business fell 18% during the period. Consequent restructuring is expected to produce savings of £100M in 2021. This is against a background of a £685M pre-tax loss for Melrose and a revenue decline by over 25% to £4.1B. Nevertheless, the firm is upbeat about its outlook saying that recent trading was at the higher end of expectations.

➤ 4 September:

Virgin Atlantic has finalised a £1.2B rescue package after the coronavirus pandemic took the 36-year old airline to the brink of collapse. Almost half of the airline's jobs will be made redundant under a radical restructuring designed to combat the crisis in the coming years. The rescue, which includes a £170M loan from hedge fund Davidson Kempner draws a line under months of uncertainty over the airline's future. Sir Richard Branson and minority shareholder, Delta, will provide £600M of support, and £200M will come from the Virgin Group. The balance will be made of up of deferrals in shareholder payments.

➤ 11 September:

NASA states it will pay private companies who are able to find ways to collect *"rocks and dust"* from the Moon as part of a first step in creating a lunar marketplace. Companies that collect samples between 50 and 500 grams can expect to be paid up to $25,000 by the US space agency. NASA believes that by creating a market for lunar materials it will help create a stable and predictable investment environment for more money to be invested in space exploration projects.

In addition, Amazon advises it has hired Peter Marquez, Director of Space Policy at the White House National Security Council under former US Presidents Barack Obama and George W. Bush, as the company's first Head of Space Policy to drive forwards Amazon's space ambitions including, but not limited to, the private space flight company, Blue Origin.

➤ 15 September:

Defense News reports that the US Air Force has secretly designed, built, and now flown at least one full-scale prototype of a sixth generation fighter aircraft. Almost every detail of the aircraft will remain a secret due to the classification of the Next Generation Dominance Program, the US Air Force's effort to field a family of connected air warfare systems that could include fighters, drones, and other networked platforms in space and the cyber realm.

➤ 27 September:

Oliver Gill, writing in The Telegraph, reports that the Qatari state has provided the largest shareholder in the owner of British Airways (IAG) a £1.5B bailout. Qatar Airways,

which owns 25% of IAG, will issue the Government of the Gulf state new shares to cover losses for the year to March 2020. Qatar's support of IAG has proved critical as the Covid pandemic has temporarily decimated the aviation sector with the company's share price dropping 80% since the beginning of the crisis.

And Andrew Field, also in The Telegraph, writes that now OneWeb has received a $1B rescue that has given the UK Government a 45% stake in the company, the next satellites in OneWeb's low orbit constellation will launch into space in December on the nose of a Soyuz rocket from the Vostochny Cosmodrome in the far east of Russia.

➤ **28 September:**

Lizzy Burden, economics reporter for The Telegraph, writes that "more firms are considering re-shoring manufacturing, but complex supply chains and uncertainty about future trading relationships are barriers." Tom Bouchier, UK Managing Director of Japanese robotics company, Fanuc, says he has been "inundated with enquiries about replacing cheap Chinese labour with automation at home after the standstill in world trade. Increasingly companies, especially in the food and aerospace sectors, want to invest in 'cobots' - collaborative robots – to increase productivity while maintaining space between workers in domestic factories." Indeed, a PwC survey of 3,500 chief executives world-wide last month found that 77% believe Covid-19 has accelerated an enduring shift from human labour to automation.

➤ **29 September:**

ADS, the Aerospace, Defence & Security trade body (and an ACP supporter) posts that from 1 October the UK Government will allow R&D funded bodies, such as the Aerospace Technology Institute, NATEP and Innovate UK to suspend the need for 50 : 50 matched funding (Government : Industry) for any future industrial research applications.

And the UK Government announces that it will publish an aviation recovery plan later this autumn. The plan, which will give details of a five-year strategy up to 2025, is expected to cover policies on such topics as travel corridors, border health checks, passenger refunds, CAA enforcement powers, aviation reform, and business rates within airports.

Finally, in the September issue of AEROSPACE Professor Keith Hayward analyses how the destructive impact of the Covid-19 pandemic on the global aerospace industry may also be a catalyst for revolutionary change and a shake-up of the sector. Follow: In the latest issue of AEROSPACE – September 2020 (aerosociety.com) - *https://www.aerosociety.com/news/in-the-latest-issue-of-aerospace-september-2020/*

➤ **7 October:**

Lawyers for Heathrow Airport Ltd advise the UK Supreme Court - where the Airport is challenging the Court of Appeal's ruling against the planned extension on the grounds that, as submitted by 'Friends of the Earth', it is incompatible with the UK's climate change goals - that their client intends to complete construction of the disputed third runway by 2030 at the earliest, at which time the pandemic will be a *"distant memory"*.

➤ **8 October:**

EasyJet advises it will only fly a quarter of its usual flights this autumn after warning it will record its first annual loss: a pre-tax loss of £845M for the year to September 2020 after it carried half the number of passengers compared with the previous 12 months. The airline has raised £2.4B in debt and equity to strengthen its finances and has plans to make the jobs of up to 4,500 staff redundant.

➤ **13 October:**

Today the UK, NASA and other partners signed an historic accord that will govern the conduct of those countries involved in a NASA-led joint mission to the Moon which it is hoped will act as a springboard for further exploration. The *Artemis* project aims to return humans, including the first women, to the Moon by 2024 as well as establishing a lunar space station as an experimental hub for future space missions.

In addition, the World Trade Organisation has ruled that the support Boeing has received over the years from the US Government in the form of subsidies and tax breaks has been illegal and caused Airbus damages of $4B per year in lost sales and market share. Under this ruling the European Commission can now impose levies on US goods equal to the value of the damage the WTO has decided has been suffered by Airbus. The ruling is seen as the final stage of a 16-year battle between Airbus and Boeing which has been fought by proxy through their respective governments with each claiming the other received illegal support. Last year the WTO issued a ruling permitting the US to impose tariffs on $7.5B of EU goods over state support.

➤ **18 October:**

The Mail on Sunday reports that a major recovery plan is being devised by the new British Airways Chief Executive, Sean Doyle. Under the plan, geared to help steer BA out of the effects of the Covid-pandemic, flights will be moved from London Gatwick to London Heathrow until next March and boost long-distance leisure flights to such destinations as Barbados and Barbuda to help compensate for dwindling business travel demand.

➤ **19 October:**

Flybe, once Europe's largest regional carrier that collapsed at the beginning of the pandemic after a rescue bid to the UK Government failed, could start flying again early next year after administrators have sold the airline to Thyme Opco. The company, controlled by hedge fund executive, Lucien Farrell, has bought the airline out of bankruptcy protection, including its intellectual property, stock and equipment; it will now work with the CAA to revive the airline. The firm has stated: *"While we plan to start off smaller than before, we expect to create valuable airline industry jobs, restore essential regional connectivity in the UK, and contribute to the recovery of vital parts of the country's economy."*

Additionally, the British Army unveils an insect-like drone that weighs 191 grams, can travel at 80kph, withstand 40mph winds, conduct surveillance, and carry different payloads. When the drone was displayed at Salisbury Plain the UK Defence Secretary, Ben Wallace, said *"the future of defence is about converting scientific and technological genius into the heart of defence capability."* Continuing, having already warned of the threats faced by the UK from China and Russia, he advised that *"we are in a very real race with our adversaries for technological advantage."*

➤ **22 October:**

The UK Space Agency confirms that Lockheed Martin will move its UK Pathfinder satellite launch operations from a space hub at Sutherland to Shetland Space Centre. There are seven spaceports currently being developed across the UK which will be able to conduct rocket launches both vertically from the ground and in the air from aircraft. The first launch will take place *"in the next few years."*

Furthermore, Airbus have announced that hydrogen powered aircraft will be commercially viable by the 2030s, and technically feasible in five years only held back until the fuel price comes down.

The concept Airbus ZEROe

➤ **25 October:**

Rolls-Royce shareholders are demanding a massive overhaul of the sprawling business ahead of a critical vote tomorrow on a deeply discounted £2B rights issue. According to The Telegraph *"there is a groundswell of support for Warren East, the Chief Executive, but investors want to know that the Board will back him making changes."* Rolls-Royce has long struggled to convince the market that it operates as efficiently as possible, a problem dating back decades to rapid expansion when it was forced to meet the demand of WWII and factories were distributed around the UK to avoid bombing raids. This was accepted in a pre-pandemic world with growing demand for aerospace engines as this helped mask huge costs, but it did mean that production of components in the UK was sometimes duplicated at its factories overseas.

In addition to the £2B rights issue the company is also issuing £2B of bonds, has secured a £1B Government backed loan, has launched a programme of sell-offs, and is reducing head-count by 9,000 including the reduction of management costs by 33%. So far 4,700 front-line staff, mainly from the civil aerospace division, have left the business, although 200 engineers have been transferred to the defence and nuclear divisions to preserve skills. There are no plans to exceed the overall reduction of 9,000.

➤ **27 October:**

The Rolls-Royce £2B rights issue at a 41% discount has been "overwhelmingly" backed by shareholders. This now allows the company to access the £2B of bonds it has sold, and the UK Government has backed a potential £1B of further debt.

➤ **28 October:**

Boeing plans to cut another 7,000 jobs after recording a $3.5B loss in the three months to September 2020. During the quarter the company had revenues of $14.1B, down

29% on the same period last year. The company's airliner division, normally the largest part of the business, had sales of $3.6B compared with $8.3B during the third quarter of 2019; this resulted in a $1.4B loss. The company, which expects to reduce its total workforce to 130,000 by year-end, has an order backlog worth $393B, including more than 4,300 airliners. The defence and space division, however, and the services division, both made a profit - $628M and $271M respectively.

➤ 30 October:

The Committee on Foreign Investments in the USA, which vets overseas takeovers of US companies, has cleared OneWeb's sale to a joint venture led by the UK Government and India's Bharti Global. The Federal Communications Commission, which regulates wireless spectrum in the US, has also approved the takeover.

➤ 4 November:

BAE Systems has responded to a request from the Japanese Ministry of Defence for information about how it could provide technical assistance to Japan's new fighter aircraft known as the FX (below). Although it had been suggested that Japan might join the UK Tempest programme it now seems likely that it wishes to develop its own aircraft with Mitsubishi Heavy Industries having been announced as the main contractor. A domestic led project would bolster Japan's defence sector and reduce reliance on other countries. Nevertheless, technologies being developed for Tempest, such as laser weapons, autonomous flight and AI control, could find their way into the FX if BAE Systems comes on board. Furthermore, working together on systems that could be used in both programmes has the potential to reduce costs to both parties.

In addition, Rolls-Royce has announced a new project to accelerate 20 future aerospace technologies in conjunction with the Aerospace Technology Institute, the intention being to reduce disruption for airlines and lessen environmental impact by repairing components rather than scrapping them. Other industries, such as nuclear and off-shore renewables, will also benefit.

➤ 6 November:

Virgin Galactic, having already completed several crewed test flights of its VSS Unity spaceship, plans to launch its first human mission from its new home of Spaceport America, New Mexico, between 19 and 23 November 2020. In addition to people the test flight will carry *"revenue generating payloads"* for NASA. Before flying any paying passengers ($200K - $250K each) however, company founder, Richard Branson, will take the trip to the edge of space. VSS Unity vehicles will take passengers into suborbital space, about 62 miles altitude, and then return them to Earth including several minutes of weightlessness and stunning views of the planet and stars. Such flights will also allow scientists to perform experiments that require only a few minutes of microgravity.

VSS Unity approaches a runway landing at Spaceport America on 1May 2020

➤ 11 November:

Emirates has commenced using Airbus A380s as cargo planes to meet a surge in demand for transported goods while awaiting a recovery in passenger air travel. The Boeing 777 is better suited to the task and Emirates have already converted ten of them. Overall air cargo transportation is recovering and is now only 20% down on this time last year.

Additionally, a study by Edinburgh University based on tests conducted on the International Space Station, suggests that bacteria can extract useful materials from rocks on Mars and the Moon that could aid efforts to develop ways of sourcing metals and materials essential for survival in space such as iron and magnesium. It is hoped that this bacteria could be used in future to break down rocks into soil for growing crops, and to provide minerals for life support systems that produce air and water.

➤ 12 November:

An order from Germany for 38 Typhoon Tranche 4 fighter aircraft will deliver a £1.3B boost to the UK economy and safeguard 15,000 British jobs. BAE Systems produces about one-third of the aircraft, and Rolls-Royce is an important member of the Eurojet consortium that builds the engines. With the announcement of the potential Covid vaccine, Rolls-Royce shares have increased in value by almost 50%.

➤ 15 November:

Leonardo is lobbying for an estimated £400M contract to provide its AW149 helicopter as a replacement for the MOD's 20-plus medium helicopter fleet such as the Puma which first entered service nearly 50 years ago. Leonardo's managing director, Norman Bone, stated that an order for the AW149 would not only protect manufacturing jobs but also generate UK intellectual property for research and design work modifying the helicopter to British military specifications and open up an export market of at least 500 AW149 aircraft.

➤ 16 November:

Elon Musk's SpaceX launched four astronauts aboard the company's Dragon capsule on a flight to the International Space Station on Sunday. This was NASA's first fully-fledged mission sending a crew into orbit aboard a privately owned spacecraft.

➤ 17 November:

EasyJet has reported an annual loss of £1.7B (compared with a profit of £430M for the same period last year) – its first ever full-year loss in its 25-year history – while revenues collapsed by more than 50% to £3B. In addition, the company has advised that it will have flown no more than 20% of its usual schedule in the last three months of 2020.

➤ 18 November:

The US Federal Aviation Administration has advised that the Boeing 737 Max is now cleared to fly again after being grounded for nearly two years following two crashes that killed almost 350 people. The decision has seen Boeing shares rise almost 3%, but the stock is still down more than one-third this year. Boeing posted revenues of $14.1B for the three months to September 2020, down 29% on the same period last year. It has announced 26,000 redundancies. Just 28 Boeing 737 Max aircraft were handed over to customers during the quarter, down from 62 in the same quarter last year.

In addition, Alan Tovey, the Industry Editor of The Telegraph, writes that cash-rich but time-poor technology executives are driving up the second-hand market for private jets, including aircraft capable of transcontinental travel without the need for fuel stops. Over the past five years 80% of private used aircraft purchases made by younger buyers (defined as those aged under 50) were for large jets. Jetcraft, a broker, forecasts a continuing rise in sales of these aircraft, partly driven by the increasing number of Ultra-High Net Worth Individuals (investable assets in excess of $30M) rather than corporate or government buyers.

Jetcraft also forecasts that these relatively youthful buyers will become early adopters of new technology in the business aircraft sector. This means they are likely to be among the first customers for companies such as Aerion and Boom who are working on supersonic private jets.

➤ 19 November:

Athena, the UK's new national space team has published its suggestions for a roadmap to lead the UK space sector to a world class position. The Athena team, made up of Serco, Inmarsat, CGI UK and Lockheed Martin UK, published the report which outlines a new approach to space for the UK supported by Bryce Space and Technology. The suggested roadmap reports on the technological, economic and industrial benefits and growth that can be gained from having a world class space sector.

Athena, which represents an end-to-end, sovereign, UK-based approach to space services, believes that the UK has reached a pivotal moment in its space aspirations. The report states that the UK is currently trailing behind nations such as France and Japan who are considered robust space powers due to the depth and sophistication of their space capabilities which are put to use in pursuit of a clearly defined national strategy and the resulting widely-recognised economic, technical, societal and security benefits.

Chris Rocks, Capability Director Space and Security at Serco, said: *"The UK is at a critical point and the time to step forward and become a leading space nation is now. The UK Government is taking steps towards achieving this aim with the formation of the National Space Council and its forthcoming National Space Strategy. Industry also needs to play its part and it is in this spirit of cooperation that Athena has published this report to set out a proposed roadmap to success with emphasis on key focus areas that can deliver the most benefit to the UK to make its space ambitions reality."*

The report, called 'A New Approach to Space', recommends seven key areas of focus for the UK to 2030:

1. Integrate military and civil space operations into a National Space Operations Centre to jointly operate key national infrastructure and maximise data sharing.
2. Invest in satellite communications to deliver a secure platform for military and government.
3. Develop a sovereign space-based Positioning, Navigation and Timing capability to address urgent national requirements and enable burden sharing with key allies.
4. Establish satellite launch operations from the UK.
5. Invest in research and development, and create a National Space Academy to nurture STEM talent and develop a career pathway into space.
6. Increase contributions to space domain awareness.
7. Participate in the European Space Agency Copernicus Programme and further support earth observation activity with additional UK programmes.

➤ 23 November:

The UK and Scottish Governments have signed a commitment to invest more than £80M in a UK Space Centre of Excellence in Ayrshire which will enable satellites to be launched from Europe for the first time. The funding package will develop and support a wide range of aerospace and space activities around Glasgow Prestwick Airport and, by 2035, should add a further 4,000 aerospace jobs to an already 3,500 in the region. As an aside it is also interesting to note that Scotland produces more small satellites than any other country outside of California in the USA.

➤ 24 November:

MTU Aero Engines, Germany's leading aero engine manufacturer, sees three possible uses for hydrogen in this field. One, converted to sustainable aviation fuels (SAFs), hydrogen could be dropped into existing aircraft and engines immediately. Two, direct combustion of liquid hydrogen in gas turbines, but this would require some adjustments in the engine, especially the combustion chamber. Three, conversion into electricity by means of a fuel cell. This technology promises almost zero emissions, but it is still in the early stages of development in aircraft propulsion applications.

➤ 25 November:

Bloomberg News reports that Emirates could put the world's largest fleet of Airbus A380s back in the air by early 2022 after forecasting a sharp recovery in the demand for air travel next year.

➤ 26 November:

Elon Musk has announced that SpaceX will perform the first proper flight of the Mars-bound spacecraft 'Starship' next week. The plan is for the craft to be used eventually to transport people and cargo around the Solar System with up to 100 passengers travelling to Mars.

Artist's impression of SpaceX 'Starship'

➤ 2 December:

In an attempt to rebuild confidence in Boeing's 737 Max, today American Airlines, one of Boeing's largest customers, took a party of media personnel on a demonstration flight. Also today Cyrus Capital, which bought bankrupt Flybe from administration in October this year, filed an application for an operating licence with the UK Civil Aviation Authority.

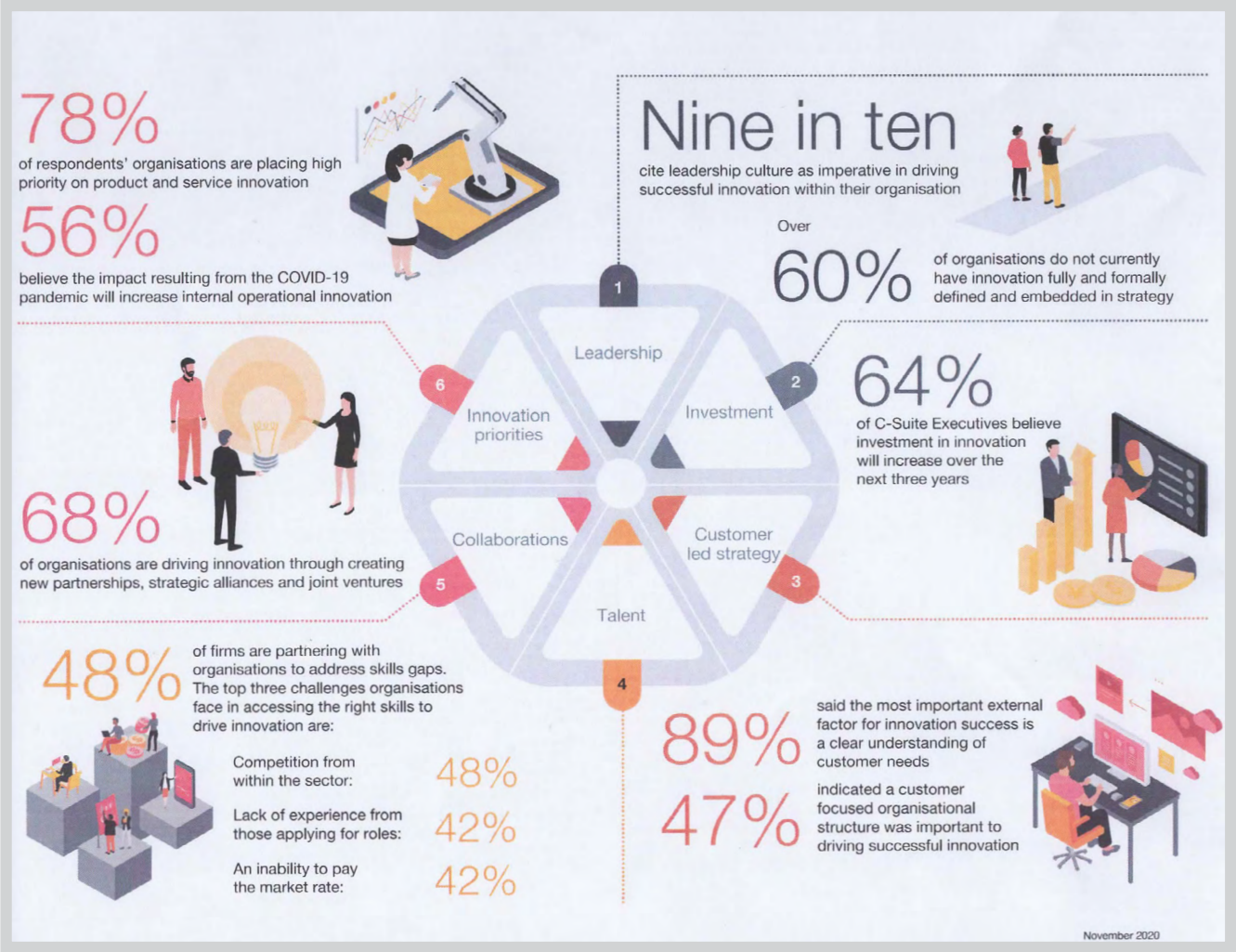
➤ 3 December:

Ryanair, Europe's largest airline before the pandemic, has given Boeing its first firm order for the 737 MAX just weeks after the aircraft was cleared to fly again by the FAA. The agreement to purchase 75 of the aircraft takes Ryanair's total delivery of 737 Max starting in 2021 to 210.

In addition, the UK Transport Secretary has confirmed that 'high-value' business travellers, along with performing artists certified by the Arts Council, TV production staff, journalists and elite sportsmen and women will now be able to enter the UK without needing to go into self-isolation.

We conclude this section with reference to the PwC/ADS *Harnessing Innovation in Aerospace & Defence* report dated November 2020, the key findings of which are as follows:

Innovation in Aerospace and Defence: Key survey findings



See ADS Advance - PwC and ADS release Harnessing Innovation in Aerospace and Defence report - *https://www.adsadvance.co.uk/pwc-and-ads-release-harnessing-innovation-in-aerospace-and-defence-report.html*

The Report asks the question: *"What are we to make of an industry sector that has unambiguous confidence in its status as a global innovation leader but, at the same time, acknowledges major barriers preventing it from fully flexing its innovation muscles?*

Are those two positions – expressed in our survey – at odds with each other, or simply an expression of an industry in flux, coping with wide-ranging volatility?

The answer, as we make clear in this report, lies much closer to the latter position. The story our survey tells is of a vibrant industry facing a series of live economic, political, and social events, complicated by existing sector-specific barriers and challenges."

8
UK DEFENCE

Probe & Drogue Refuelling of a UK F35B

➤ **October:**

Ahead of HMS Queen Elizabeth's first operational deployment next year, 617 Squadron RAF, the first operational squadron of the UK Lightning Force, prepares for their first operational deployment. There is a requirement for 138 F-35Bs and, to date, 48 have been ordered with 18 being delivered so far: three to Edwards Air Force Base in California flying with 17 Squadron RAF, and 15 to RAF Marham, the home of the UK Lightning Force Another three are expected by the end of this year. 207 Sqn is the Lightning Operational Conversion Unit.

Additionally this month, the UK MOD announced £317M funding to continue the development of Active Electronically Scanned Array radar for the RAF Typhoon fleet. The continued development will be undertaken by BAE Systems and Leonardo and will secure more than 600 jobs across the UK. The equipment will come into service from the mid-2020s.

Furthermore during October, the UK's first Protector RG Mk1 aircraft (pictured below) successfully completed its first flight after coming off the General Atomics production line. Sixteen Protectors will replace the current Reaper Force and more than double its capability. Aircraft will commence delivery in 2023 and will be deployed in wide-ranging Intelligence, Surveillance, Targeting and Reconnaissance (ISTAR) operations. Capable of flying constantly for up to 40 hours, the aircraft will use enhanced data links and can carry the next generation low collateral, precision strike weapons Brimstone and Paveway IV. In addition, they will be available, if requested, to support civilian UK agencies in such roles as search & rescue and disaster response missions.

Protector RG Mk1

➤ **November:**

The first four RAF Poseidon MRA Mk1 aircraft arrived at RAF Lossiemouth, their permanent home, this month to join 120 Squadron. Nine Poseidons have been ordered from Boeing; designated the P-8 they are based on the Next Generation 737 with the first arriving on British soil last February at Kinloss Airfield (see below) because the P-8 facility at RAF Lossiemouth was still under construction. That aircraft has been on operational duty with CXX Squadron since then. In addition, 54 Squadron has been training new pilots and weapons systems operators on the platform as 400 additional military personnel will be joining the new P-8 force to fly and operate the nine aircraft.

The next batch of aircraft are located at Boeing's P-8 Installation and check-out facility in Tukwila, south of Seattle, where missions systems are installed and further testing takes place before delivery. The final P-8 is expected to be in the UK by the end of 2021. Poseidon has the capability to locate, identify and attack hostile submarines and surface vessels. It includes a comprehensive communications suite which means intelligence can be passed to commanders in the air, on a ship, on the ground, or back at RAF Lossiemouth.

➤ **19 November:**

Boris Johnson, UK Prime Minister, has announced *"an end to the era of retreat"* for Britain's Armed Forces with a £24B spending increase that marks the largest financial boost since the Cold War. He has pledged to restore the Royal Navy to its position as *"Europe's most powerful maritime force"* and will invest heavily in drones, cyber warfare and a space programme. Downing Street has advised that 40,000 jobs will be created over the course of the four-year settlement which provides the Armed Forces with an extra £16.5B on top of the 2019 manifesto pledge to increase defence spending by 0.5% above inflation every year.

It would appear that the Royal Navy is one of the principal 'winners' in the settlement which will enable it to place orders for eight Type 26 Frigates and five Type 31 Frigates, plus an unspecified number of yet to be described Type 32 Frigates. This, it is understood, is intended to bring the *"escort fleet"* up to 24 vessels including the existing six Type 45 Destroyers at the same time as replacing ageing Type 23 Frigates. In addition, there will be three replacement support ships and a new multi-role research vessel.

Furthermore, Mr Johnson announced the creation of a National Cyber Force involving the resources of MI5, MI6, GCHQ and the MOD that will target terrorism, organised crime and hostile state activity, a new agency dedicated to the development of Artificial Intelligence, and a new RAF Space Command capable of launching the UK's first rocket in 2022.

Overall this extra money, he advised the House of Commons, will enable a *"generational modernisation programme" for the Armed Forces and is necessary because "the international situation is now more perilous and intensely competitive that at any time since the Cold War"*.

Ahead of the publication of the integrated review of defence, security and foreign policy early next year Mr Johnson hinted at a future reduction in Armed Forces manpower saying: *"The latest advances will multiply the fighting power of every warship, aircraft and infantry unit many times over, and the prizes will go to the swiftest and most agile nations, not necessarily the biggest."*

➤ **22 November:**

The UK MOD could be using swarms of small UAVs within six months to complement strategic assets such as the RAF's Protector aircraft mentioned earlier. Their uses could include overloading enemy defences, conducting cyber-attacks, providing live images to control centres thousands of miles away or to special forces teams on the ground, delivering medical aid direct to a battlefield casualty, and so on. Each with a modular payload of 2Kg and operating as a swarm, they would form a system with, as Blue Bear Research Systems Ltd (the company behind the drones) explains, a digital backbone and nervous system. The company has developed two drones that interest the MOD: Cobra, which launches off a miniature catapult system and can operate up to 16,000 ft; and Ghost which is a vertical Take-Off and Landing UAV. See below.

The Blue Bear 'Ghost' UAV

➤ **23 November:**

The UK MOD has advised that a hostile act in space is likely to occur in the next two years as calls increase for countries to agree on new operating rules. The Director General of the MOD's Strategic and International Department has warned that an act of aggression in space will test the limits of what the international community deems a hostile act. Speaking recently at the Defence Space Conference, Angus Lapsley said *"space is one of those areas where I think a new era of great power competition is going to be felt most keenly."*

Mr Lapsley, who is responsible for the UK's key defence relationships with allies, as well as leading on policies for cyber, space and the Country's nuclear deterrent, also said *"evolving policy, technology and commercial use of space was an opportunity to define Britain's personality"* in that respect. *"It could be that what Britain is really good at, and why we have influence, is because we are nimble, fast, agile and capable of moving things in, perhaps, a slightly risky way whilst bringing new technologies to bear."*

➤ **5 December:**

An increasing number of British technology start-ups are expanding into defence contracting. When Adaptix from Oxford first met with officials from the MOD two years ago it didn't take long for the latter to spot the potential of a cutting edge British technology. Adaptix specialises in 3D imaging equipment for healthcare which allows doctors to see inside people's bodies. But Mark Evans, Adaptix CEO, recalls how the officials from the Defence and Security Accelerator part of the MOD started discussing how the same technology could potentially be used to scan electronic gadgets for bugs and detect if they had been tampered with.

Two years later Adaptix has secured a grant to repurpose its technology for security uses, potentially helping the UK Government check that computers installed in secure facilities around the world haven't been fitted with espionage devises. And Adaptix is hardly alone! Now see The real-life Q's building cutting edge technology for the military (telegraph.co.uk) - *https://www.telegraph.co.uk/technology/2020/12/05/real-life-qs-building-cutting-edge-technology-military/*

We conclude this section with reference to the UK MOD's introduction of The Integrated Operating Concept 2025. See The Integrated Operating Concept 2025 (defense-aerospace.com) - *https://www.defense-aerospace.com/articles-view/release/3/213608/uk-mod-unveils-new-integrated-operating-concept.html*

In short, the Integrated Operating Concept calls into question the traditional approach to war fighting. It sets out a new approach to the utility of armed force in an era of persistent competition and a rapidly evolving character of warfare. It represents the most significant change in UK military thought in several generations. It will lead to a fundamental transformation in the military instrument and the way it is used.

To quote from General Sir Nick Carter, the UK Chief of the Defence Staffs:

> *"The nature of war remains constant: it is visceral and violent…and it is always about politics. What is changing is the character of warfare, which is evolving significantly due to the pervasiveness of information and the pace of technological change…. Above all we must never lose sight of always being prepared to fight the war we might have to fight. As Trotsky observed: 'You may not be interested in war, but war is interested in you!' "*

9

AEROSPACE & AVIATION CAREERS IN THE UK

The Section should be read in conjunction with Sections 5, 6, 7, 8 & 10.

During lockdown BAE Systems announced a programme to recruit over 800 new engineering and business-based apprentices.

IN ADDITION...

➤ **3 November:**

The UK Space Agency has announced a new four-year apprenticeship that will commence on 1 January 2021 and help young people gain the technical skills required for a career in the growing space sector which aims to create 30,000 new jobs over the next decade. The scheme follows a successful collaboration between the UK Space Agency, Airbus and the University of Leicester. The (level 4) Space Engineering Technician apprenticeship, which is the first to be recognised by the Institute for Apprenticeships and Technical Education and approved by the Department of Education, has paved the way for the development of a degree equivalent (level 6) space engineering diploma which is expected to be available from September 2021.

BAE Systems, Thales Alenia Space UK, Nammo Westcott, Reaction Engines, the STFC, RAL Space, the UK Atomic Energy Authority and Oxford Space Systems have supported a process to enable over 900 space sector companies access to the qualification. The UK space sector currently generates an annual income of £14.8B, employs 42,000 people, and supports an additional £300B of economic activity through the use of satellite services. The new generation of apprentices will learn how to support the development, manufacturing, assembly, integration and testing of complex, high-value space hardware and ground based equipment including satellite mechanical structures, sub-systems for in-space power generation and distribution, spacecraft attitude control, thermal control, rocket propulsion, space communication, sensors, planetary landers, and associated support systems.

➤ **4 November:**

See the RAeS Careers in Aerospace Live:
https://www.aerosociety.com/careers-education/resources/careers-in-aerospace-live/

➤ **19 November:**

The new National Cyber Force announced by the Prime Minister today will be recruiting 3,000 staff. Jointly led by GCHQ and MOD with representation from MI5 and MI6, the Force will seek to disrupt terrorist, hostile state and criminal activities against the UK. Example operations could include interfering with mobile phones or cell towers to prevent communication between known terrorists, and destroying servers hosting material deemed a risk to national security. The agency will also protect UK military hardware such as the F-35 stealth fighter from targeting by hostile weapon systems

Additionally, Ben Wallace, the UK Secretary of State for Defence, has said that the Armed Forces must recruit *"specialists"* in fields such as cyber technology rather than concentrating on personnel numbers if they are to win future wars. He went on to say that *"Britain must also become a world-beater in military satellites, lasers and drones as well as on traditional battlefields."* He described how a future soldier in hostile territory *"will be alerted to a distant ambush by sensors on satellites or drones instantly transmitting a warning using artificial intelligence to devise the optimal response and offering an array of options from summoning an air strike to ordering a swarm attack by drones or paralysing the enemy with cyber weapons."*

➤ **21 November:**

The RAF is actively recruiting; see
www.raf.mod.uk/recruitment.
So is the Army Air Corps; see
https://apply.army.mod.uk/roles/army-air-corps

➤ **27 November:**

CAE, the training and simulation specialists, have estimated that, despite the pandemic, the aviation industry will still require 27,000 new pilots in 2021, and 264,000 over the next ten years, due to "age-based retirements and attrition".

➤ **5 December:**

Finally, in this issue we feature one of our supporters: Leading Edge Aviation.

Leading Edge Aviation, the newest aviation Academy in Europe, but based on a combined 200 years of aviation and pilot training experience, is currently located at London Oxford Airport. Launched in 2018, Leading Edge Aviation have created a new kind of aviation academy which is highly innovative, hands-on, team orientated, and very comprehensive.

Employing glass cockpit, Diamond DA 40 and DA 42 training aircraft in the air, and high-tech, open, interactive 'learning studios' on the ground, everything is totally digital including course material on tablets, the latest virtual and mixed reality technology, and ALSIM AL 42 Boeing 737 and Airbus A320 simulators. Working on solo projects, or as part of a team, the Leading Edge instructors, who are current, and former commercial and military pilots, navigators and engineers, employ the latest learning approaches such as neuro-tracking.

The Academy's fully comprehensive approach, whether it be by their all-inclusive LEAP® course, or step-by-step modular training, takes students from zero aviation experience to airline-ready, along the way enabling them to achieve professional qualifications, a degree, and a full range of technical, non-technical, and soft skills that airlines look for.

For more information see
https://leadingedgeaviation.com
in addition, keep an eye on
www.raeng.org.uk/education
and
www.raeng.org.uk/grants-prizes/grants/schemes-for-students
plus
www.aerosociety.com/careers-education
and in particular Careers in Aerospace
www.aerosociety.com/careers-education/resources/careers-in-aerospace-website-and-social-media

And finally such publications as: Aviation Week and Space Technology; Flight International; Airliner World; Airports of the World; Air International; World Air Power Journal; Air Forces Monthly; Aerospace Manufacturing; The Engineer.

To conclude, see Annex F, a list of RAeS: accredited company training schemes and apprenticeships; accredited academic programmes; and approved academic programmes.

10

USEFUL CONTACTS

ACADEME

Hotcoursesabroad - *www.hotcoursesabroad.com*
SI>UK - *www.studyin-uk.com/studyuk/aerospace-engineering*
SpaceCareers.UK - *www.spacecareers.uk*
Space Universities Network - *www.spaceuniversitiesnetwork.ac.uk/space-courses*
STEM Learning - Resources, CPD, STEM Ambassadors and enrichment
https://www.stem.org.uk/
StudyPortals, Bachelors - *www.bachelorsportal.com*
The Complete University Guide - *www.thecompleteuniversityguide.co.uk*
Top 10 UK Aviation Universities - *www.aircharter.co.uk*
Top Universities - *www.topuniversities.com*
What Uni - *www.whatuni.com*

AIR TRANSPORT MANAGEMENT

SI>UK - *www.studyin-uk.com/studyuk/air-transport-management*

APPRENTICESHIPS

Aeroacademy - *www.aero-academy.org*
Airbus - *www.com/careers/apprentices-and-pupils/in-the-united-kingdom.html*
BAE Systems Apprenticeships - *www.baesystems.com*
Boeing - *www.boeing.co.uk/working-at-boeing/graduates-apprentices-interns.page*
British Airways - *www.careers.ba.com/apprentices*
Career Finder - *www.careerfinder.ucas.com*
Careers in Aerospace - *www.careersinaerospace.com*
Cobham plc - *www.cobham.com/the-group/careers*
Employment 4 Students - *www.e4s.co.uk/jobs/5-airport-apprenticeships.htm*
Find Apprenticeships - *www.findapprenticeships.co.uk/aerospace-apprenticeships*
GE Aviation - *www.geaviation.com*
Institute for Apprenticeships & Technical Education - *www.instituteforapprenticeships.org*
Prospects - *www.prospects.ac.uk*
QinetiQ Apprentice Training School - *www.qinetiq.com/careers/apprenticeships*
Raytheon - *www.jobs.raytheon.com/uk-graduate-and-apprenticeships*
Rolls-Royce plc - *www.rolls-royce.com*
Thales - *www.thalesgroup.com/en/europe/united-kingdom/careers/apprenticeships*
The Apprenticeship Guide - *www.apprenticeshipguide.co.uk*

AVIATION TRAINING ORGANISATIONS

www.bestaviation.net
Aerobility - *www.aerobility.com*
Air Service Training - *www.airservicetraining.co.uk*
CAA: Finding a flight schoo - *www.caa.co.uk*
Cranfield Flying School - *www.cranfieldflyingschool.com*
EFG Flying School - *www.flyefg.co.uk*
Flight Training London - *www.flighttraininglondon.co.uk*
Flying Time Aviation - *www.fta-global.com*
Go Fly - *www.goflyuk.com*
Leading Edge Aviation - *www.leadingedgeaviation.com*
Resource Group - *www.resourcegroup.co.uk*

EMPLOYERS WITH OWN, OR LINKS TO, EDUCATION BODIES

BAA Training Aviation Academy - *www.baatraining.com*
BAE Systems - *www.baesystems.com/en/careers/careers-in-the-uk*
British Airways - *www.careers.ba.com/future-pilots*
British Airways Emerging Talent - *www.ba.com*
CAE - *www.cae.com*
easyJet careers - *www.easyjet.com*
GKN - *www.gknaerospace.com*
Gradcracker – where the STEM jobs are - *www.gradcracker.com*
Heathrow employment & skills academy - *www.heathrowacademy.co.uk*
Meggitt plc - *www.meggitt.com/careers/engineering-the-future-with-stem*
Virgin Atlantic - *www.virgin-atlantic.com*

GOVERNMENT BODIES

Aerospace Growth Partnership - *www.theagp.aero*
Aerospace Technology Institute - *www.ati.org.uk*
Aviation Skills Board - *www.people1st.co.uk*
British Army - *www.army.mod.uk*
NATS - *www.nats.aero/careers*
Royal Air Force - *www.raf.mod.uk*
Royal Navy - *www.royalnavy.mod.uk/careers*
UK Space Agency - *www.gov.uk/government/organisations/uk-space-agency*

INDUSTRY BODIES

A/D/S - *www.adsgroup.org.uk*
Aviation Schools in the UK - *www.bestaviation.net*
Aviation Skills Partnership - *www.aviationskillspartnership.com*
British Business & General Aviation Association - *www.bbga.aero*
British helicopter Association - *www.britishhelicopterassociation.org*
Farnborough International - *www.farnboroughairshow.com*
Pilot Career News - *www.pilotcareernews.com*
The Airport Operators Association - *www.aoa.org.uk*
The Association of UK Airlines - *www.airlinesuk.org*
Tomorrow's Engineers - *www.tomorrowsengineers.org.uk*
UK Space - *www.ukspace.org*

PROFESSIONAL BODIES

British Airline Pilots Association - *www.balpa.org*
Careers in Aerospace - *www.careersinaerospace.com*
Engineering Council - *www.engc.org.uk*
EngineeringUK - *www.engineeringuk.com*, which is supported by members of the following professional engineering bodies: bcs; CIPHE; BINDT; CIWEM; icme; IHE; IMarEST; IOM3; InstMC; IOP; IAgrE; IChemE; ICE; IED; IFE; IGEM; IRSE; INSTRE; NI; RAeS; CIBSE; CIHT; IStructE; RINA; SOE; TWI.
The Chartered Institute of Logistics & Transport - *www.ciltuk.org.uk*
The Institution of Engineering & Technology - *www.theiet.org*
The Institution of Mechanical Engineers - *www.imeche.org*
The Royal Academy of Engineering - *www.raeng.org.uk*
The Royal Aeronautical Society - *www.aerosociety.com*
Women's Engineering Society - *www.wes.org.uk*

SCHOLARSHIPS & BURSARIES

Arkwright Engineering Scholarships - *www.arkwright.org.uk*
Boeing - *www.boeing.co.uk/featured-content/flying-scholarships*
Pilot Shortage – scholarships - *www.pilotshortage.co.uk*
The Air League - *www.airleague.co.uk*
The Complete Guide: Flying Scholarships in the UK - *www.icadet.com*
The Honourable Company of Air Pilots - *www.airpilots.org*
The Worshipful Company of Coachmakers - *www.coachmakers.co.uk*

YOUTH ORGANISATIONS

Air Scouts - Introduction to Air Scouting - *www.scouts.org.uk*
Combined Cadet Force - *www.combinedcadetforce.org.uk*
RAF Air Cadets - *www.raf.mod.uk/aircadets*

11
SUGGESTED FURTHER READING

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ANNEXES

A. UK Economic Forecasts by HMG: August 2020.

B. UK Economic Forecasts by HMG: September 2020.

C. UK Economic Forecasts by HMG: October 2020.

D. UK Economic Forecasts by HMG: November 2020.

E. PwC UK Economic Update Summary October 2020 (abridged).

ANNEX A

UK ECONOMIC FORECASTS BY HMG: AUGUST 2020

FORECASTS FOR 2020	Independent				Average* of new forecasts
	Averages		August		
	August	July	Lowest	Highest	
GDP growth (%)	-10.0	-9.2	-14.2	-6.6	-10.1
Inflation rate (Q4 %)					
- CPI	0.5	0.7	-0.1	1.8	0.5
- RPI	1.1	1.5	0.3	2.2	1.0
LFS unemployment rate (Q4 %)	8.3	8.1	5.0	12.7	8.3
Current account (£B)	-76.8	-85.5	-244.0	-22.1	-57.2
PSNB (2020 – 2021 £B)	322.2	293.1	239.1	382.0	324.0

FORECASTS FOR 2021	Independent				Average* of new forecasts
	Averages		August		
	August	July	Lowest	Highest	
GDP growth (%)	6.6	6.3	2.9	9.6	6.5
Inflation rate (Q4 %)					
- CPI	1.9	1.7	0.6	3.2	2.1
- RPI	2.7	2.8	1.1	4.6	2.9
LFS unemployment rate (Q4 %)	6.5	6.4	5.0	8.8	6.6
Current account (£B)	-76.2	-80.7	-143.0	-19.5	-61.0
PSNB (2021 – 2022 £B)	164.4	150.3	91.4	307.2	171.2

GDP: Gross Domestic Product is the monetary measure of the total market value of final goods & services produced in one year.
CPI: The Consumer Price Index is a measure that examines the weighted average of prices of a basket of consumer goods and services.
RPI: The Retail Price Index is no longer considered an official statistic by the U.K., but it is used for certain types of cost escalation.
Current Account: Records the payments for goods and services, plus investment income and transfers, between an economy and the rest of the world.
PSNB: Public Sector Net Borrowing is a monthly assessment of expenditures minus revenue to determine a fiscal surplus or deficit.

*All averages use the Mean

ANNEX B
UK ECONOMIC FORECASTS BY HMG: SEPTEMBER 2020

FORECASTS FOR 2020	Independent				Average* of new forecasts
	Averages		September		
	September	August	Lowest	Highest	
GDP growth (%)	-10.1	-10.0	-13.4	-6.6	-10.0
Inflation rate (Q4 %)					
- CPI	0.6	0.5	-0.1	1.8	0.6
- RPI	1.2	1.1	0.1	2.3	1.2
LFS unemployment rate (Q4 %)	8.3	8.3	6.2	12.7	8.0
Current account (£B)	-60.3	-76.8	-103.0	-22.1	-56.8
PSNB (2020 – 2021 £B)	326.6	322.2	239.1	385.0	323.6

FORECASTS FOR 2021	Independent				Average* of new forecasts
	Averages		September		
	September	August	Lowest	Highest	
GDP growth (%)	6.7	6.6	3.9	9.7	7.0
Inflation rate (Q4 %)					
- CPI	1.9	1.9	0.5	3.2	2.0
- RPI	2.8	2.7	1.0	4.9	2.8
LFS unemployment rate (Q4 %)	6.6	6.5	5.0	8.6	6.5
Current account (£B)	-73.9	-76.2	-116.3	-19.6	-72.1
PSNB (2021 – 2022 £B)	164.8	164.4	93.1	269.9	160.7

GDP: Gross Domestic Product is the monetary measure of the total market value of final goods & services produced in one year.
CPI: The Consumer Price Index is a measure that examines the weighted average of prices of a basket of consumer goods and services.
RPI: The Retail Price Index is no longer considered an official statistic by the U.K., but it is used for certain types of cost escalation.
Current Account: Records the payments for goods and services, plus investment income and transfers, between an economy and the rest of the world.
PSNB: Public Sector Net Borrowing is a monthly assessment of expenditures minus revenue to determine a fiscal surplus or deficit.

*All averages use the Mean

ANNEX C
UK ECONOMIC FORECASTS BY HMG: OCTOBER 2020

FORECASTS FOR 2020	Independent				Average* of new forecasts
	Averages		October		
	October	September	Lowest	Highest	
GDP growth (%)	-10.1	-10.1	-12.5	-6.6	-10.2
Inflation rate (Q4 %)					
- CPI	0.6	0.6	-0.1	1.8	0.6
- RPI	1.2	1.2	0.1	2.2	1.2
LFS unemployment rate (Q4 %)	7.7	8.3	5.0	12.7	7.3
Current account (£B)	-61.3	-60.3	-88.6	-42.8	-62.1
PSNB (2020 – 2021 £B)	340.6	326.6	239.1	386.3	343.4

FORECASTS FOR 2021	Independent				Average* of new forecasts
	Averages		October		
	October	September	Lowest	Highest	
GDP growth (%)	6.0	6.7	2.5	9.0	5.9
Inflation rate (Q4 %)					
- CPI	1.9	1.9	0.4	3.3	1.9
- RPI	2.7	2.8	0.9	4.8	2.6
LFS unemployment rate (Q4 %)	6.9	6.6	5.0	9.6	7.0
Current account (£B)	-80.6	-69.3	-115.4	-40.0	-81.5
PSNB (2021 – 2022 £B)	184.2	164.8	101.9	268.8	195.4

GDP: Gross Domestic Product is the monetary measure of the total market value of final goods & services produced in one year.
CPI: The Consumer Price Index is a measure that examines the weighted average of prices of a basket of consumer goods and services.
RPI: The Retail Price Index is no longer considered an official statistic by the U.K., but it is used for certain types of cost escalation.
Current Account: Records the payments for goods and services, plus investment income and transfers, between an economy and the rest of the world.
PSNB: Public Sector Net Borrowing is a monthly assessment of expenditures minus revenue to determine a fiscal surplus or deficit.

*All averages use the Mean

ANNEX D
UK ECONOMIC FORECASTS BY HMG: NOVEMBER 2020

FORECASTS FOR 2020	Independent				Average* of new forecasts
	Averages		November		
	November	October	Lowest	Highest	
GDP growth (%)	-10.6	-10.1	-12.4	-8.9	-11.0
Inflation rate (Q4 %)					
- CPI	0.6	0.6	0.1	1.2	0.6
- RPI	1.2	1.2	0.7	1.7	1.2
LFS unemployment rate (Q4 %)	6.4	7.7	4.5	9.1	6.1
Current account (£B)	-61.2	-61.3	-88.6	-31.8	-60.5
PSNB (2020 – 2021 £B)	359.2	340.6	239.1	422.7	366.1

FORECASTS FOR 2021	Independent				Average* of new forecasts
	Averages		November		
	November	October	Lowest	Highest	
GDP growth (%)	5.3	6.0	0.7	7.6	4.8
Inflation rate (Q4 %)					
- CPI	1.9	1.9	0.4	3.9	2.0
- RPI	2.6	2.7	0.9	5.2	2.8
LFS unemployment rate (Q4 %)	7.2	6.9	5.0	9.6	7.2
Current account (£B)	-77.2	-80.6	-118.2	-34.2	-77.5
PSNB (2021 – 2022 £B)	195.9	184.2	101.9	272.5	195.0

GDP: Gross Domestic Product is the monetary measure of the total market value of final goods & services produced in one year.
CPI: The Consumer Price Index is a measure that examines the weighted average of prices of a basket of consumer goods and services.
RPI: The Retail Price Index is no longer considered an official statistic by the U.K., but it is used for certain types of cost escalation.
Current Account: Records the payments for goods and services, plus investment income and transfers, between an economy and the rest of the world.
PSNB: Public Sector Net Borrowing is a monthly assessment of expenditures minus revenue to determine a fiscal surplus or deficit.

*All averages use the Mean

ANNEX E

PwC UK ECONOMIC UPDATE SUMMARY OCTOBER 2020 (ABRIDGED)

"This month's edition provides an update on the latest UK economic data, including the third quarter GDP and employment data. We provide an update to our projections reflecting England's second national lockdown in November and other developments, including the outcome of the US election and progress in a vaccine for Covid-19.

The pace of the UK's economic recovery continues to slow down. After two consecutive quarters of decline the UK economy grew by 15% in Q3 from the previous quarter. But this hides a slow down in the quarterly rate of growth: 6.3% in July; 2.2% in August; and 1.1% in September. This means that more than 80% of the UK's recovery occurred in June and July. As of September economic output stood at 8.2% below pre-Covid levels.

The labour market remains under pressure. In September a record increase of 181,000 people were made redundant, bringing the unemployment rate for the three months to September up to 4.8%. However, there was also a record flow of 215,000 people from economic inactivity to unemployment which suggests that the gradual relaxation of social distancing measures and the opening of schools has encouraged workers to seek employment.

We expect the UK economy to end the year with negative quarterly growth for Q4 of between -2.1% and -3.3%. Therefore the expected contraction in 2020 GDP ranges from -11.2% to -11.4%, before returning to growth of 6.0% to 3.4% in 2021.

Our revised scenarios of 'quick and slow rebounds' reflect the introduction of a second lockdown in England and slow progress in UK-EU trade negotiations. Under our 'quick rebound' scenario we expect the level of GDP to reach pre-pandemic levels in Q3 2022. Under our 'slow rebound' scenario an assumption of further restrictions and a 'thin' trade deal with the EU pushes back recovery to the end of 2023.

Nevertheless, we expect all sectors to return to growth in 2021. With the prospect of an earlier than expected mass roll-out of vaccines in sight we expect the healthcare, hospitality and transport sectors to lead growth in 2021. They are estimated to grow by between 21% to 48% under our quick rebound scenario and 4% to 13% under our slow rebound scenario.

Finally, Government policy continues to evolve rapidly in response to developments in the pandemic, and the coming weeks will likely see key information emerging regarding the outcome of the UK-EU negotiations; consequently, we will continue to revise and refine our scenarios and projections. A new Update will be released in December 2020."

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