*Inside Hybrid Air Vehicles' Airlander 10 with acknowledgement to Design Q*

# The Schools'
# Aerospace Careers Programme
# Newsletter

## Autumn 2023

### *Edited by: Dr Michael Smith FRAeS*

# COVER PICTURE

Inside Airlander 10, the world's largest airship



Image credit: Hybrid Air Vehicles

Details about one of the world's largest aircraft, Airlander 10, reveal a spacious cabin with floor-to-ceiling windows (and plenty of legroom) inside the blimp-like exterior. And the futuristic aircraft will be much better for the environment. British company, Hybrid Air Vehicles, recently released concept images of its forthcoming airship, which is 299 feet (91 meters) long and 112 feet (34 m) wide, with the capacity to hold about 100 people. But rather than being crammed in like sardines, passengers will be treated to floor-to-ceiling windows and the kind of space and legroom commercial airlines currently reserve for business-class customers. The firm thinks the vehicle, which is expected to enter service by 2025, will soon challenge conventional jets on a number of popular short-haul routes, thanks to its improved comfort and 90% lower emissions.

"The number-one benefit is reducing your carbon footprint on a journey by a factor of 10," Mike Durham, Hybrid Air Vehicles' chief technical officer, told Live Science. "But also, while you're going to be in the air a little bit longer than you would if you were on an airplane, the quality of the journey will be so much better." The Airlander is so much greener than a passenger plane, Durham said, primarily because it relies on a giant balloon of helium to get it into the air. In contrast, airplanes need to generate considerable forward thrust with their engines before their wings can provide the lift to get them airborne.

Once it's in the air, the airship relies on four propellers on each corner of the aircraft to push it along. In the first generation, two of these propellers will be powered by kerosene-burning engines, but the other two will be driven by electric motors, further reducing the vehicle's carbon emissions. By 2030, the company expects to provide a fully electric version of the Airlander. Rather than conventional

batteries, liquid hydrogen fuel cells will power the Airlander's electric motors. Liquid hydrogen can store much more energy for a given weight than batteries, Durham said. The hydrogen will be kept in cryogenically cooled tanks in the hull and pumped to the fuel cells, where it will react with oxygen to generate electricity.

The airship design does come with some trade-offs, though. For one, its top speed will be about 80 mph (130 km/h), and it will generally average closer to 60 mph (100 km/h). That's closer to a car or train than a short-haul jet, which cruises at more than 450 mph (720 km/h). For some intercity journeys of around 100 to 250 miles (160 to 400 kilometres), Durham said traveling from one city centre to another is only slightly slower, thanks to the airship's ability to land in much smaller spaces or even on bodies of water.

For example, the company estimates that traveling between Seattle and Vancouver would take just over 4 hours by Airlander compared with slightly more than 3 hours by plane. Crucially, it would produce only 10 lbs. (4.6 kilograms) of carbon dioxide per passenger over that journey, compared with 117 lbs. (53 kg) for a conventional plane. But considering the journey only takes 2.5 hours by car, passengers are more likely to be wooed by the aircraft's creature comforts than it's speed. On that front, Durham is confident the Airlander will be a much more pleasant experience than the alternatives. The cabin is such a small part of the vehicle's overall cross section that it has little effect on drag, which means the company has been able to make the airship much more spacious than a streamlined jet ever could be.

The floor-to-ceiling windows, combined with a cruising altitude below 10,000 feet (3,040 meters), means passengers will get spectacular views. And because the gigantic, helium-filled hull separates the engines from the cabin, there's little vibration and almost no noise. The aircraft is also largely unaffected by turbulence. "Once you're up into the climb, you're pretty much running in a near-silent flight environment," Durham said.

*Original article by Ed Gent, Live Science.*

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# INTRODUCTION

As we approach Christmas and I look back over 2023 the strong theme that emerges for the ACP is one of steady growth and substantial advancement. For example, we have nearly doubled the number of schools we send information to, and that number continues to grow; furthermore, we have substantially increased both the number of Host Schools and companies supporting the ACP with more to be announced in the next edition of the Newsletter.

In addition, we have almost doubled the number of students and teachers that have attended our presentations, and there are still nine more roadshows this academic year. We have also conducted our second trial Network event, and are now about to reach out to schools, and then to companies, to establish what the former would like the Network to include, and the latter to advise how they might do so.

Furthermore, the Board of Trustees has welcomed its first new member – Elaine Whyte – and a recruitment programme will be launched in the New Year to seek up to two more new members. Additionally, the Support Team has grown from effectively zero to four with the recruitment of Emma Versen, Chris Marshall, Mike Stokes and now Lee Mason.

This is not all, our Digital Support under the guiding hand of Mike builds apace with the number of social media platforms about to increase to five with the introduction of our own You Tube channel next month which will feature our first video – the Network day at GKN Aerospace on 9 November.

Likewise, social media link-ups with schools continue to increase as does our knowledge of the schools we support due to the hard work of Emma, and the technology that we now take with us on the Roadshow is quite simply stunning in capability and impact. Chris is the man that makes it all work. And with technology in mind Lee's demonstration of AR/VR totally engages the students. Moreover, we are now almost independent of schools' audio-visual equipment if necessary, and totally independent of their WiFi provision. Spot, as you would expect, steals the show, and a student dressed as an astronaut is the icing on the cake for each school.

As usual this edition contains sections on 4IR, the UK economy, aerospace manufacturing and commercial aviation operations – this time highlighting air traffic control. Then there is the growing Advanced Air Mobility industry, Space, Cyber and the Environment sections, with one new section – UK Defence as a whole. Finally, we provide further information on STEM related careers and, in particular, reference to our growing Useful Contacts links on the page of that name on our website: www.aerospacecareersprogramme.co.uk.

So, in summary, the ACP is now well established and developing most healthily in accordance with sound planning, finance and management, and we look forward to continuing this progression over the years to come always, at the same time, ensuring we meet the needs of the young people we serve.

We sincerely hope all our readers find our series of Quarterly Newsletters helpful, informative and enjoyable. If you have any questions, or would like to discuss sponsorship/support of the Schools' ACP Charity (#1190721) please do contact me on chairman@aerospacecareersprogramme.co.uk

It only leaves me now to wish all of you from all of us at the ACP Team the very warmest best wishes for the Festive Season and every success for 2024. In doing so we invite you to click on the following link: Tree's Company | Happy Holidays from Boston Dynamics - YouTube


Dr Michael Smith FRAeS                                                    November 2023

# THE SCHOOLS'
# AEROSPACE CAREERS PROGRAMME



As you would expect, since the publication of our Summer 2023 Newsletter there has been a great deal of work going on behind the scenes to prepare for our academic year 2023/24 Roadshow of Presentations to Groups of Schools around the UK which commenced on 13 September hosted by Bromley High School and attended by 7 visiting schools and, in all, 161 students (see the News Page of www.aerospacecareersprogramme.co.uk). At the time of 'going to press' the roadshow has now undertaken six more presentations with nine more programmed in the current academic year. So far that has involved 1,137 students and teachers. New to the programme, and therefore not published in the Summer edition, is Silverstone UTC at the world famous motor racing circuit on 16 July 2024.

Several important additions have been made to the roadshow, especially in respect of equipment. One is the addition of SPOT as you can see from the picture above; another is the arrival of our own replica NASA space suit. A third is the 3D printing machine we now use to present the host school with a printed model of the BAE Systems led Tempest sixth generation fighter aircraft and, most recently, ten sets of AR/VR equipment plus three 85" TV screens so that everyone can see what the users are up to.

Also, in an endeavour to ensure we are completely independent of a school's audio-visual and WiFi systems if necessary we have acquired a 120" floor rising screen, an associated short-throw projector, a sound system complete with mixer and lapel microphones, a mobile router that can be used by all members of the presentation team and its associated 5G broadband sim. Finally we have purchased our own Mini 4 Pro drone to both demonstrate and ensure we can take video film if permitted.

Naturally, much other activity has taken place in addition to the Presentations Roadshow. For example, the development of the digital support service embracing our website and increasing social media continues apace and our first YouTube video will be release very shortly featuring our Network event

hosted by GKN Aerospace at their Global Technology Centre in Filton near Bristol. It was 'sold out' and attended by 70 students and teachers.

Regarding the Network, the ACP will shortly begin the process of surveying those schools supporting the ACP to establish exactly what they would like the Network to provide and how, and then once that is known we will survey the companies supporting the ACP to establish how they can assist. In addition, the survey will also include the establishment and involvement of an ACP Alumni for those who have reached the age of 18. Furthermore, in addition to the feedback gained via our website the alumni will enable us to develop a process to ascertain over the coming years the performance and, therefore, success of the ACP.

Concerning our Host Schools, these continue to increase and, because we are now planning the academic year 2024/25 roadshow programme, their number will continue to increase over the next few months onwards. Already our database of schools we provide information to has reached 570. Likewise, contact with industry continues to grow and there will be some very significant developments announced in the Winter 2023/24 Newsletter. The linkage of the ACP's social media platforms with those of our supporting schools' and companies also continues to develop.

Our overall in-person outreach to students and teachers has already exceeded 3,600 and by the end of this academic year should have reached 5,000. Digital outreach is increasing accordingly and we will report on that in the Summer 2024 Newsletter once we have reviewed the 2023/24 academic year.

One new service we will introduce in 2024 will be the development of ACP School Aviation Clubs based on training for and certification of drone piloting. We will report on that in the next Newsletter.

Finally, turning to the Support Team we are delighted to welcome on board Lee Mason as our VR designer. See his Bio on the 'About Us Page' on www.aerospacecareersprogramme.co.uk



*Lee Mason*

# TECHNOLGIES OF THE
# FOURTH INDUSTRIAL REVOLUTION



*Credit: Cadlog                 The Digital Twin – an Industry 4.0 Technology*

We commence this section of the Autumn 2023 Newsletter with an extract from a 'StartUs-Insight' article based on their analysis of 770 start-up and emerging companies which was first published in 2020 and then updated in August 2023 entitled *'10 Top Industry 4.0 Trends & Innovations in 2024'*.

**1. AI and Industry 4.0**
AI and machine learning are driving innovations across industries and functional areas. AI-specific hardware and new algorithms are being developed to optimize the existing systems and tackle new challenges facing manufacturing. **Factories are beginning to integrate AI** across their production systems and processes.

Advanced AI makes it possible to conduct predictive maintenance, cognitive computing, swarm intelligence, context-aware computing, smart machines, hardware accelerators, and generative design. All of these technologies propel manufacturing facilities to move towards complete lights-out manufacturing.

**2. Human Augmentation & Extended Reality**
The physical and cognitive augmentation of humans forms another major industry 4.0 trend. The limitations in humans are being augmented with the help of technologies such as wearables and exoskeletons. Furthermore, industrial mobile devices, natural and intuitive UI (User Interface) and portable machine control screens enhance the ease of using such technology.

XR technologies like **mixed reality (MR)**, **augmented reality (AR)**, and **virtual reality (VR)** are already in use in Industry 4.0 from research and development (R&D) to full-scale production and post-production processes. This multi-experience paradigm is changing the way industrial manufacturing

systems function. The nature of human-machine interaction is aligning more toward machine-enabled workers.

## 3. Edge, Fog & Cloud Computing in Industry 4.0

The immense amount of data being generated by the Industrial Internet of Things (IIoT) is **propelling the adoption of edge, fog, and cloud computing** capabilities in Industry 4.0. Custom hardware and software solutions like connected clouds, distributed clouds, distributed computing and storage, and hybrid computing are shaping this industry 4.0 trend.

Low code development platforms, microservices, mobile computing, and multi-access edge computing are the other technologies advancing the integration of edge, fog, and cloud computing across industries.

## 4. Network & Connectivity

Network and connectivity are among the main driving forces in enabling Industry 4.0. A number of technology developments such as edge-to-cloud, gigabit ethernet time-sensitive networks, low-power wide-area network (LPWAN), **5G**, machine-to-machine communication (M2M), real-time deterministic ethernet, time-sensitive networking (TSN), ubiquitous radio access, unified IoT framework, and zero-touch networks nudge factories to implement IIoT to transform into Industry 4.0 facilities.

These technologies constantly improve machine-machine and human-machine communication, as well as data transmission. As a result, innovations in this area increase speed, improve security and efficiency, and reduce the cost of network connectivity.

## 5. Advanced Robotics

**Advancements in robotics** make the processes in Industry 4.0 faster, more efficient, and safer. The most prominent robotic technologies impacting manufacturing include autonomous robots, collaborative robots (cobots), collaborative autonomous mobile robots, humanoid, mobile robots, cloud robotics, APIs, pick and place robots, and robot swarms.

The use of robots offers higher precision and agility while improving the capability of rapidly developing customizable robots. Robots also free up time for the human workforce to focus on other non-repetitive or high-value tasks.

## 6. Internet of Everything

The **machine-machine**, **human-machine**, and human-human real-time connectedness together comprise the internet of everything in manufacturing. It includes **IIoT**, internet of skills, internet of services, internet of systems, and shop floor IoT.

The internet of everything combines together real-time data, machine intelligence, and human skills, resulting in faster, more efficient, and cost-effective manufacturing processes. Interoperability and a unified internet of things framework are crucial for the smooth implementation of industry 4.0 facilities.

## 7. Big Data & Analytics

The scale of industrial data collection eventually enables factories to make the transition into industry 4.0 facilities. Big data is complex and is valuable only when it is captured, stored, and analysed in a quick and cost-effective manner.

Advancements to utilize data for gaining valuable insights into manufacturing systems, along with the availability of immediate and real-time data, **open up opportunities for prescriptive and predictive analytics** at different levels of a company's manufacturing facilities.

## 8. Additive Manufacturing in Industry 4.0

Manufacturers constantly search for new technologies to cater for all aspects of the growing market demand. Additive manufacturing, which started out as a prototyping technique, is revolutionizing and decentralizing production. Hybrid manufacturing aims to integrate both additive manufacturing and subtractive manufacturing.

The advancements in material science and techniques such as **stereolithography** and metal 3D printing enables a simple fabrication of intricate structures and complex components. **Additive manufacturing** is making highly customizable and sustainable cloud-based production a reality.

## 9. Cybersecurity, Transparency & Privacy

The flow of information due to the connectedness in Industry 4.0 is raising concerns about security, transparency and privacy. As manufacturing practices are increasingly becoming personal and customizable, the data management practices done outside and within the shop floor will hugely influence the appeal of the company. The transmission and processing of sensitive industrial data need to be done securely to avoid cyberattacks on critical industrial facilities.

Digital ethics and privacy, privacy-enhancing technologies, self-adaptive security, zero-trust security, end-to-end communication security, DevSecOps, and blockchain are some of the new developments in this field. The focus on **cybersecurity needs to be balanced with transparency** and privacy.

## 10. Digital Twin

Digital twin technology creates virtual models of industrial assets by combining dynamic real-time sensing and visualization data. Some of the promising use cases of digital twins include model-driven design, virtual prototyping, virtual system validation, throughput optimization, and evolutionary design. The use of digital twins is propelling industry 4.0 manufacturing towards hyper-automation. **Digital twins provide valuable insights** into all steps of the manufacturing process.

And now we continue with our chronological news reporting.

➢ **19 August 2023**

James Titcomb writes a very substantial and pertinent article in The Telegraph about the H100 computer chip that "the world's superpowers are scrambling to own".

The H100, a rectangular black maze of circuits with a shimmering microchip at its centre, is a niche piece of equipment even by Silicon Valley's nerdy standards. Its $40,000 price tag is exceptional for a computer processor, although even if you have the cash, good luck getting your hands on one. The half a million H100s expected to be made this year are already sold out. Not that one chip would do

you much good. Last week, it emerged that Saudi Arabia had ordered some 3,000 H100s. Almost all of the chips are being snapped up by the richest companies in the world: Microsoft, Amazon, Google and Mark Zuckerberg's Meta are believed to account for the vast majority of demand.

Joe Biden has banned their export to China under rules designed to prevent sensitive technology ending up in enemy hands. While more than a trillion microchips – the brains of our electronics – are made each year, the H100 is at the centre of a global race for intelligence. The chip is described by its maker, the Silicon Valley giant Nvidia, as the world's first designed for "generative" artificial intelligence, the type of powerful, "creative" AI behind technologies such as ChatGPT that has taken the world by storm. Now read on at The computer chip the world's superpowers are scrambling to own (telegraph.co.uk)

➤ **20 August 2023**

Rishi Sunak is to spend up to £100m of taxpayer money on thousands of high-powered artificial intelligence chips in an effort to catch up in a global race for computing power, reports James Titcomb.

Government officials have been in discussions with IT giants Nvidia, AMD and Intel about procuring equipment for a national "AI Research Resource" as part of Rishi Sunak's ambitions to make Britain a global leader in the field. The effort, led by science funding body UK Research and Innovation, is believed to be in the advanced stages of an order for up to 5,000 graphics processing units (GPUs) from Nvidia whose chips power AI models such as ChatGPT.

Although £100m has been allocated to the project it is believed that the outlay is seen as insufficient to match the Government's artificial intelligence ambitions, with civil servants pushing Jeremy Hunt to allocate far more funds in the coming months. Read on at Sunak to spend £100m of taxpayer cash on AI chips in global race for computer power (telegraph.co.uk)

➤ **22 August 2023**

In the space of just a few months the spectre of artificial intelligence has come to haunt the world. The release in late 2022 of ChatGPT, the most prominent of a new wave of generative AI models, has ignited concerns about the potentially disastrous consequences of the technology. Depending on the telling, AI could lead to the rapid spread of misinformation, kill democracy, eliminate millions of jobs, even result in the end of the human species. These fears have overshadowed discussions of the technology's promise. Whereas the rapid advances of recent decades – in telecommunications and digital technology, for instance – were often greeted with unwise euphoria, the recent leaps forward in AI have inspired much more circumspection about the direction of technological change. Many people are questioning the hype, realizing that innovation may not always be a good thing. Now read further at Innovation and Its Discontents | Foreign Affairs by Diane Coyle.

➤ **29 August 2023**

The long and pointless virtual meeting has become the bane of many an office worker's day after an explosion in video calls caused by the rise of working from home. But those who cannot stomach the thought of sitting through another Friday afternoon presentation may now have a solution – sending artificial intelligence to do the job instead, writes James Titcomb.

Google is poised to give users of its video-meeting software the option to send an AI assistant to meetings, where it will take notes and present talking points on their human instructor's behalf. The technology is designed to give employees an alternative to cancelling meetings when they have a last-minute change of plans or are forced to attend a different call. However, it could also empower a new wave of slacking-off as employees automate parts of their working day.

The assistant, Duet AI, has been created as a meeting companion, automatically recording and scanning what other attendees say to provide notes on the meeting. It is meant to allow workers to be more productive by preventing them from having to concentrate on meticulous note taking as they go along. Attendees who turn up to meetings late will also be able to ask the chatbot for details about what they have missed and see video clips of key moments. The assistant will also allow workers to skip the meeting altogether, with the AI generating a list of bullet points on their behalf.

When receiving a meeting invitation on their virtual calendars, workers will be able to select an "attend for me" option that will record the meeting and generate the summary. They will be able to write a note that is displayed to other meeting attendees in their absence, or click a "help me write" option that uses AI to create a list of questions or talking points for the meeting. Users will be able to review the auto-generated note before the meeting to prevent it from making inappropriate suggestions or comments. See: Don't want to go to a meeting? Send Google's AI instead (telegraph.co.uk)

> **3 September 2023**

James Titcomb reports that officials are scrambling to secure extra electricity capacity for the likely home of Britain's new sovereign artificial intelligence (AI) lab amid fears the overloaded grid could undermine Rishi Sunak's ambitions for the technology.

The Prime Minister is understood to have become personally interested in efforts to secure extra grid capacity for a supercomputing lab in Bristol, which is the leading contender for a taxpayer-funded £100m "AI Research Resource". It comes amid fears that a lack of power and long delays in accessing additional capacity from the grid could undermine Mr Sunak's bid to establish Britain as an international hub for AI. The Prime Minister is to host a global summit on the technology in November and hopes Britain will play a key role in setting standards and establishing global rules and standards around AI.

Building a system powerful enough to run and assess AI systems will prove crucial to these efforts. However, there are fears that the leading contender for the AI Research Resource will be constrained by the available power supply from the electricity grid. Bristol University's Isambard 3 site, one of the few "Tier 2" supercomputer facilities in the UK, is understood to be the frontrunner to host the project. The site currently has an existing electricity supply of 5 megawatts. This capacity is likely to max out running about 5,000 of the high-performance chips, known as GPUs, that power AI systems. Read: Scramble to secure more power for Rishi Sunak's AI lab (telegraph.co.uk)

> **September 2023**

Dr Robert Joslin FRAeS, Associate Professor, College of Aeronautics, Embry-Riddle Aeronautical University, asks in the September edition of AERO SPACE, can computers replicate the tangible and intangible considerations made by a human? See 'A Turing test for pilots' – how will AI be incorporated in both new and legacy flying machines?

➢ **20 September 2023**

Matthews Field advises that Elon Musk's brain implant company, Neuralink, has been cleared to start recruiting patients for its first human trial. The US start-up, which wants to insert microchips into human brains, has said it secured approval from an independent review board and a hospital partner. Mr Musk said Neuralink's chips could cure paralysis and help restore vision to blind people.

The initial trials will focus on helping people with paralysis control devices using their thoughts, with brain signals picked up by the Neuralink implant. People over the age of 22 who have lost the use of all their limbs can apply to be part of the trial. The study is expected to last six years. The study will include testing the company's R1 Robot, which will surgically insert Neuralink's N1 chip into the patient's brain and wire it up with tiny filaments.

The trial will also test a wireless app that can decode brain signals and control a computer cursor and keyboard. Neuralink said its "prime" study was an important step in creating a "generalised brain interface to restore autonomy to those with unmet medical needs". Now read on at https://www.telegraph.co.uk/business/2023/09/20/elon-musk-neuralink-brain-implant-humans-animal-cruelty/

➢ **27 September 2023**

James Titcombe reports from California that Mark Zuckerberg's Meta has unveiled a £299 pair of sunglasses with an inbuilt artificial intelligence assistant that can answer questions and translate foreign languages on the go. The Ray-Ban Meta smart glasses connect to Meta AI, the company's rival to the ChatGPT chatbot, and respond to voice commands to look up facts or settle disputes. Mr Zuckerberg said the device would help turn high-tech glasses into a mainstream product.

The glasses, which go on sale next month, mark an attempt by Meta to maintain interest in the "metaverse" and catch up to technology such as ChatGPT in AI. The glasses feature cameras that can recognise images in the world around them, for example to identify landmark buildings, or translate food menus written in foreign languages.

Meta launched a pair of sunglasses two years ago that could take photos and make phone calls, but has reportedly only sold around 300,000 pairs with just one in 10 still using the frames. However, Mr Zuckerberg has long seen smart glasses that can project holograms into the real world as the next major device in computing, potentially replacing smartphones as people's most-used gadget.

He said glasses were the "ideal form factor" for interacting with AI, rather than chatting to a chatbot on a screen. "Smart glasses are gonna be an important platform for the future, not only because they're the natural way to put holograms in the world… but also, because if you think about it, the smart glasses are the ideal form factor for you to let an AI assistant see what you're seeing and hear what you're hearing," he said. The AI features will only launch in the US at first.

➢ **7 October 2023**

Brain implants which allow people to dial their emotions up and down could be available in the coming decades, the co-founder of Elon Musk's mind-reading company has said. Philip Sabes, the neuroscientist who founded Neuralink with Musk and six others, said that devices similar to Philip K Dick's Penfield mood organ were on the horizon. In Dick's 1968 science fiction novel, Do Androids Dream of Electric Sheep? - the basis of the film Blade Runner - inhabitants of post-apocalyptic San

Francisco could choose from hundreds of moods ranging from "cheerful" to "self-accusatory depression".

Professor Sabes told a conference in London that such devices were possible and that brain stimulation was already being trialled to help boost the mood of people suffering from untreatable depression. "You could imagine devices where you had multi-dimensional control over your state, including sleep and arousal," he said. "This might sound like it's getting towards sci-fi, like Philip K Dick's mood organ, but the idea that you can wake up and dial up your mood is something that might be a possibility. "You won't need drugs anymore, because everything you can do with drugs you could do with these devices. "If you had this multiple mood keypad, you could decide, I want to feel elated now, or I want to feel focussed, or calm. It sounds like sci-fi, but it's something we will probably be facing in the decades to come."

Deep brain stimulation (DBS) is already being used as an experimental treatment to help patients with severe depression who have reached a point where no other treatment works. The technique involves surgically placing an electrode in "depression circuits" of the brain, such as the ventral striatum, and delivering a low-level pulse to act as a pacemaker, regulating mood at the touch of a button. Patients who have had the implants have reported feeling euphoric and say all thoughts of self-harm and suicide disappear. Read on with Sarah Knapton at Brain implants that control emotions 'available within decades' (telegraph.co.uk)

➢ **17 October 2023**

The US is escalating its semiconductor war against China. Xi Jinping's plan for global mastery of artificial intelligence and supercomputing is about to collide with the hard reality of American power. Cutting edge AI requires ultra-fast chips and enormous 'compute' power to train large language models as they draw on ever larger pools of data. Any company that lacks access to these chips will see costs spiral upwards, leaving it unable to compete at the technological frontier.

Nvidia, the market leader in AI chips, says the rule of thumb is that the computing power required doubles every six to 12 months. China has spent some $100 Billion in three successive 'Manhattan Projects' trying to develop a world-class chip industry, but it is not yet close to parity. It lacks access to the lithography needed to master miniaturisation below 7 nanometres.

The Biden administration has been pulling its punches on semiconductor controls, but this is about to change. The Departments of State, Defense, Commerce and Energy have agreed on a tougher regime for advanced chips and supercomputing technology. It will split the world into two camps: either you are in the advanced US sphere, or you are in the Chinese sphere with areas of strength in 'mid-critical' semiconductors, but a step behind where it really matters. This makes no difference for chips in laptops and 4G mobile, but it is critical for AI and weapons technology. Read further at: America takes dead aim at China's plan for global AI domination (msn.com) by Ambrose Evans-Pritchard.

➢ **19 October 2023**

Matthew Field reports that Amazon has begun testing humanoid robots in its warehouses, insisting the machines will help eliminate repetitive tasks and not replace people. The US tech giant has deployed a mobile, bipedal robot called Digit, that can lift and move containers using its 'hands', in one of the company's warehouses near Seattle. The machine stands 5ft 9 inches tall, weighs 65kg and can carry

up to 35kg. Amazon said in a blog post: "Its size and shape are well suited for buildings that are designed for humans, and we believe there is a big opportunity to scale a mobile manipulator solution, such as Digit, which can work collaboratively with employees." The robot will initially be used to pick up and collect empty baskets for workers, meaning humans will not need to lift as much.

Digit has been built by Agility Robotics, a start-up Amazon backed last year from a $1bn (£820m) investment fund. The launch comes amid fears that artificial intelligence and robotic automation could rapidly replace millions of jobs in both offices and factories. Tye Brady, technology chief at Amazon Robotics, told reporters people were "irreplaceable" in its fulfilment centres. He said the launch of Digit "does not" mean Amazon will need fewer human workers, the Guardian reported. Read on at: Amazon launches humanoid robots to do 'mundane and repetitive' warehouse tasks (telegraph.co.uk)

Also on this date James Titcombe advises that Nokia will slash up to 14,000 jobs after waning demand for 5G mobile networks sparked a drop-off in sales. The Finnish telecoms giant announced the cuts, which amount to as much as one in six staff, as part of a plan to drastically reduce costs. Pekka Lundmark, the company's chief executive, said mobile networks had been "disappointed" with 5G. The take-up of the technology, which promised higher speeds, had been slower than expected.

➢ **21 October 2023**

"It's good to be back home in Vancouver", says Gary Marcus, after a typical 10 days criss-crossing the United States. As an AI startup entrepreneur, Emeritus Professor of Psychology and Neural Science at New York University and a best-selling author, Marcus's work takes him across the continent and beyond. But one destination that is not on his itinerary is Bletchley Park.

In a fortnight, the UK's AI Safety Summit will assemble the great and the good of artificial intelligence in the hope of creating an international 'Bretton Woods'-style agreement to regulate it. Although he was one of three experts invited to give testimony to the United States Congress on AI regulation, alongside OpenAI founder Sam Altman, Marcus hasn't been invited to Buckinghamshire. He isn't surprised that his views aren't welcome.

"Generative AI can't live up to the current expectations," he says. "It's simply not smart enough to do many of the things we think it will be able to do. The systems are not transparent, they're not reliable, they don't really understand the world. These are very serious problems that are not being faced."

Such talk makes him a heretic, and pointing out some very inconvenient truths is not universally welcome. Marcus explains these flaws very elegantly: for years he was The New Yorker magazine's go-to guy to explain developments in neuroscience and data. *Guitar Zero*, his book explaining how the brain learns, based on his own initially hopeless quest to master a musical instrument, became a bestseller. But when so many hopes are pinned on the transformative power of AI, and with venture capitalists in the goldrush phase, a witty sceptic is not what people want to hear. Rather than being burned at the stake, he takes a roasting on social media and snubs such as Bletchley.

"I've been treated badly, but most of it just rubs off. Some of it is genuinely irritating, though," he says. But he's noticing a pattern. Ridicule can be followed by bullying, but then sometime later, his critics concede a vital point. A long-running spat with the distinguished AI pioneer and Meta executive Yann LeCun, a Turing Award winner, saw LeCun loftily tweet Marcus to dismiss his points. Then

one day LeCun simply adopted Marcus' position. Read further at: <u>Meet the AI heretic battling the hype with a warning for Rishi Sunak (telegraph.co.uk)</u> by Andrew Orlowski.

- ➤ **24 October 2023**

Ambrose Evans-Pritchard writes in The Telegraph that "The UK is galloping ahead with the world's most advanced ecosystem for commercial nuclear fusion, the ultimate prize of clean and limitless energy. The British national plan is superb. But it could be even better. The Government risks betting everything on one technology, and it is not the one winning the global race.

The International Atomic Energy Agency's conference on fusion last week was a festival of optimism following breakthroughs that shatter all assumptions about the future of energy. Some 65pc of specialists think commercial fusion at viable cost could be a reality by 2035, and 90pc by 2040. The stakes are massive. Fusing two hydrogen nuclei into a larger helium atom replicates the process of the sun, releasing 20 million times more energy than burning fossil fuels. It is endlessly renewable. It promises baseload power around the clock.

It could be an economic rocket-booster for two or three pioneer countries first able to roll it out anywhere near the goal of $50-$60 MWh. "The moment the first fusion electron hits the grid, the world is going to change," said Nick Walkden, UK director of the Fusion Industry Association. He says the Government could help seal the UK's place as a fusion superpower by offering the industry CfD contracts, as it does for wind, solar, and fission."

- ➤ **26 October 2023**

The dangers of AI cannot be ignored, states The Telegraph in an editorial. Because it is short and important we quote it in full here.

*Any of the scenarios sketched out by the Government for the future progression of artificial intelligence (AI) are alarming. They include the development of deadly bioweapons, automated cybersecurity attacks, mass unemployment and social breakdown. A discussion paper focuses on what is called Frontier AI – highly capable systems far more advanced than anything we have at present. Much of this is guesswork. No one really knows how AI will mutate, whether it will work as intended or if it will have a malign impact or be greatly beneficial. It is the job of governments to mitigate the possibility of the former while enhancing the latter.*

*To that end, Rishi Sunak has sought to show leadership by convening a summit of leaders and experts from around the world to be staged next week at Bletchley Park, home to Britain's wartime code-breakers. Past technological breakthroughs, such as the Industrial Revolution or the recent extraordinary developments in communications, have been mainly market-driven, with state intervention to ameliorate some of the more egregious consequences coming later. These included regulation to ensure safer working conditions, to prohibit child labour or, latterly, to control content on the internet.*

*Mr Sunak, in a speech on Thursday, said there should be "no rush to regulate", but equally the dangers posed by AI could not be ignored or left solely to non-state players such as Google and others developing the technology. This must be the right approach. The benefits of AI could be enormous if*

*properly harnessed in many areas of life, but the pitfalls need to be addressed and, if possible, avoided before it is too late to do anything.*

*The danger is that governments and state actors will stifle innovation when the presumption should be in favour of encouraging it. But there is a quid pro quo: the companies involved in AI technology have to demonstrate far more awareness of what it is they are unleashing – and certainly more than they did with the free-for-all on the internet. We do not yet fully understand what AI is capable of, where it is going and whether anything can or should be done to contain it. Arguably, Mr Sunak has more immediate problems on his plate ahead of a general election. But he cannot be faulted for taking this matter seriously.*

> ### 1 November 2023

We conclude this Autumn edition of the Newsletter with reference to a joint article by James Titcombe, Matthew Field and Amy Gibbons in The Telegraph which reports on the Prime Minister's AI summit at Bletchley Park. China, the US and the EU have signed Rishi Sunak's declaration warning of the potential for "catastrophic harm" from artificial intelligence.

Twenty-seven countries – all those attending the Prime Minister's AI summit – as well as the EU have put their name to the 'Bletchley declaration', an agreement to work together to address risks from AI. It warns: "We are especially concerned by such risks in domains such as cybersecurity and biotechnology, as well as where frontier AI systems may amplify risks such as disinformation. There is potential for serious, even catastrophic, harm, either deliberate or unintentional, stemming from the most significant capabilities of these AI models. Given the rapid and uncertain rate of change of AI, and in the context of the acceleration of investment in technology, we affirm that deepening our understanding of these potential risks and of actions to address them is especially urgent." Read on at: China and US sign Bletchley declaration warning of 'catastrophic' risks from AI (telegraph.co.uk)

And we leave the final word to His Majesty who addressed the summit via video link calling AI "one of the greatest technological leaps in the history of human endeavour". Read in full at: AI is greatest breakthrough since splitting the atom, says King Charles (telegraph.co.uk)

# THE UK ECONOMY



Credit: bnn                    *Chancellor Jeremy Hunt*

The following is an article by Roger Bootle, a senior independent adviser to Capital Economics, dated 29 October 2023 which we include as an opening to this section during the current turbulent times.

Pity the members of the Monetary Policy Committee (MPC) who meet this week to decide what to do about interest rates. As usual, it is a delicate judgment. To make matters worse, there are now serious doubts about the reliability of key official statistics. We have always known that official statistics should come with a government health warning but recently their reliability has seemed to deteriorate.

Two months ago, we saw a dramatic upward revision to GDP which squashed the story that the UK had been a laggard in recovering from Covid. According to the latest figures, the UK is shown as pretty much in the pack with other European countries. Moreover, GDP performance since the Brexit vote in 2016 is also shown as reasonable, albeit not as strong as the United States and Canada, but roughly in line with France and a fair bit stronger than Germany and Italy.

More recently, it has emerged that UK labour market data is also under suspicion. The response rate to the survey on which official employment and unemployment data is based has fallen to just 15pc, down from almost 50pc 10 years ago. This has since forced the Office for National Statistics to seek other methods of estimating labour market data.

At least, you might say, the figures on inflation itself are hard and fast and don't get revised. But this isn't much consolation. There are a number of different measures of inflation, with the main ones being RPI and CPI. More importantly, the current rate of inflation, on whichever measure you choose, is not a very good indicator of what inflation is going to be in the future and is, therefore, not the best guide to setting monetary policy.

Monday will see the publication of some figures which, arguably, should command much more attention, namely data on money supply. Last month, Britain's money supply was shown as contracting year on year. Interestingly, the same thing has been happening in the US and the eurozone. Fully paid-up monetarists, who give close attention to such data, argue that this shows that central banks have already overdone the monetary tightening and that it is now high time they began to loosen policy by reducing interest rates, as well as ending the policy of Quantitative Tightening, under which they sell government bonds back to the market. The aim, they say, should be to keep the money supply expanding at a steady rate determined by the sustainable real growth of the economy and the targeted rate of inflation, plus an allowance for an increased – or decreased – demand to hold money.

In fact, things aren't quite so straightforward. We don't know what the sustainable real rate of growth of the economy is, nor how demand for money is likely to evolve. Moreover, controlling the money supply is easier said than done. Central banks can try to influence it by their interest rate policy and by varying their sales and purchases of financial assets. But this gives them less than perfect control, to put it mildly.

Furthermore, there is a serious debate to be had about the relative importance of stocks and flows. The money supply might have started to contract, but this does not necessarily mean there is an inadequate amount of money in the system, because the current bout of negative monetary growth follows an earlier period when the money supply was expanding quite strongly. Accordingly, it is perfectly possible that the current stock of money is still excessive in relation to the need to reduce inflation to its 2pc target. Indeed, that is how things currently seem – although it wouldn't take many months of monetary contraction to eradicate this excess. More generally, there is a serious problem with the reliability of monetary data as a guide to inflationary pressures. In the UK, we discovered this all too painfully in the 1980s.

Like everything else in the economy, the financial system is constantly in flux and movements between different financial instruments can cause major changes in the monetary aggregates that have no bearing on aggregate demand or inflation. That is why in the mid-1980s, even those ministers and officials who had earlier pinned their colours to the monetarist mast felt forced to change their position and abandon red claw monetarism. So the money supply is, in my view, not an indicator that you can rely on absolutely come what may. It should, however, be seriously considered, along with others, in an assessment of what is likely to happen to aggregate demand and inflation.

I also attach importance to what is happening to bank lending. Strikingly, bank lending growth has recently been dropping back sharply and has indeed turned negative. When both the money supply and bank lending are contracting, at the very least monetary practitioners should ask themselves why this is, and ask why this should not be presumed to lead to sharply lower inflation. Such is the change in the monetary environment that the Shadow Monetary Policy Committee, of which I am a member, recently voted for an immediate reduction in interest rates of 0.25pc.

I was one of the dissenting few who voted instead to keep rates on hold. I am not generally known as a fence-sitter but I would like to see more data before deciding which way to jump. For me, data on the money supply and bank lending would be an important element in that decision. Yet the money supply has been virtually ignored by the members of the MPC. It is extraordinary that the British economic policy-making establishment has moved within a comparatively short period of time from believing that money was pretty much all that mattered to believing that it doesn't matter at all. In my view, both positions are wrong.

[Since this article was published in The Telegraph, the Bank of England MPC has decided to keep interest rates on hold.]

We now look at selected news items which led up to this article's date.

➢ **1 September 2023**

Eir Nolsøe reports that new official figures show that the UK economy shrank less and bounced back faster during the pandemic after the Office for National Statistics (ONS) admitted its previous assumptions were too gloomy. The revised figures add nearly 2pc to the size of the economy as of the end of 2021, meaning Britain recovered to its pre-pandemic size almost two years ago.

The ONS previously said the economy was still 1.2pc smaller than its pre-lockdown size at the time. However, GDP is now believed to have been 0.6pc above pre-pandemic in the final three months of 2021, dispelling the notion that the UK is the only G7 country that had failed to bounce back from Covid. Assuming that data in 2022 and 2023 are not heavily revised, it suggests the economy is now much bigger than its pre-Covid levels – not 0.2pc smaller as current figures suggest.

Chancellor Jeremy Hunt said: "The fact that the UK recovered from the pandemic much faster than thought shows that once again those determined to talk down the British economy have been proved wrong. There are many battles still to win, most of all against inflation so we can ease cost of living pressures on families. But if we stick to the plan we can look forward to healthy growth which according to the IMF will be faster than Germany, France and Italy in the long term."

Economist Julian Jessop said that while the impact was largely symbolic two years later, the revisions showed that "Brexit Britain is no longer the outlier people thought it was". He said: "Bigger revisions are not a surprise because of the uncertainty created by the impact of Covid. But the good news is that it's upward revisions rather than down. Unless there is now a massive downward revision in 2022, which there won't be, the UK has just leapt up the G7 league table for growth. Symbolically, I think it is significant because it means that people can no longer say that the UK is the weakest of the world's major economies. That's no longer true when we're somewhere in the middle of the pack rather than being at the bottom of the table." Mr Jessop said that it was possible other countries would also revise their pandemic growth figures, making it difficult to predict exactly how the UK compares with its peers.

The ONS said the economy shrank by less than expected in 2020, shrinking by 10.4pc rather than 11pc. In 2021, the stats body now estimates the economy bounced back by 8.7pc, rather than an earlier estimate of 7.6pc growth. Ruth Gregory of Capital Economics said the revisions suggested the UK economy has expanded by 1.5pc compared with before the pandemic rather than being 0.2pc smaller. This would put the UK ahead of Germany, which has only grown 0.2pc, and just behind France at 1.7pc to the second lowest rung among the G7 countries where data is available.

George Buckley of Nomura said the revised data could help explain why the Bank of England initially underestimated inflation, as consumer demand was stronger than originally suggested. He said the stronger-than-expected growth could bolster the case for interest rates staying higher for longer as policymakers may decide that "inflation might be a bit stickier going forward".

Mr Buckley said: "It could justify the notion of what the market is expecting, which is another couple of rate hikes." The Bank of England has raised interest rates 14 times since December 2021, lifting them from 0.1pc to 5.25pc. Read on at: UK economy bigger than before the pandemic, ONS admits (telegraph.co.uk)

➢ **13 October 2023**

Tim Wallace writes that "Amid Britain's underwhelming growth, economists question how bad it could get" He goes on to say that a split is growing between policymakers in Downing Street and their counterparts at the Bank of England. Listen to one side and you will find that growth is robust and the economy strong, yet switch to the other and you'll find Britain on the brink.

Unsurprisingly, Chancellor Jeremy Hunt is in the bullish camp. "The UK has grown faster than France and Germany," says the Chancellor, as he said on Thursday that the economy is proving "more resilient than expected". However, over in the City of London, Swati Dhingra, a member of the Bank of England's Monetary Policy Committee, sees things differently. "The chances of recession or not recession is going to be pretty equally balanced," she said in a BBC interview. "It's not going to be great times ahead."

So which is it? August's GDP figures found that the economy grew by 0.2pc, which itself is a welcome, albeit underwhelming, return to growth after output slid by 0.6pc in strike-riven July. However, the long-term growth pattern matters more than any individual month's figures, and that is where analysts see worrying signs. Read on at: The four charts that show the UK economy is flatlining (telegraph.co.uk)

➢ **20 October 2023**

Szu Ping Chan advises that Jeremy Hunt has "wiggle room" for pre-election tax cuts after the Government borrowed almost £20bn less than official forecasts. Stronger tax receipts and lower debt interest payments helped fuel the windfall, as public borrowing stood at £14.3bn in September, according to the Office for National Statistics (ONS). This was £4bn less than economists had predicted, meaning borrowing has undershot official predictions every month this financial year.

Overall, Britain has borrowed £19.8bn less than expected in 2023. September's boost was aided by a 7pc rise in tax receipts compared with a year earlier, including increases in income tax and VAT. Corporation tax receipts jumped as big companies paid their tax bills. Debt interest payments also eased sharply amid slower price rises, although high inflation is expected to keep debt service costs high for several years.

September's deficit means the Government has borrowed £81.7bn so far this financial year to plug the gap between tax revenues and public spending. This is far less than the £101.5bn that the Office for Budget Responsibility (OBR), the independent tax and spending watchdog, predicted just six months ago. The figures will pile pressure on the Chancellor to announce tax cuts ahead of the next election. Mr Hunt has already ruled out tax cuts in the Autumn Statement next month, warning instead of "difficult decisions" on spending. Read further at: Hunt handed £19.8bn borrowing boost ahead of Autumn Statement (telegraph.co.uk)

➢ **31 October 2023**

The interest rate cycle seems finally to have peaked, says Jeremy Warner at Markets are right to bet on higher for longer interest rates (telegraph.co.uk).

By common agreement, all three of the central banks due to make policy decisions this week – the US Federal Reserve, the Bank of England and the Bank of Japan – are set to leave rates on hold. At its council meeting in Athens last week, the European Central Bank decided to further pause its monetary tightening; both the Fed and the Bank of England are expected to do the same. Many believe that's the end of it – that the rate rises that began nearly two years ago have run their course.

I wouldn't disagree, though another quarter point from the Bank of England, which faces more acute inflationary pressures than elsewhere, is still just about possible. The rather bigger question nevertheless now becomes: when will official policy rates might start falling and how low they'll go? On this, I'm going to take issue with my colleague, Ambrose Evans-Pritchard.

I've no doubt official rates will be coming down – very late 2024 or early 2025 is my guess – with the presidential election in the US and a general election in the UK getting in the way of anything earlier – but I also think the pandemic was a defining moment, which has transitioned us from a negative real interest rate environment back into a more normal world of more expensive money costing somewhat more than the rate of inflation. A real rate of interest, in other words, which, up until the financial crisis, is broadly the way it used to be. It's the near-zero rates of the post-financial crisis years which are the aberration.

Judging by the recent surge in bond yields, investors have made up their minds that the so-called natural rate of interest (otherwise known as the neutral rate, or r-star) – a rate which is neither contractionary or expansionary but keeps output at potential and inflation stable – has shifted permanently higher. I agree, but would argue that rates are also higher because investors have started to worry not just about inflation, but credit risk as well. In the UK, we haven't quite reached the crossover point yet: the inflation rate remains stubbornly higher than both the official policy rate and government bond yields. But at some stage next year as inflation falls back towards target, that moment will come.

Read on at the link above, but see also Ambrose Evans-Pritchard and take a view: Inflation is dying and bonds are a screaming buy (telegraph.co.uk)

# AEROSPACE MANUFACTURING

In early 2023, a joint survey from the Royal Aeronautical Society and digital manufacturing specialists, Protolabs, was conducted to learn more about the aerospace sector's most important concerns and top priorities. **Tim Robinson** FRAeS examines the results.

*The rear centre fuel tank for the Airbus A321XLR built directly into the fuselage*

"It may be a cliché, but it is a time of unprecedented change in the global aviation, aerospace and space industries. No sooner had the Covid pandemic ended, temporarily grounding air travel, than a high-intensity peer-on-peer war erupted in Eastern Europe with Russia's invasion of Ukraine. Climate action, meanwhile, is now top of the agenda in many places, and the aerospace industry is racing to decarbonise itself – even as it struggles with supply chain shortages and a skills crisis. Meanwhile, sci-fi dreams of flying taxis, rockets that land vertically, hotels in space and now AI that can hold lengthy conversations with humans, are almost here. All of these external factors make for a challenging landscape for today's firms to navigate when deciding on technology and investment priorities.

This landmark survey, with an impressive take-up, saw over 1,800 responses from RAeS members, with respondents ticking job roles, such as Engineer (29.48%), Procurement (15.15%), Product Designer/Development (13.66%), R&D (12.61%), Retired (8.46%), Other (8.08%), IT/Digital (7.47%) and Student (5.09%). In addition, as might be expected for the 'Other' category, this also included a significant number of respondents with 'pilot' in their job title. In terms of seniority, some 27.32% of respondents were in the 'Middle Management' category, while 23.41% described

themselves as 'Experienced' and 21.73% as 'Team Lead' level. Let us take a look at some of the key takeaways from this survey.

**Key takeaways**

Reflecting on the key priorities of the global aerospace industry, recruiting more skilled personnel was chosen as the number one focus by respondents at 52.9%, closely followed by Sustainability (51.6%) and Supply Chain Shortages (50.7%). This tracks closely with the sector-wide skills crisis the aerospace industry now finds itself in, with a combination of demographics and workers not returning after being furloughed or downsized during the pandemic. Meanwhile, the sustainability agenda is also accelerating as the industry races to decarbonise itself. Yet, aerospace is still reeling and attempting to play catch-up with disrupted supply chains that have played havoc with tightly integrated 'just-in-time' global networks. In November 2022 Airbus CEO Guillaume Faury said he expected 'supply chain constraints' to last another year.

The 'Other' (5.59%) category, which allowed respondents to specify additional issues threw up some further challenges and issues, such as 'inflation and its negative effects on sustainability and growth', 'regulation changes post-leaving EASA', 'fuel price increases' and a call from one respondent to embrace digitalisation fully: "….the industry is operating in the past. Most of the leaders in the industry are missing the key lessons regarding AI and automated systems. Nobody is looking at information technology as a key component in aerospace… Why?"

Meanwhile, the survey found that CNC machining (53.85%) was the key prototyping/manufacturing technology in the aerospace sector, followed by 3D printing (51.41%) and then Robotic Manufacturing (44.88%) and Injection Moulding (41.51%). While the option of CNC machining in grinding, cutting and milling metallic structures as the number one choice is perhaps no surprise for aircraft production, the selection of 3D printing/additive manufacturing by nearly 50% of respondents is more noteworthy. This indicates that 3D printing has now gone mainstream in the aerospace and space industry, passing from a niche 'rapid prototyping tool' to more widespread use. Indeed, earlier this year saw the first-ever fully 3D-printed rocket, Terran 1, attempt to reach orbit.

In the 'Other' category at 4.10%, additional suggestions included 'casting', 'digital twinning' and 'MBSE (model based system engineering)', as well as several entries suggesting 'composites and composites moulding'.

**In-house or outsourced?**

Roughly 25-50% of components are manufactured in-house, found the survey, with 39.68% of respondents picking this option, followed by 23.35% indicating a greater vertically integrated in-house capability at 51-75% and 21.35% for more outsourced enterprises – under 25%. This backs up consolidation trends in the aerospace industry that have seen mergers and acquisitions in recent years concentrate manufacturing in a smaller number of large 'Tier 1' or 'Super Tier 1' suppliers.

**The digital skills gap**

However, in embracing the possibilities of this new digital manufacturing landscape, the survey highlighted that the aerospace sector could well be falling behind with respondents selecting 'Lack of expertise' as the biggest obstacle – highlighting a growing need for 'digital natives' and IT specialists

in the aerospace industry. Despite its history of being on the cutting-edge of technology, the aerospace industry is now competing with the financial sector, app developers, AI specialists, motorsports and more. Indeed, consultants McKinsey found that, for every traditional engineer the global aerospace and defence (A&D) industry is trying to recruit, it is also trying to recruit two software engineers.

Other challenges identified were 'Project costs' – an admission perhaps that investing in 'Factory 4.0' technology may be initially expensive. Meanwhile, 'Secure networks/cybersecurity' was also highlighted as a concern. This is particularly relevant with the current geostrategic environment and the 'decoupling' of some industries from China and Russia.

The industry as a whole is significantly automated with 29.84% of respondents replying their manufacturing was 51-75% automated, followed closely by the 25-50% segment (28.47%). Interestingly, some 11.29% of respondents chose 'none' as an answer. This could very well indicate sub-sectors in small batch production, artisan-style manufacturing, such as rebuilding WW2 'warbirds' or assembling custom UAV prototypes.

In automated manufacturing, it would also be interesting to revisit this question in a few years' time to see the effect of the nascent eVTOL sector on the answers. Here 'air taxi' manufacturers are aiming for automotive-levels of production with Archer and Vertical both planning 2,000 air vehicles a year. This is over double the 661 airliners that Airbus delivered in 2022 and strongly suggests that the level of automation will increase.

As might be expected from a highly-regulated industry, designing safety-critical equipment and components, 'quality' was the overriding (64%) factor chosen by respondents in designing and manufacturing parts for the aerospace sector. Yet 'quality' is not purely just about safety – but also flows into overall costs with tightly integrated and complex supply chains, where the discovery of substandard parts or components can cascade further down the production process and disrupt deliveries. Recent examples include the pause in some Boeing 737 MAX deliveries, due to sub-standard fittings from Spirit AeroSystems. The focus on quality, standards and experts on hand was echoed in the largest (47.47%) 'very important' answer to the question: 'How important is certification when working with manufacturing partners?''

**Certification priorities**

A free-form poll of the most valuable aerospace certifications to hold produced a wide range of answers – not all of them manufacturing related. However, despite the UK respondents slightly outnumbering US ones in this survey, the number of people who put 'FAA' as a single answer outnumbered 'EASA' two to one – potentially a sign of how dominant the US still is in the global aviation regulatory framework and the importance of designing products for this key market.

Finally, the top priority for the next three years was again recruiting skills and talent (55.77%), followed by sustainability (52.33%) and ramping up civil production post-Covid (47.56%).

This then is a clear message about the immediate skills and recruitment crisis that the industry is facing – and one that if not solved, then the other two (sustainability/ramping up production) cannot happen. Among the comments in the 'Other' category (4.83%) were 'Competition with China, Security of Proprietary Data and Technology', 'Space Exploration and Commercialisation' and, interestingly, one

suggestion that: 'a strong PR campaign should be launched to counteract present trends that (falsely) consider aviation a highly polluting industry.'

**Summary & Conclusion**
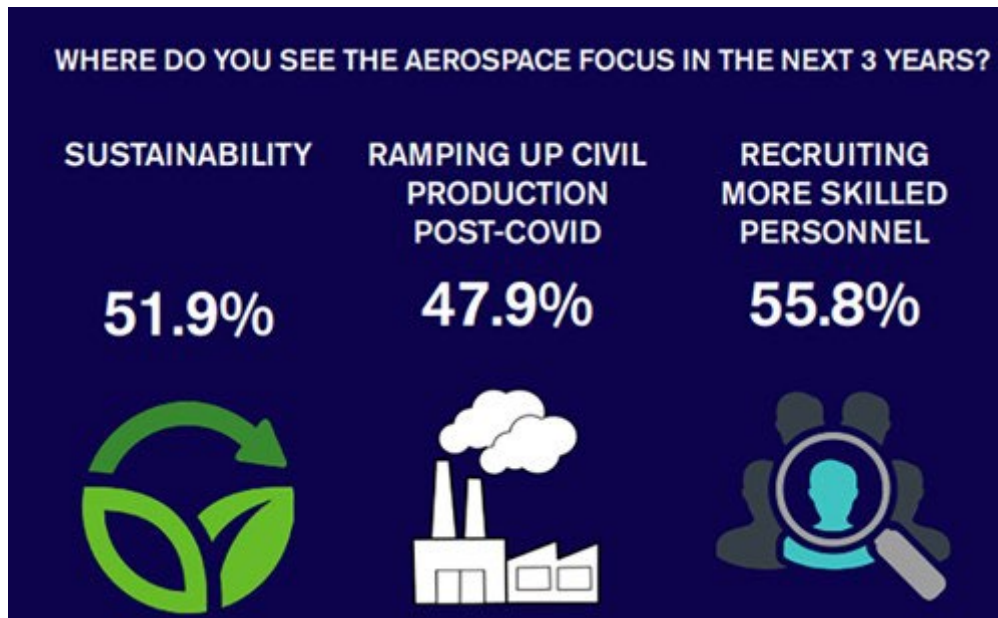


In conclusion then, this was a landmark survey into the state of the aerospace industry in 2023, providing a significant snapshot of the global aerospace sector as it emerges from the pandemic and attempts to ramp up production, recruit skilled workers and meet sustainability targets. It will be interesting to see what lies ahead for the industry in the future, and good to keep a close eye on how widely digital manufacturing expands through the industry."

Continuing now with our chronological news items …

➢ **4 August 2023**

Ben Marlow, The Telegraph's Chief City Commentator, reports "from a 'burning platform' to a red-hot turnaround in the space of just a few months." Assessments don't come much more withering than the one that Tufan Erginbilgic made upon taking charge of Rolls-Royce in January. Shocked employees were told that Rolls had been so "grossly mismanaged" that it was now a "burning platform" that urgently needed to reduce debts and make more money. It was a high-stakes gamble but it appears to have focused minds dramatically. Just six months later Rolls looks to be firing on all cylinders again as it surges back into the black amid a flurry of bumper orders from overseas customers.

Let's hope ministers are paying attention for once. The revival of the 117-year-old industrial titan – one of Britain's most prestigious companies – should be the catalyst for it to be picked to spearhead the country's push into so-called mini-nukes. As if one was needed anyway. Rolls might have flirted with bankruptcy during the pandemic, but then so too did many of the world's largest corporations. Its engineering prowess and status as a national champion remain unchanged, and it is staging a welcome resurgence. There won't be a better time to throw the full weight of the state behind it.

Turnover is up by nearly a third to £6.9bn thanks partly to a record order for 68 Trent XWB-97 engines from Air India, and another engine order from the US Army to power the Bell V-280 Valor tiltrotor helicopter that will replace its aging fleet of Black Hawks. Now read on at: <u>One of Britain's most prestigious companies is being senselessly undermined (telegraph.co.uk)</u>

➢ **August 2023**

This month's edition of AERO SPACE reports that Airbus has opened its new Wing Technology Development Centre in Filton, a subject which is taken up in detail by Stephen Bridgewater in the October edition under the heading of 'Wing of tomorrow'.

Robert Coppinger discusses ionic propulsion, and in the September edition he does likewise with magnetic rim-ducted fans

➢ **17 September 2023**

John-Paul Ford Rojas writes in This is Money that "The boss of defence contractor BAE Systems has opened the door to Saudi Arabia becoming involved in the UK's flagship fighter jet programme. Charles Woodburn, BAE's chief executive, said the kingdom can "offer a lot" and had a talented workforce that could boost the project. Woodburn was speaking after it emerged that the Saudi government is pushing to become a full partner in the international global combat air programme. The project, currently a collaboration between the UK, Italy and Japan, aims to get a demonstrator jet in the air by 2027.



*Credit: BAE Systems*

Britain has already committed £2 billion to the programme, which aims to deliver Tempest – Britain's next-generation supersonic stealth combat aircraft – by 2035. But doubts have been raised about its viability in a recent official report. The involvement of Saudi Arabia could unlock a huge source of funding for a project expected to cost tens of billions of pounds, as well as engineering expertise.

Woodburn, speaking at a recent defence industry event in London, emphasised that any decision on including Saudi Arabia would be taken at a government level. But he stressed during the event at the Royal United Services Institute that the Gulf nation, where BAE employs 7,000 "very capable" staff, had more to contribute than just cash. "For any programme, the kingdom can offer a lot in terms of talent base," he said. Saudi Arabia is already a leading buyer of UK military aircraft, including Typhoons.

But the country's direct involvement in a flagship defence collaboration could prove controversial, given its abysmal human rights record. It is also said to have raised hackles in Japan, with Tokyo reportedly opposing it on the grounds that it could delay the project.

The UK collaborated with Spain and Germany on the Typhoon programme, but with that generation of jets due to be replaced, those countries are now pursuing their own project. Woodburn said that only the US had the financial clout to develop a fighter jet alone and for other countries it was a "team sport". "My objective all the way through has been to get the strongest team we possibly can around the table." He said the countries currently involved were making "very good progress". But he added: "When it comes to future partnerships, then I think the door is open."

The project's lead contractors – Britain's BAE, Japan's MHI and Italy's Leonardo – said last week that they had agreed on the next steps to deliver the concept phase. When asked about Saudi involvement, Richard Berthon, the Ministry of Defence lead on the programme, said that "while there had been conversations to explore future options, there had been no decision beyond that." See: https://www.thisismoney.co.uk/money/markets/article-12528375/BAE-opens-door-Saudi-Arabia-tie-Tempest-fighter-jet-programme.html

➢ **26 September 2023**

And staying with BAE Systems, Nick Gutteridge reports that Rishi Sunak is pushing Berlin to approve the sale of Typhoon jets to Saudi Arabia ahead of a visit to Britain by Mohammed bin Salman. The Prime Minister has personally urged Olaf Scholz, the German chancellor, to give the green light to the defence deal, which is worth at least £5billion. Typhoon jets are designed, manufactured and maintained by BAE Systems, which employs 5,000 people on the programme in Lancashire.

However, defence sources told The Telegraph it was possible Germany could "scupper" the inter-government deal agreed in March 2018 to sell 48 of the multi-role jets to the Middle Eastern country, which accounts for 12pc of BAE revenues. The Eurofighter Typhoon was developed by a consortium of British, German, Italian and Spanish companies under NATO's watch in the 1980s. As a result, the consent of all four nations involved is required to export the planes.

Germany imposed a ban on exporting weapons to the Middle Eastern country after Saudi agents killed Jamal Khashoggi, a journalist and critic of Crown Prince Mohammed. Mr Sunak has become heavily involved in talks over how to rescue the agreement, which is threatened by splits within the German coalition. The Crown Prince is expected to visit the UK this autumn after he and the Prime Minister pledged to boost Anglo-Saudi defence ties. See: Sunak urges Scholz to back £5bn sale of jets to Saudi Arabia (telegraph.co.uk)

> **October 2023**

Following the USAF announcement earlier that it is helping to fund a full-scale prototype blended wing body (BWB) aircraft, Stephen Bridgewater in AERO SPACE asks how this could affect the future US aerospace industry.

> **14 October 2023**

Howard Mustoe reports that the global aviation industry is grappling with a fake parts scandal that has left airlines and regulators scrambling to assess engines and trace equipment. The emergency has grounded flights and sparked lawsuits, amid claims that a one-time DJ based in the South of England is at the centre of a ploy to pass off old parts with doctored papers. The fake parts scandal began in August when a document was circulated by European aviation regulators asking airline companies and their suppliers to investigate errant engine parts. Two months later and the true scale of the problem is emerging: TUI, Virgin Australia and nearly every major US carrier have been caught up in the crisis which has forced the grounding of jets and delayed flights as operators try to weed out bogus components of unknown origin.

The company said to be at the centre of the scandal is British-headquartered AOG Technics, founded and owned by 35-year-old Jose Zamora Yrala. Zamora has been accused by US engine giant General Electric and its French business partner Safran of large-scale fraud that they allege has led to fake or old parts being falsely installed into more than a hundred engines. His company is accused of falsifying the records that come with aviation components to show they are the real deal. CFM, a joint venture between GE and Safran that manufacturers engines, is now pursuing a legal case against AOG in Britain's High Court. Zamora is defending the case. Read on at: The airline parts scandal sparking panic and introspection in aerospace (telegraph.co.uk)

> **18 October 2023**

Howard Mustoe also writes that ten months after joining, Tufan Erginbilgic's master plan to rescue Rolls-Royce is emerging. The chief executive has announced up to 2,500 job cuts in an effort to make the engineering giant "fit for the future". In the process, he will be hoping to crush the corporate fiefdoms that have confounded the efforts of his predecessors to modernise the company.

By targeting redundancies in areas such as finance, HR and procurement, Erginbilgic – who has been nicknamed "Turbofan" by analysts in reference to the modern jet engine – will curb the autonomy of the company's three biggest divisions in an attempt to fix the loss-making business for good.

While Rolls-Royce is best known for making engines for passenger jets, the company also makes turbines for fighter jets and bombers and has a large business called Power Systems, mostly based in Germany, that makes diesel-burning engines for electricity generators, trains and ships.

Each division has historically had wide leeway to manage its own budget and this has led to duplication of both jobs and costs in areas such as personnel management and legal advice. Erginbilgic was not shy in calling out these inefficiencies when he took charge. He told staff in January that the company was a "burning platform" and had "not been performing for a long, long time".

The former BP executive then said in May that the power business had been "grossly mismanaged", stoking speculation that he may sell the division. Instead, he is bringing it closer into the Rolls-Royce fold. The cuts will centralise many of the spending and buying decisions of the three businesses: civil, defence, and power. Read further at: 'Turbo' Tufan has wielded the axe at Rolls-Royce – now he's after its culture (telegraph.co.uk)

- **26 October 2023**

A giant airship built by a company backed by the billionaire co-founder of Google will take to the skies after receiving approval from a US regulator, reports Gareth Corfield at Airship half the length of Hindenburg cleared to fly (telegraph.co.uk)

The 400ft-long blimp, named Pathfinder 1, has been approved for 25 test flights in California, with its first journey set to take place at Moffett Airfield on an unspecified date. LTA Research, the start-up behind the airship, was founded in 2014 and has received $250m (£205m) in backing from ex-Google executive Sergey Brin. Flight tests will begin with the airship – which has been built at a California hangar near Google's headquarters – tied to a mast for safety reasons.

At half the length of the Hindenburg, perhaps the world's most infamous airship, Pathfinder 1 differs from the German aircraft in that it flies using inert helium gas rather than highly flammable hydrogen. Pathfinder 1 is also powered by electric motors rather than the 1930s aircraft's diesel engines and is expected to reach speeds of up to 75mph.

- **31 October 2023**

And we conclude this section of our Autumn Newsletter with the news that a report from the ADS Group has revealed new aircraft orders are at their highest since 2014. The report shows that 2,188 orders have been placed so far in 2023, with single-aisle aircraft accounting for almost 80%. Global deliveries have risen 12% compared with the previous year, with single-aisle and wide-body aircraft increased by 10% and 24% respectively at the end of Q3. Order backlogs have also hit a record-breaking high at 14,690 aircraft - a 10% increase on Q3 2022 – with an estimated value of £229 Billion for the UK aerospace sector.

# COMMERCIAL AVIATION OPERATION



*Cranfield University Airport's new Digital Air Traffic Control Centre*

We commence this section with an explanation of one of the most important elements of aviation operation – Air Traffic Control (ATC). It is taken from an entry in Wikipedia, the references for which can be found online.

ATC is a service provided by ground-based air traffic controllers who direct aircraft on the ground and through a given section of controlled airspace, and can provide advisory services to aircraft in non-controlled airspace. The primary purpose of ATC worldwide is to prevent collisions, organize and expedite the flow of air traffic, and provide information and other support for pilots.

Air traffic controllers monitor the location of aircraft in their assigned airspace by radar and communicate with the pilots by radio. To prevent collisions, ATC enforces traffic separation rules, which ensure each aircraft maintains a minimum amount of empty space around it at all times. It is also common for ATC to provide services to all private, military, and commercial aircraft operating within its airspace. Depending on the type of flight and the class of airspace, ATC may issue *instructions* that pilots are required to obey, or *advisories* (known as *flight information* in some countries) that pilots may, at their discretion, disregard. The pilot in command is the final authority for the safe operation of the aircraft and may, in an emergency, deviate from ATC instructions to the extent required to maintain safe operation of their aircraft.

In accordance with requirements of the International Civil Aviation Organization (ICAO), ATC operations are conducted either in the English language or the language used by the station on the ground. In practice, the native language for a region is used; however, English must be used upon request.

The primary method of controlling the immediate airport environment is visual observation from the airport control tower. The tower is a tall, windowed structure located on the airport grounds. Air traffic controllers are responsible for the separation and efficient movement of aircraft and vehicles operating on the taxiways and runways of the airport itself, and aircraft in the air near the airport, generally 5 to 10 nautical miles (9 to 18 km) depending on the airport procedures. A controller must carry out the job using the precise and effective application of the rules and procedures that apply; however, they may need flexible adjustments according to differing circumstances, often under time pressure.

Surveillance displays are also available to controllers at larger airports to assist with controlling air traffic. Controllers may use a radar system called secondary surveillance radar for airborne traffic approaching and departing. These displays include a map of the area, the position of various aircraft, and data tags that include aircraft identification, speed, altitude, and other information described in local procedures. In adverse weather conditions, the tower controllers may also use surface movement radar (SMR), surface movement guidance and control system (SMGCS), or advanced surface movement guidance and control system (ASMGCS) to control traffic on the manoeuvring area (taxiways and runway).

The areas of responsibility for tower controllers fall into three general operational disciplines: local control or air control; ground control; and flight data/clearance delivery. Other categories, such as airport apron control or ground movement planner, may exist at extremely busy airports. While each tower may have unique airport-specific procedures, such as multiple teams of controllers at major or complex airports with multiple runways, the following provides a general concept of the delegation of responsibilities within the tower environment.

Remote and virtual tower (RVT) is a system based on air traffic controllers being located somewhere other than at the local airport tower and still able to provide air traffic control services. Displays for the air traffic controllers may be live video, synthetic images based on surveillance sensor data, or both.

**Local control or air control**

Local or Air control is responsible for the active runway surfaces. Air control clears aircraft for take-off or landing, ensuring that prescribed runway separation exists at all times. If the air controller detects any unsafe conditions, a landing aircraft may be instructed to 'go-around' and be re-sequenced into the landing pattern. This re-sequencing will depend on the type of flight and may be handled by the air controller, approach, or terminal area controller.

Within the tower, a highly disciplined communications process between air control and ground control is an absolute necessity. Air control must ensure that ground control is aware of any operations that will impact the taxiways, and work with the approach radar controllers to create gaps in the arrival traffic to allow taxiing traffic to cross runways and to allow departing aircraft to take off. Ground control needs to keep the air controllers aware of the traffic flow towards their runways to maximise runway utilisation through effective approach spacing. Crew resource management (CRM) procedures are often used to ensure this communication process is efficient and clear. Within ATC, it is usually known as TRM (team resource management) and the level of focus on TRM varies within different ATC organisations.

**Ground control**

Ground control (sometimes known as ground movement control, GMC) is responsible for the airport movement areas, as well as areas not released to the airlines or other users. This generally includes all taxiways, inactive runways, holding areas, and some transitional aprons or intersections where aircraft arrive having vacated the runway or departure gate. Exact areas and control responsibilities are clearly defined in local documents and agreements at each airport. Any aircraft, vehicle, or person walking or working in these areas is required to have clearance from ground control. This is normally done via VHF/UHF radio, but there may be special cases where other procedures are used. Aircraft or vehicles without radios must respond to ATC instructions via aviation light signals or else be led by vehicles with radios. People working on the airport surface normally have a communications link through which they can communicate with ground control, commonly either by handheld radio or even cell phone. Ground control is vital to the smooth operation of the airport because this position impacts the sequencing of departure aircraft affecting the safety and efficiency of the airport's operation.

Some busier airports have surface movement radar (SMR), such as ASDE-3, AMASS, or ASDE-X, designed to display aircraft and vehicles on the ground. These are used by ground control as an additional aid to control ground traffic, particularly at night or in poor visibility. There is a wide range of capabilities on these systems as they are being modernized. Older systems will display a map of the airport and the target. Newer systems include the capability to display higher-quality mapping, radar targets, data blocks, and safety alerts, and to interface with other systems such as digital flight strips.

**Flight data and clearance delivery**

Clearance delivery is the position that issues route clearances to aircraft, typically before they commence taxiing. These clearances contain details of the route that the aircraft is expected to fly after departure. Clearance delivery or, at busy airports, ground movement planner (GMP) or traffic management coordinator (TMC) will, if necessary, coordinate with the relevant radar centre or flow control unit to obtain releases for aircraft. At busy airports, these releases are often automatic and are controlled by local agreements allowing 'free-flow' departures. When weather or extremely high demand for a certain airport or airspace becomes a factor, there may be ground 'stops' (or 'slot delays') or 're-routes' to ensure the system does not become overloaded.

The primary responsibility of clearance delivery is to ensure that the aircraft has the correct aerodrome information, such as weather and airport conditions, the correct route after departure, and time restrictions relating to that flight. This information is also coordinated with the relevant radar centre or flow control unit and ground control to ensure that the aircraft reaches the runway in time to meet the time restriction provided by the relevant unit. At some airports, clearance delivery also plans aircraft push-backs and engine starts, in which case it is known as the ground movement planner (GMP); this position is particularly important at heavily congested airports to prevent taxiway and apron gridlock.

Flight data (which is routinely combined with clearance delivery) is the position that is responsible for ensuring that both controllers and pilots have the most current information: pertinent weather changes; outages; airport ground delays/ground stops; runway closures; etc. Flight data may inform the pilots using a recorded continuous loop on a specific frequency known as the automatic terminal information service (ATIS).

**Approach and Terminal Control**

Many airports have a radar control facility that is associated with the airport. In most countries, this is referred to as terminal control and abbreviated to TMC; in the US it is referred to as a TRACON (terminal radar approach control). While every airport varies, terminal controllers usually handle traffic in a 30-to-50-nautical-mile (56 to 93 km) radius from the airport. Where there are many busy airports close together, one consolidated terminal control centre may service all the airports. The airspace boundaries and altitudes assigned to a terminal control centre, which vary widely from airport to airport, are based on factors such as traffic flows, neighbouring airports and terrain. A large and complex example was the London Terminal Control Centre which controlled traffic for five main London airports up to 20,000 feet (6,100 m) and out to 100 nautical miles (190 km) before being temporarily relocated to Swanick as part of a redevelopment programme.

Terminal controllers are responsible for providing all ATC services within their airspace. Traffic flow is broadly divided into departures, arrivals, and overflights. As aircraft move in and out of the terminal airspace, they are handed off to the next appropriate control facility (a control tower, an en-route control facility, or a bordering terminal or approach control). Terminal control is responsible for ensuring that aircraft are at an appropriate altitude when they are handed off, and that aircraft arrive at a suitable rate for landing.

Not all airports have a radar approach or terminal control available. In this case, the en-route centre or a neighbouring terminal or approach control may co-ordinate directly with the tower on the airport and vector inbound aircraft to a position from where they can land visually. At some of these airports the tower may provide a non-radar procedural approach service to arriving aircraft handed over from a radar unit before they are visual to land. Some units also have a dedicated approach unit which can provide the procedural approach service either all the time or for any periods of radar outage.

ATC also provides services to aircraft in flight and between airports. Pilots fly under one of two sets of rules for separation: visual flight rules (VFR) or instrument flight rules (IFR). Air traffic controllers have different responsibilities to aircraft operating under the different sets of rules. While IFR flights are under positive control, in the US and Canada VFR pilots can request 'flight following' which provides traffic advisory services on a time permitting basis and may also provide assistance in avoiding areas of weather and flight restrictions, as well as allowing pilots into the ATC system prior to the need for a clearance into certain airspace. Across Europe, pilots may request a 'Flight Information Service', which is similar to flight following. In the UK it is known as a 'basic service'.

En-route air traffic controllers issue clearances and instructions for airborne aircraft, and pilots are required to comply with these instructions. En-route controllers also provide air traffic control services to many smaller airports around the country, including clearance off the ground and clearance for an approach to an airport. Controllers adhere to a set of separation standards that define the minimum distance allowed between aircraft. These distances vary depending on the equipment and procedures used in providing ATC services.

**General characteristics**

En-route air traffic controllers work in facilities called air traffic control centres. Each centre is responsible for a given flight information region (FIR). Each flight information region covers many thousands of square miles of airspace and the airports within that airspace. Centres control IFR aircraft

from the time they depart from an airport or terminal area's airspace to the time they arrive at another airport or terminal area's airspace. Centres may also 'pick up' VFR aircraft that are already airborne and integrate them into the system. These aircraft must continue under VFR flight rules until the centre provides a clearance.

Center controllers are responsible for issuing instructions to pilots to climb their aircraft to their assigned altitude while, at the same time, ensuring that the aircraft is properly separated from all other aircraft in the immediate area. Additionally, the aircraft must be placed in a flow consistent with the aircraft's route of flight. This effort is complicated by crossing traffic, severe weather, special missions that require large airspace allocations, and traffic density. When the aircraft approaches its destination, the centre is responsible for issuing instructions to pilots so that they will meet altitude restrictions by specific points, as well as providing many destination airports with a traffic flow which prohibits all of the arrivals being bunched together. These flow restrictions often begin in the middle of the route as controllers will position aircraft landing in the same destination so that when the aircraft are close to their destination they are sequenced.

As an aircraft reaches the boundary of a centre's control area it is 'handed off' or handed over to the next area control centre. In some cases this hand-off process involves a transfer of identification and details between controllers so that air traffic control services can be provided in a seamless manner; in other cases local agreements may allow 'silent handovers' such that the receiving centre does not require any co-ordination if traffic is presented in an agreed manner. After the hand-off, the aircraft is given a frequency change and begins talking to the next controller. This process continues until the aircraft is handed off to a terminal controller.

**Radar coverage**

Since centres control a large airspace area they will typically use long range radar that has the capability, at higher altitudes, to see aircraft within 200 nautical miles (370 km) of the radar antenna. They may also use radar data to control when it provides a better picture of the traffic or when it can fill in a portion of the area not covered by the long range radar. In the US system, at higher altitudes, over 90% of the US airspace is covered by radar and often by multiple radar systems; however, coverage may be inconsistent at lower altitudes used by aircraft due to high terrain or distance from radar facilities. A centre may require numerous radar systems to cover the airspace assigned to them, and may also rely on pilot position reports from aircraft flying below the floor of radar coverage. This results in a large amount of data being available to the controller. To address this, automation systems have been designed that consolidate the radar data for the controller. This consolidation includes eliminating duplicate radar returns, ensuring the best radar for each geographical area is providing the data, and displaying the data in an effective format.

Centres also exercise control over traffic travelling over the world's ocean areas. These areas are also flight information regions (FIRs). Because there are no radar systems available for oceanic control, oceanic controllers provide ATC services using procedural control. These procedures use aircraft position reports, time, altitude, distance and speed to ensure separation. Controllers record information on flight progress strips and in specially developed oceanic computer systems as aircraft report positions. This process requires that aircraft be separated by greater distances, which reduces the overall capacity for any given route.

Some air navigation service providers (e.g., Airservices Australia, the US Federal Aviation Administration, Nav Canada, etc.) have implemented automatic dependent surveillance-broadcast (ADS-B) as part of their surveillance capability. This new technology reverses the radar concept. Instead of radar 'finding' a target by interrogating the transponder, the ADS-B equipped aircraft sends a position report as determined by the navigation equipment on board the aircraft. ADS-C is another mode of automatic dependent surveillance; however ADS-C operates in the 'contract' mode where the aircraft reports a position, automatically or initiated by the pilot, based on a predetermined time interval. It is also possible for controllers to request more frequent reports to more quickly establish aircraft position for specific reasons. ADS-C is significant because it can be used where it is not possible to locate the infrastructure for a radar system (e.g. over water). Computerized radar displays are now being designed to accept ADS-C inputs as part of the display. This technology is currently used in portions of the North Atlantic and the Pacific by a variety of states who share responsibility for the control of this airspace.

Precision approach radars (PAR) are commonly used by military controllers of several countries to assist the pilot in final phases of landing in places where an instrument landing system and other sophisticated airborne equipment is unavailable to assist the pilots in marginal or near zero visibility conditions. This procedure is also called 'talkdown'.

A radar archive system (RAS) keeps an electronic record of all radar information, preserving it for a few weeks. This information can be useful for search and rescue. When an aircraft has 'disappeared' from radar screens a controller can review the last radar returns from the aircraft to determine its likely position. RAS is also useful to technicians who are maintaining radar systems.

**Flight traffic mapping**

The mapping of flights in real-time is based on the air traffic control system and volunteer ADS-B receivers. In 1991, data on the location of aircraft was made available by the US Federal Aviation Administration (FAA) to the airline industry. The National Business Aviation Association (NBAA), the General Aviation Manufacturers Association, the Aircraft Owners and Pilots Association, the Helicopter Association International, and the National Air Transportation Association petitioned the FAA to make ASDI information available on a 'need-to-know' basis.

Subsequently, NBAA advocated the broad-scale dissemination of air traffic data. The Aircraft Situational Display to Industry (ASDI) system now conveys up-to-date flight information to the airline industry and the public. Some companies that distribute ASDI information are FlightExplorer, FlightView, and FlyteComm. Each company maintains a website that provides free updated information to the public on flight status. Stand-alone programs are also available for displaying the geographic location of airborne IFR air traffic anywhere in the FAA air traffic system. Positions are reported for both commercial and general aviation traffic. The programs can overlay air traffic with a wide selection of maps such as geo-political boundaries, air traffic control centre boundaries, high altitude jet routes, satellite cloud and radar imagery.

**Potential Problems; Traffic and Weather**
The day-to-day problems faced by the air traffic control system are primarily related to the volume of air traffic demand placed on the system and weather. Several factors dictate the amount of traffic that can land at an airport in a given amount of time. Each landing aircraft must touch down, slow, and

exit the runway before the next crosses the approach end of the runway. This process requires at least one, and up to four, minutes for each aircraft. Allowing for departures between arrivals, each runway can thus handle about 30 arrivals per hour. A large airport with two arrival runways can handle about 60 arrivals per hour in good weather. Problems begin when airlines schedule more arrivals into an airport than can be physically handled, or when delays elsewhere cause groups of aircraft – that would otherwise be separated in time – to arrive simultaneously. Aircraft must then be delayed in the air by holding over specified locations until they may be safely sequenced to the runway.

Up until the 1990s, holding, which has significant environmental and cost implications, was a routine occurrence at many airports. Advances in computers now allow the sequencing of planes hours in advance. Thus, planes may be delayed before they even take off (by being given a 'slot'), or may reduce speed in flight and proceed more slowly thus significantly reducing the amount of holding.

Air traffic control errors occur when the separation (either vertical or horizontal) between airborne aircraft falls below the minimum prescribed separation. Separation minimums for terminal control areas (TCAs) around airports are lower than en-route standards. Errors generally occur during periods following times of intense activity when controllers tend to relax and overlook the presence of traffic and conditions that can lead to loss of minimum separation.

Beyond runway capacity issues, the weather is a major factor in traffic capacity. Rain, ice, snow or hail on the runway cause landing aircraft to take longer to slow and exit, thus reducing the safe arrival rate and requiring more space between landing aircraft. Fog also requires a decrease in the landing rate. These, in turn, increase airborne delay for holding aircraft. If more aircraft are scheduled than can be safely and efficiently held in the air, a ground delay program may be established, delaying aircraft on the ground before departure due to conditions at the arrival airport.

In Area Control Centres (ACC) a major weather problem is thunderstorms, which present a variety of hazards to aircraft. Aircraft will deviate around storms, reducing the capacity of the en-route system by requiring more space per aircraft or causing congestion as many aircraft try to move through a single hole in a line of thunderstorms. Occasionally weather considerations cause delays to aircraft prior to their departure as routes are closed by thunderstorms.

Much money has been spent on creating software to streamline this process. However, at some ACCs air traffic controllers still record data for each flight on strips of paper and personally coordinate their paths. In newer sites these flight progress strips have been replaced by electronic data presented on computer screens. As new equipment is brought in more and more sites are upgrading away from paper flight strips.

Turning now to our chronological news reporting there is good news for British Airways staff.

➢ **4 August 2023**

James Warrington reports that staff at British Airways have secured a pay rise worth more than 13pc, reversing cuts rolled out at the height of the pandemic. Around 24,000 employees at the airline will receive a 13.1pc increase in pay over an 18-month period, as well as a one-off payment of £1,000, the Unite union said.

The deal, which excludes pilots and management, restores and increases pay after British Airways used so-called 'fire and rehire' tactics during the pandemic, leading to many workers suffering pay cuts. The company said there was potential for pay to increase further, while no member of staff will have the pay increase applied at a lower rate of pay than they were receiving in 2020.

> **3 September 2023**

Matt Oliver advises that, months before an expected showdown with climate campaigners, Gatwick Airport's chief executive has insisted that the airport's expansion plans do not conflict with net zero and will boost Britain's economy. Stewart Wingate insisted the airport would put in place measures to mitigate the impact of adding capacity to fly and stressed "the economic benefits" of adding a second runway. It comes as Rishi Sunak prepares to face down the Government's climate advisers over demands for ministers to halt the expansion of airports.

The Prime Minister is preparing to reject the Climate Change Committee's formal advice that all airport expansions must be halted, The Telegraph revealed. Mr Sunak believes airport expansion is key to boosting Britain's growth. Gatwick's £2.1bn proposal, which was submitted this summer, would allow it to operate up to 300 extra flights a day by bringing its northern runway into full-time use. At the moment, the strip is used as a taxiway or serves as a stand-in when the main runway is unavailable.

The change would allow the annual number of flights at Gatwick to rise from 285,000 to 386,000, according to plans submitted in July. Climate campaigners are preparing to challenge the expansion at public hearings scheduled for the first half of 2024 on the grounds that it would conflict with the need to reduce the air industry's carbon emissions. They have argued that British holidaymakers travelling to Europe should instead be urged to catch the train. The proposal also faces opposition from disgruntled residents in Surrey and Sussex over the extra noise that could be created. Read on at: Gatwick second runway won't clash with net zero, says airport chief (telegraph.co.uk)

> **6 September 2023**

The air traffic control chaos which saw hundreds of flights cancelled last week was caused after a flight plan glitch made it look like a plane would jump out of UK airspace, the industry body has said, reports Jack Simpson. National Air Traffic Services (NATS) said its automated air traffic control system experienced a "one in 15 million" event, which presented a flight plan with two identical location codes, one of which was in the UK, while another was in a different part of the world.

Last week, tens of thousands of travellers faced huge delays across the UK's airports after the fault at NATS forced the body to manually process flights for six hours. According to the report, on the Bank Holiday Monday alone there were more than 1,500 cancellations, with 575 flights delayed, while disruption continued throughout Tuesday as airlines attempted to recover their schedules.

Flight plan data sent to NATS includes codes – five letter capitalised words – which are used to mark a plane's entry point into UK airspace and its exit point when it leaves. After NATS accepts the plan, it is sent to EuroControl, the European air traffic control body, which processes the data alongside that of other European flights. During this stage, the flight plan inadvertently picked up a duplicated exit point with the same five letter code which corresponded to a different point in another part of the world outside UK airspace. When this was returned to the NATS system it was unable to properly read the

data and entered a 'fail safe mode', meaning both the primary system and its backup shut down. The flight plan in question was never put into practice. Read further at: <u>Air traffic control chaos caused after glitch appeared to show plane jumping out of UK airspace (telegraph.co.uk)</u>

- ➢ **11 September 2023**

Jack Simpson also reports that Wizz Air has been forced to ground some of its planes and warned it would run fewer flights over Christmas after faults were uncovered in engines used by Airbus. The budget airline said its capacity for the second half of the year would be 10pc lower after issues were uncovered with engines in its Airbus SE A320neo aircraft.

Aerospace supplier RTX informed Wizz Air that it had detected issues with a certain engine manufactured by US aviation giant Pratt & Whitney. The faulty engines are used in some A320neo aircraft. While other British airlines including easyJet use that aircraft, other British and European carriers are understood to rely on engines manufactured by different suppliers.

The issue with the Pratt & Whitney engines involves a "rare condition in powder metal used to manufacture certain engine parts which could cause them to crack" RTX said. A number of Wizz Air engines will need to be checked for the remainder of the year and into 2024. The airline said it was "assessing the implications to understand the extent of the impact on its fleet".

The engine is used in hundreds of Airbus SE A320neo aircraft and will see hundreds of planes ground across the globe. RTX estimates that around 600 to 700 engines will have to be removed. Wizz Air said it would "continue to work with Pratt & Whitney to minimise the impact to its fleet plan and costs to the business". Read further at: <u>Wizz Air forced to ground planes after fault uncovered with engines (telegraph.co.uk)</u>

- ➢ **4 October 2023**

The Farnborough International News Network (FINN) announces that Farnborough Airport will become the first UK airport to adopt a next generation 'hybrid' digital control tower working position, as part of a new project with air traffic service provider, NATS, and digital tower platform supplier, Searidge Technologies.

The new digital working capability will provide the airport's controllers with enhancements to manage aircraft both by direct visual reference from the control tower window as they do today, and via fully interactive panoramic video presentation on screen displaying key parts of the airfield. Strategically placed ultra-high-definition cameras will provide the controllers with customisable views of the airfield, including around the airport's new, state of the art hangar development, Domus III, due to open next year.

Not only will the cameras be able to provide views that could otherwise be distant or obscured from the tower, but Searidge's technology platform will give the controllers access to tools which provide improved tracking of the whole airport surface via integration of new ADS-B surveillance and 'head-up' labelling of the panoramic video. This new technology will allow the controllers to monitor individual aircraft and airport vehicles more effectively, boosting safety and efficiency especially during low visibility scenarios such as fog. The deployment is the first of its kind in the UK and

represents the next evolution in airport air traffic management, delivering the technology enhancements of a digital solution but within an airport's existing control tower.

➢ **11 October 2023**

Jamie Bullen reports in The Telegraph that all flights to and from Luton Airport have been suspended until 3pm after a major fire caused a multi-story car park to partially collapse. Up to 1,500 cars were affected as flames ripped through the third floor of the airport's newly built Terminal Car Park 2. Five people, including four firefighters, were admitted to hospitals in Luton and Dunstable for smoke inhalation. Another patient was discharged at the scene. Bedfordshire Fire and Rescue said the car park had suffered a "significant structural collapse" as more than 100 firefighters tackled the flames.
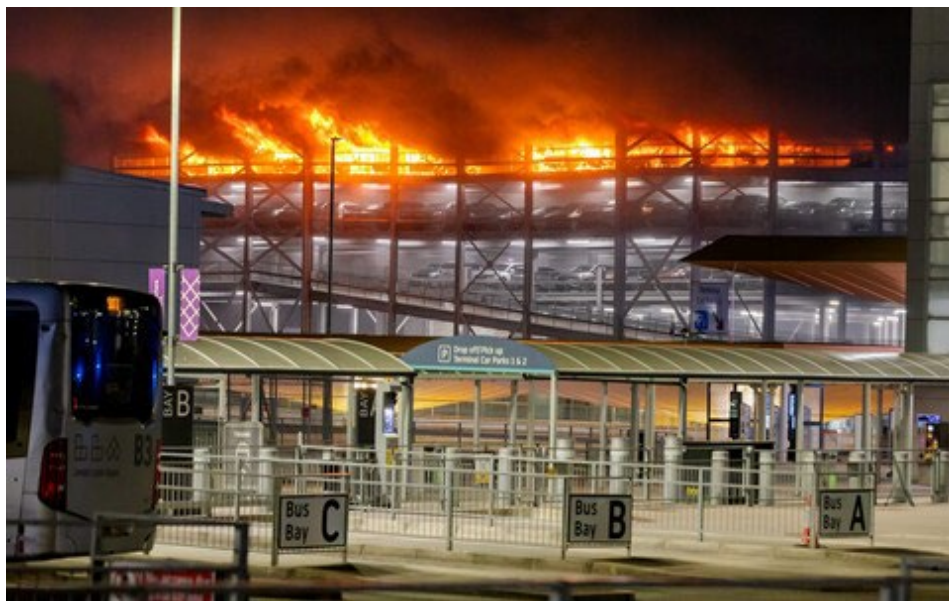


Read on at: Luton Airport: All flights suspended after huge fire rips through car park (telegraph.co.uk)

➢ **29 October 2023**

Ryanair chief executive Michael O'Leary has urged Boeing to get its s--- together as he threatened to abandon aircraft orders if the manufacturer does not deliver on time, writes Luke Barr in The Telegraph. His warning comes just days after the US aviation giant revealed fresh delays to deliveries of its flagship 737 Max. Setbacks at Boeing have already forced Ryanair to make changes to its winter schedule, disrupting holiday plans for up to 1.4m passengers. Last week, Boeing said it expects to deliver between 375 and 400 of its narrow-body aircraft this year, which is lower than previous forecast of 400 to 450.

Mr O'Leary has responded to the announcement by saying Ryanair could scrap orders if Boeing is unable to deliver another batch of planes in time for next summer. He said: "Boeing needs to get its act together and start delivering these aircraft on time. I had a lot of sympathy for Boeing. The Max was grounded for two years, but that was two years ago. It's time for them to get their s--- together and start delivering these aircraft." See: Ryanair threatens to scrap aircraft orders as Boeing crisis deepens (telegraph.co.uk)

# ADVANCED AIR MOBILITY



Credit: sUAS News

In the Summer 2023 edition of our Newsletter we introduced the rapidly developing aviation sector called Urban Air Mobility (UAM) which is an element of the wider field of Advanced Air Mobility (AAM) – or as it is sometimes colloquially known – flying taxis. However, that is a much too restrictive name. If one asks Microsoft's AI powered Bing 'what is AAM?' the following is the answer:

*Advanced Air Mobility (AAM) is a new concept of air transportation that aims to move people and goods using electric vertical take-off and landing (eVTOL) aircraft. It is a part of the aviation industry's efforts to deliver new and innovative products to the market. AAM seeks to develop new, environmentally friendly aircraft designs to move people and goods and, in many cases, it involves eVTOL aircraft. These technologies have the potential to benefit consumers and contribute to the UK's Jet Zero objectives.*

*The Civil Aviation Authority (CAA) is working on developing an appropriate regulatory framework for the safe introduction of passenger-carrying eVTOL aircraft. BAE Systems defines AAM as an air transport system concept that integrates new, transformational aircraft designs and flight technologies into existing and modified airspace operations. The National Business Aviation Association (NBAA) defines AAM as a new concept of air transportation using eVTOL aircraft to move people and cargo between places not currently or easily served by surface transportation or existing aviation modes. The Florida Department of Transportation (FDOT) defines AAM as an air transportation system that moves people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible.*

Earlier this year the Farnborough International News Network (FINN) published the five principal findings of a survey into the AAM industry by Orbit Management Services which the latter entitled 'AAM Risk Report 2023'. In undertaking the survey Orbit involved more than 150 executives and

experts across the globe and gathered exclusive insights into experts' perceptions of the developments in the AAM industry and its complex risk landscape.

Here are the top five takeaways from the AAM Risk Report 2023:

1. **AAM industry outlook: Strongest outlook for logistics and enterprise applications**

The AAM industry represents a disruptive force, promising revolutionary changes in transport and logistics. While there may be some scepticism and uncertainty in the short term, the entire industry and all sub-sectors are expected to experience positive developments and opportunities in the long term. By 2033 logistics and enterprise applications especially are poised for significant growth. These areas show the most optimistic outlook, even with challenges such as regulatory delays and battery technology limitations.

2. **Regulatory risks dominate in the short and long term**

The AAM industry's risks are diverse. yet regulatory issues are perceived as the biggest challenge. both in the short and long term. Key risks include battery technology limitations, airspace integration challenges, regulatory delays, and certification and airworthiness standard concerns. Addressing these challenges requires technological and regulatory innovation and effective collaboration between regulatory bodies and industry leaders.

3. **Lack of government support, unsustainable business models and increasing competitive pressures**

Other critical risks identified in the report include a lack of government support, unsustainable business models. and growing competition within the AAM industry. These factors underscore the need for strategic planning and support from diverse stakeholders to ensure sustainable growth and innovation within the field as they help address technological and regulatory challenges, ensuring long-term growth and economic sustainability.

4. **Need for balanced risk management**

Managing the different risks is essential for informed decision-making and fostering a resilient ecosystem. Orbit's AAM Risk Report emphasises the importance of balanced risk management within the AAM industry. Risk management responsibilities are generally split between the private sector (focusing on technology and business) and the public sector (focusing on policy, regulation, and leadership) requiring cooperative action. Stakeholders must address risks proactively to ensure the growth and resilience of the entire ecosystem. This involves enhancing risk identification, investing in risk readiness, and fostering collaboration as part of a unified strategy.

5. **Collaboration and strategic partnerships between the public and private sectors**

Building on the need for a cooperative approach in risk management, both private and public sectors should engage in strategic partnerships to address an array of concerns. This encompasses technological development, business and policy challenges, regulatory compliance, infrastructure planning, and insurance matters. Collaboration within the industry, across sectors, and at the

international level is crucial for collective resilience. Stakeholders must align and collaborate for a sustainable and resilient AAM ecosystem, recognizing that a coordinated approach will be vital in navigating the complex risk landscape.

FINN suggests that this report shows that while the road to realising AAM's potential is fraught with challenges, it also presents exciting opportunities. Success in this dynamic field will likely depend on collaboration and innovation, a clear understanding of risks, and robust strategies to navigate them. As the industry evolves, this report offers a crucial roadmap for those striving to drive growth and innovation in the advanced air mobility landscape.

To learn more about this new and rapidly developing sector of aerospace and aviation we recommend the September edition of the RAeS's AERO SPACE journal entitled 'Future of Flight'. In particular, 'Prepare for take-off', an article by Charlotte Bailey who explains those eVTOL designs which are closest to being ready for market; and an article by Jack Richardson entitled 'Going the distance' who discusses regional air mobility (RAM).

Furthermore, Darrell Swanson and Jarek Zych from EA Maven, and AAM consultancy, ask "Where might RAM services fit into next generation air transport systems?" And they answer questions put to them by AERO SPACE on UAM and RAM.

Additional references that readers may care to consider are:

UK Research and Innovation's independent 'Market assessment for advanced air mobility in the UK. See: Market assessment for advanced air mobility in the UK – UKRI

UK Government Funds New 'Advanced Mobility Ecosystem Consortium' | FutureFlight

Advanced Air Mobility challenge | Civil Aviation Authority (caa.co.uk)

Advanced Air Mobility - UK Economic Impact Study - PwC UK

ADS launches Advanced Air Mobility (AAM) Market Outlook - ADS Group

Why the urban air mobility market (UAM) won't take off until 2030 (verdict.co.uk)

Finally, have a look at these two video clips by AERTEC entitled' What is Advanced Air Mobility?': Bing Videos and 'What is Urban Air Mobility?' by Global Update: Bing Videos

# SPACE



*Earthrise, viewed from the 'Apollo 11' mission's lunar landing module in 1969* CREDIT: NASA
HANDOUT/EPA-EFE/REX

We commence this section with an article by Boris Starling entitled 'How humans will colonise the
Moon – and when it will happen' published in the 24 August 2023 edition of The Telegraph.

It was in 1962, 61 years ago, that President John F Kennedy pledged to put a man on the Moon before
that decade was through. Now NASA has stated that humans will be living and working there within
the next 10 years – an ambition that shuffled just a little closer to reality this week after India became
the first country to successfully land a craft near the Moon's south pole.

If that sounds like an extraordinarily expensive, ferociously ambitious project, remember the words of
President Kennedy who, during that same speech, pointed out that humans choose to do these things,
"not because they are easy, but because they are hard". That sentiment remains as true today as it was
then. Permanent lunar habitation will be one of the most difficult things mankind has ever done, and
it poses several immediate questions.

For a start, where on the Moon would such a settlement be? Not everywhere on our friendly satellite
is equal when it comes to settling there. Thanks to its orbital path, the Moon has a long day-night
cycle, with each day or night lasting more than an Earth fortnight. This means that the most likely
place for human settlements is near one of the poles, where light is all but permanent, and the variations
between temperature extremes are much less severe than in equatorial regions. There are also thought
to be considerable water deposits at the poles – though Chinese scientists have just reported that glass
beads found on the lunar surface contain water, raising the prospect of another potential source for
astronauts to use for fuel and drink. Two specific sites often mentioned are Mount Malapert, near the
south pole, and the rim of the Peary crater, near the north.

Experts from the Goddard Space Flight Center say that Mount Malapert is probably saturated with implanted hydrogen and helium. There's a broad, smooth landing area, demonstrably in continuous microwave visibility of Earth (for tracking and communications). And, not far away, are permanently shaded areas to the south, which could be easily reached by a vehicle driven down the south flank of the mountain. But if that doesn't appeal, advantages of the rim of the Peary Crater (named after the polar explorer, Robert Peary) include its large, flat topography, surrounded by four mountainous regions on the rim – known as peaks of eternal light – which stay bright all lunar day. This light source means a relatively stable temperature and solar power.

Having chosen the location, accommodation would also likely take one of two forms: below the surface in subterranean lava tubes, or on the surface in biodomes. Underground has the advantage of greater protection from meteorite strikes and from solar radiation, which is around 200 times more powerful on the Moon than on Earth. But overground offers easier access and transport, not to mention the mental fillip of being 'outside'. A mixture of the two is most likely. Lunar buildings could be created with 3D-printing technology, using regolith – moon dust – as the primary construction material: it contains aluminium, silicon, iron, calcium, magnesium and titanium.

Like any Earth city, settlements would need supplies of energy and food – so where would they be found? The former will come from a mixture of solar power (hence the need to be near the poles) and water (broken down into its constituent parts of hydrogen and oxygen to make propulsive fuel). At first, food would need to be brought from Earth, but eventually hydroponic crops and artificial food production should be ongoing concerns. Think Matt Damon in The Martian, cultivating potatoes and using biowaste to fertilise them.

The project may sound like a Hollywood plot line, but six space agencies have lunar ambitions: NASA, the European Space Agency (ESA), Russia, China, Japan and India – as do individual billionaires such as Elon Musk and Jeff Bezos. Accommodating them all, beyond an initial smattering of scientists, will pose serious legal and practical problems, and will involve building a new society from scratch. In legal terms, the Moon is currently under the jurisdiction of the 1966 Outer Space Treaty, which states that outer space is "not subject to national appropriation by claim of sovereignty" and shall be "free for exploration and use by all states". This treaty will obviously need to be renegotiated and hugely expanded, finding a way to balance the demands of individuals as wealthy and powerful as entire countries.

Whatever the mix of nations and cultures, every person there will have to deal with the huge physical and psychological consequences of living in one-sixth gravity and 250,000 miles from Earth. Most of these effects are as yet unknown. For example, our bodies have evolved in Earth gravity over tens of thousands of years: how will our musculoskeletal and cardiovascular systems adapt to a much lighter force? And while it's true that astronauts have spent more than a year at a time on board the ISS (International Space Station), Earth has always loomed vast and comforting just below them; how will it feel when their home planet is little bigger in the lunar sky than the Moon is in ours? Psychologists already warn that astrophobia – fear of outer space itself – could be a future concern. Loneliness would surely be an immediate worry.

With so many complicating factors, the idea of setting up colonies on the Moon does seem to be fantastical still. But the rewards of achieving the goal go far beyond President Kennedy's suggestion that humans are driven by the need to achieve the impossible for its own sake. He could not have

imagined the space-suited conquistadors of the 21st century would have their eyes on quite a different, less noble, prize. To be precise, Helium-3, an element vital for producing nuclear power.

Then again, that most cynical explanation is unlikely to justify the vast effort and expense of permanent lunar habitation. Estimates of cost vary hugely; but NASA has estimated that it costs $10,000 for every pound of equipment – whether you are weighing equipment, rice or souvenirs from home – it sends to the Moon. Online science project Wendover suggests a figure of $36 billion is needed to support four astronauts for a year, or about $100 million a day.

The true rationale and imperative are likely to be much more existential, predicated on the fear that, so long as we are confined to Earth, humanity has too many eggs in one rather fragile basket. The possibilities of nuclear war, pandemics and climate change make a back-up home somewhere between desirable and essential.

"Single-planet species don't survive," said John Young, the ninth man to walk on the moon. "Living off the planet is probably not a bad strategy for survival. Sooner or later it will be one of the motivations of having bases on the Moon." Nor is lunar habitation an end in itself, but the first step in off-world living and exploration: a jumping-off point for missions to Mars, other planets, and interstellar travel.

This, however, is not a matter of just a decade, but a long process. The ISS orbits 250 miles above Earth; the Moon is around 250,000 miles away; and Mars can at times be 250 million miles away. Each destination is, therefore, a thousand times further away than the previous one. "You don't want to send humans to the Moon," said Andy Weir, author of The Martian. "You want to send robots. Humans are soft and squishy and they die. Robots are hard and nobody gets upset when they die."

But we are going back, soft and squishy or not. "There is no strife, no prejudice, no national conflict in outer space as yet," Kennedy said in that 1962 speech. "Its conquest deserves the best of all mankind, and its opportunity for peaceful cooperation may never come again." The second part still holds: how long the same can be said for the first part remains to be seen.

And as the world sets its sights on the Moon, patent attorneys Michael Jaeger and Dr Peter Heines from European intellectual property firm, Withers & Rogers, look at how space tech companies can protect their innovations.  Read: Back to the Moon, AERO SPACE August 2023 edition.

Now we continue with our chronological news reports.

➢ **26 August 2023**

**The Telegraph reports that** Nasa with SpaceX's Dragon spacecraft has blasted off carrying four astronauts to the International Space Station. The Crew-7 mission is commanded by American Jasmin Moghbeli and includes Andreas Mogensen of Denmark, Satoshi Furukawa of Japan and Konstantin Borisov of Russia. The Dragon spacecraft carried by a Falcon 9 rocket lifted off from Launch Complex 39A at Nasa's Kennedy Space Center in Florida on Saturday in front of around 10,000 people. "We have liftoff!" Nasa said on Twitter. Cheers could be heard in the mission control room soon after the Dragon craft separated from the Falcon 9 rocket with the crew in orbit. Read on at: SpaceX rocket blasts off to International Space Station (telegraph.co.uk)

And Julian Ryall from Tokyo reports that Japan is preparing to fire the latest shot in the intensifying international space race with the launch on Monday of its "Moon Sniper" lander mission. A domestically built H2-A rocket is scheduled to take off from southern Japan on Sunday night carrying a lander module that is expected to reach the lunar surface in four to six months. The rocket, the launch of which has been pushed back due to poor weather, will also deploy an x-ray imaging satellite.

Earlier this week, India completed the historic landing of a craft near the lunar south, becoming only the fourth nation to achieve a so-called soft-landing on the Moon after the United States, Russia and China.

Japan's hopes of keeping up in the race to exploit the Moon's resources are now focused on the Smart Lander for Investigating Moon (Slim), although the probe has been dubbed the "Moon Sniper" due to the precision with which it is meant to hit its landing target. Less than 8ft high and weighing 1,545lbs, Japan Aerospace Exploration Agency (Jaxa) is aiming to land its spacecraft within 300ft of its target on the surface, significantly better than the mile or more that is traditionally regarded as an accurate touch-down. The agency plans to put the probe down in the Sea of Nectar, in the lower latitudes of the near side of the Moon. See: Japan prepares shape-shifting Moon rover for launch after Indian success (telegraph.co.uk)

➤ **6 September 2023**

Anthony Cuthbertson writes in The Independent that SpaceX is ready to launch its next-generation Starship rocket, according to Elon Musk, pending regulatory approval. Starship is the most powerful rocket ever built, measuring 121 metres in height and capable of producing 5,000 metric tons of thrust. Once testing is complete, the craft will form part of Nasa's Artemis mission to return astronauts to the Moon.

Mr Musk also plans to use the rocket to transport people and cargo around the solar system, eventually using fleets of Starships to establish a permanent human colony on Mars. The next launch will be the second attempt at an orbital flight test, with the only previous effort ending in an explosion just three minutes into the 90 minute flight earlier this year. Each launch attempt requires approval from the US Federal Aviation Administration (FAA), while also requiring favourable weather conditions. Read: Starship 'ready to launch' on historic SpaceX flight, Elon Musk says | The Independent

➤ **10 September 2023**

The space race gave us freeze-dried food, the basics of modern computer technology, medical treatments and firefighting equipment, among many other innovations – although not, despite the popular legend, Teflon, which was actually first invented in the 1930s.

Even though they were vastly expensive, the historic Apollo Moon landings of the late 1960s and early 1970s had huge technological spin-offs. They kick-started many industries that are now an essential part of everyday life. It could be about to happen again. With India, Japan and China, as well as perhaps South Korea, all sending vehicles to land on the surface of the Moon, we are about to witness a second great age of lunar exploration. From boosting research in developing countries, to creating new lower cost ways of exploring space, to potentially opening up mines, and in time perhaps whole colonies, we may be about to see a whole new generation of space exploration spin-offs.

The world has been trapped in a low-growth, minimal innovation trap for at least a couple of decades. But a new generation of moonshots could enable the global economy to break out of that – just as it did in the 1960s. See: The return to the Moon can turbocharge the global economy (telegraph.co.uk) by Matthew Lynn.

➢ **20 September 2023**

Benedict Smith writes that when a tiny helicopter nicknamed Ginny took off from the surface of Mars, it was only expected to survive for 30 days. Its mere lift-off – the first attempt to fly a powered aircraft on another planet – was swiftly hailed as a second "Wright brothers moment" by excited observers on Earth. More than two years later, Nasa's Ingenuity is still going strong, flitting across the planet's rocky wilderness in what its engineers have described as a "miracle".

Scientists now believe the unexpected success could prove pivotal to a growing ambition held by the likes of Elon Musk for humans to colonise Mars. "We'll have fleets of drones flying around the first astronauts," Teddy Tzanetos, team lead on the Ingenuity programme, told The Telegraph. He said Ingenuity has shown that Mars explorers could one day pilot helicopters across the planet – at least "from a purely physics standpoint". "You're trying to set up base camp on Mars and you need tools delivered, like 'oh, I left my wrench at camp'. You could send one Ingenuity drone to pick it up, things like that," he said.

At 19in tall and weighing just a few pounds, its simple design was meant to keep costs down. It was built for five flights but has now completed more than 10 times that number since it landed on Mars in February 2021 on board the Perseverance rover mission. None of its team at the Jet Propulsion Laboratory (JPL) in southern California is quite sure how it has managed to keep taking to the air, or for how long it can keep going. Nor, for that matter, are any of the onlookers in the wider scientific community.

Ian Crawford, a planetary science professor at Birkbeck, University of London, is "astonished" at how resilient the diminutive craft has proved. "I think it's fundamentally changed the paradigm for exploring the surface of Mars," he said. Mars's atmosphere is 1 per cent of the density of Earth's, meaning Ingenuity's carbon fibre rotors need to spin five times as fast to stay airborne.

Helicopters need an atmosphere to fly, which rules out the Moon, while gas giants such as Jupiter that are essentially made of atmosphere are too violent to navigate. But other worlds are ripe for discovery. Data from the Ingenuity flights is being passed on to the team preparing to launch a rotorcraft on Titan, Saturn's largest moon, as part of a mission to land in the mid-2030s.

But before any of that, the craft's success has reshaped Nasa's next mission to Mars, which will collect samples near the Jezero Crater to be sent to Earth for analysis. The space agency is now sending two vehicles modelled on Ingenuity – their blades will be marginally longer – to gather the samples. There is even a chance that the two generations of helicopters will cross paths.

The thin atmosphere on Mars means flying is "almost impossible", according to JPL engineers. This meant they faced an uneasy three-hour wait to see if it could raise itself off the ground after landing attached to the belly of the Perseverance rover in February 2021. It did, briefly hovering 10ft above Mars's dusty red surface. Back in California, project manager Mimi Aung ripped up the emergency

plans in case the flight failed. Since then, Ingenuity has completed dozens of flights, travelling up to about half a mile at a time, while braving temperatures as low as -125C.

That is not to say it was all plain sailing. The rotorcraft was never built to survive the bitter nights of the Martian winter. It froze in May last year, its team staring helplessly 150 million miles away as it disappeared from their screens. Steeling themselves for the worst, they tried to predict when it would thaw out so they could re-establish contact. For two days, the little helicopter was on its own. Finally, after an agonising game of hide and seek, a stream of data from Ingenuity began to filter back.



Credit: NASA
*image taken on May 22, 2021, by the navigation camera aboard Ingenuity*

It survived an emergency landing on its 53rd flight late last month, when images from its measurement camera failed to match data from its inertial measurement unit. The code was tweaked and it has returned to the skies twice more. Nevertheless, Mr Tzanetos is aware its time is ticking down, and that whenever Ingenuity loses contact with JPL they may never recover it. Ingenuity's solar panel has lost around 30 per cent of its output, probably thanks to a light coating of Martian dust.

Having proved an aircraft can fly in Mars's unbreathable atmosphere, the JPL scientists believe we are on the cusp of revolutionary changes in the exploration of space. "Where I think they will come into their own is they will make accessing parts of the surface of Mars possible that would be very difficult or impossible to access with a rover," said Prof Crawford. "Anywhere that needed a rover to go through very bouldery terrain … an aerial vehicle can fly over these obstacles and just land and make measurements in some inaccessible place." Read on at: The curious case of the Mars Ingenuity helicopter that won't give up (telegraph.co.uk)

➢ **24 September 2023**

Sarah Knapton, Science Editor of The Telegraph, reports that Nasa's OsirisRex capsule touched down three minutes ahead of schedule at 15:52pm BST on Sunday afternoon after a seven-year, four billion-mile, journey to collect samples from the killer asteroid Bennu. But when NASA blasted off in 2016 to drill for space dust on a giant rock, experts could never have expected to need the help of a rock giant. The mission ran into trouble after reaching Bennu in 2020 and finding the surface was strewn

with boulders, leaving mission controllers scratching their heads about where to land. Step forward <u>Sir Brian May</u>, the Queen guitarist, who had used NASA's public images of Bennu to create 3D stereoscopic pictures, giving unprecedented new detail of the tumbling space rock.

The team used his images to select the Nightingale crater, launch a space drill, and collect samples which on Sunday returned to Earth at the end of a seven year mission. NASA wanted to sample Bennu because there is a slim chance it will hit Earth in September 2182, unleashing the force of 22 atom bombs. Knowing its make-up will help the space agency launch a deflection mission if needed. The asteroid is also a pristine time-capsule that has been floating in space since the formation of the solar system and could give crucial insight into how Earth formed and how life got going.

"It worked, they got their sample without mishap and in retrospect I think we realised it was much more risky than we thought at the time because of the nature of the surface of Bennu, because of it not being a solid body, it's much more like a ball pit."



*Sir Brian May is on the Osiris-Rex science team and has compiled an atlas of asteroid Bennu*

Bennu is about the size of the Empire State Building and swings close to the Earth every six years, but it will have its closest shave 159 years from now. Although the odds of it hitting Earth are 1 in 2,700, NASA estimates that it could cause a six-mile wide crater and wreak devastation over a 600-mile radius. After viewing Sir Brian's images, NASA was forced to redesign the spacecraft's guidance system so that it could hit its new target.

Prof Dante Lauretta, the leader of the Osiris-Rex mission said: "Bennu turned out to have a rough and rugged surface strewn with boulders, which was really different from what we had anticipated. This meant that we needed to get a better idea of what was on the surface. With Brian's stereo images, we very quickly came to realise that the finely grained material which our sampling mechanism could collect was concentrated in very small craters of about 10 to 20 metres in diameter." Now read on at: <u>Nasa finally gathers dust from the 'Earth-bound' asteroid Bennu (with the help of a rock star) (telegraph.co.uk)</u>

➤ **October 2023**

Satellite development is increasing, but launch capacity is now falling short. The industry is about to step into a launch crisis. Bella Richards, in the October edition of AERO SPACE, explores what this looks like, how we got here, and how Europe will be impacted.

*Photo: UK Space Agency          Astronaut Major Tim Peake*

Tim Peake is to come out of retirement to lead the UK's first astronaut mission into space, The Telegraph understands, writes Sarah Knapton.

The UK Space Agency is joining forces with Axiom Space – the Houston-based space company – to send Major Peake back to the International Space Station (ISS), alongside three British astronauts, who may come from the European Space Agency (ESA) or elsewhere. The team will spend up to two weeks on the ISS, conducting scientific research, demonstrating new technologies and taking part in outreach activities. It will be the first time Britain has carried out an independent mission, although it will be supported by ESA. British universities, research institutions and private companies have been invited to submit ideas for experiments and technology projects that could be carried out on the mission. George Freeman, the Science Minister, is expected to announce the agreement between Axiom and the UKSA on Wednesday morning [25 October 2023] at the London Stock Exchange.

Dr Paul Bate, chief executive of the UK Space Agency, said: "This agreement paves the way for UK astronauts to conduct scientific research in orbit, and to inspire millions of us here on Earth." George Freeman MP, Minister of State at the Department for Science, Innovation and Technology, said: "The prospect of a historic UK mission with Axiom Space has the potential to inspire a whole new generation to reach for the stars, while supporting our efforts to build one of the most innovative and attractive space economies in the world, so I look forward to seeing the next stage of this exploratory work develop. We want to put the UK at the forefront of the global race for commercial space investment, continue to support scientists and engineers to test new technologies and carry out important research and, ultimately, bring the benefits back to people and businesses across the country."

Major Peake, who flew into space in December 2015, spent six months on the ISS, and held several roles at ESA including head of astronaut operations, before retiring from the astronaut programme in January. However in recent weeks he has hinted about a possible return to space telling James

O'Brien's Full Disclosure podcast 'Never say never'. "If you'd asked me that a year ago, I'd have said there perhaps wasn't a huge amount of opportunities," he said. "Actually, right now, I think there's more opportunity than I've even realised. There's a lot happening in the commercial space sector."

The other crew members are expected to be the three Britons selected for ESA's astronaut programme in 2023. They are British paralympian John McFall, 42, who is the world's first disabled astronaut, astronomer Rosemary Coogan, 32, and Meganne Christian, 35, an industrial chemist.

Axiom Space has already sent two private astronaut missions to the International Space Station with a third scheduled to lift off next year. The company launches from Nasa's Kennedy Space Centre in Florida using SpaceX's Crew Dragon spacecraft and a Falcon 9 rocket. The launch cost is likely to be around $55 million (£45 million) per astronaut, and the UKSA has not yet said how it will be funding the mission. It is likely the space agency will be relying largely on private investors who are looking to conduct research in microgravity. Axiom Space missions fly with three crew members and must be accompanied by an experienced commander, which is why Major Peake is being brought out of retirement.

Dr Alice Bunn, the president of UKspace which represents the UK commercial space sector, said: "Since the first astronauts landed on the Moon over 50 years ago, human spaceflight has captured the imagination of billions of people. But space is no longer for the privileged few; we have witnessed incredible growth in the application of space technology and data to everyday lives, and we recognise the immense and specific value of humans being able to push the boundaries of science and technology operating within the unique conditions of space. For this reason, the agreement between the UK Space Agency and Axiom Space is an incredibly exciting one, providing the potential to extend the already significant innovation that our UK space sector is spearheading."

Axiom is also planning to build the world's first commercial space station, and is designing the flight suits for NASA's Artemis mission which will return to the Moon in 2025. Michael Suffredini, Axiom Space CEO, added: "Axiom Space is looking forward to working with the UK Space Agency on a future human spaceflight mission. With this agreement as the initial foundation, we will build a comprehensive mission plan in support of the UK's national and agency objectives to advance its capabilities in space exploration and discovery. Together, we will look to harness the benefits of microgravity and help push the boundaries of innovation to advance our civilization."

# UK DEFENCE



Bearing in mind that, to one degree or another, all the aerospace companies that support the ACP are involved in defence we have decided to broaden this section from UK Defence Aviation to UK Defence as a whole. Furthermore, relevance is enhanced by the fact that the UK defence industry – in which we include the Military - is a UK economic sector that not only involves the technologies of 4IR but also continues to increase in importance due to both its contribution to UK exports and today's expanding global threats and volatility.

By way of introduction we direct the reader to the ADS website https://www.adsgroup.org.uk/ - the aerospace, defence, security and space trade body – and in particular their articles on Industry Facts & Figures, the individual Industry Sectors and Outlooks. As a demonstration of the significance of the defence industry to the UK we quote three figures: turnover £22.8B; direct employees 147.5K; exports £7.4B

Additionally, as four examples of current industry programmes see the following major programmes listed under Business Opportunities: Global Combat Air Programme; AUKUS; Stockpiling and Strengthening UK Supply Chains; Land Industrial Strategy.

Finally, with those expanding global threats and volatility in mind we refer readers to the UK Government's Defence Command Paper 2023: Defence's response to a more contested and volatile world - GOV.UK (www.gov.uk)

Having introduced the expanded section we now continue with our chronological news reporting.

➢ **August 2023**

Following on from the lessons learned in Ukraine, Richard Gardner in the August edition of AERO SPACE reports from MBDA's new Digital Battlespace Facility at its UK Headquarters on 'New conflicts – new missiles'.

- ➤ **17 August 2023**

Howard Mustoe reports that BAE Systems has agreed to buy NASA supplier Ball Aerospace for $5.6bn (£4.4bn), as the defence giant ventures further into space warfare. The blockbuster acquisition, the largest in BAE's history, will grant it technology that can track armies and weapons from space in a move towards stopping hypersonic missiles that move five times faster than sound. Ball Aerospace, which has 5,200 employees, sells hi-tech equipment to NASA and the Pentagon, as well as working on the Hubble and James Webb telescopes. It forms part of America's booming space sector, which is now worth more than $200bn.

Charles Woodburn, chief executive of BAE, said he sees space as "becoming an increasingly important domain of future warfare". "It has been one of the areas that has seen the largest growth in defence budgets, particularly in the US, which has the largest defence budget in the world," he added. Read further at: Buying £4.4bn Nasa supplier will let us track hypersonic missiles from space, says BAE (telegraph.co.uk)

- ➤ **8 September 2013**

Edward Malnick writes that RAF aircraft are protecting cargo vessels carrying grain from Ukraine, following Russian attacks, Downing Street has revealed. In recent weeks British aircraft have been conducting patrols over the Black Sea to deter Russia from carrying out strikes on civilian vessels.

The Ministry of Defence stepped up its activity in the area after Moscow began attacking grain infrastructure in July, when it scrapped a deal that allowed Ukraine to export grain from its Black Sea ports. Grain from the Black Sea region is considered vital for staving off hunger in lower-income countries. Russia said it had pulled out of the deal because Ukraine refused to reopen an ammonia pipeline that runs from central Russia to the Black Sea.

Downing Street said: "We will use our intelligence, surveillance, and reconnaissance to monitor Russian activity in the Black Sea … As part of these surveillance operations, RAF aircraft are conducting flights over the area to deter Russia from carrying out illegal strikes against civilian vessels transporting grain." The disclosure came as the Government announced that the UK will host an international food security summit in November "to tackle the causes of food insecurity and malnutrition." Read on at: UK planes protecting Ukraine ships from Russian attack after grain deal collapse (telegraph.co.uk)

Also this day, as reported in the October edition of AERO SPACE, an autonomous fixed-wing drone made naval history by landing on the aircraft carrier, HMS Prince of Wales, delivering supplies and then taking off again.
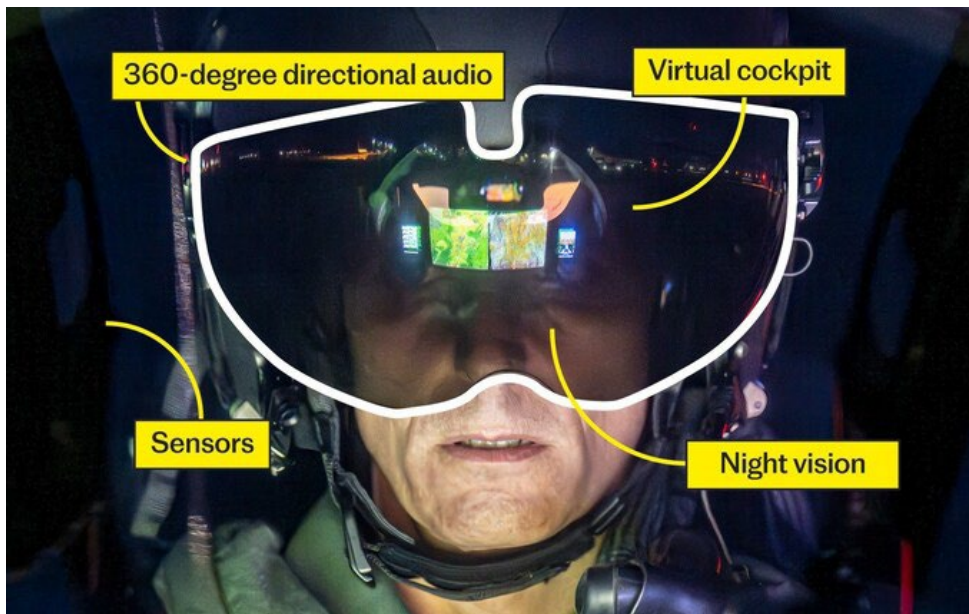
*Credit: BAE Systems*

Fighter jet pilots are to swap their trusted night vision goggles for new futuristic visors in a move that will give them a competitive edge in the battlespace, writes Danielle Sheridan.

The new Striker II helmet will enable pilots operating the Typhoon fleet, the multi-role combat aircraft used in all the RAF's current operations, to fly at night without losing any mission-critical data. Previously, when pilots wore night vision goggles over their helmets they lost all flight reference information that had been displayed on the visor during daylight hours. The goggles, tube-like in design, would also impact the pilot's peripheral cues and meant they were flying without any visible information detailing the aircraft's altitude, speed, horizon line and potential targets. Pilots could choose to fly without the goggles, but it meant their range of vision was limited.

The new helmet, designed by BAE Systems, has a fully digital system combining a 40-degree field of view, a colour display setting out flight information and integrated night vision, all contained within the helmet's visor. See: RAF fighter pilots get new 'cutting-edge' visors to replace night vision goggles (telegraph.co.uk)

➤ **19 September 2023**

Danielle Sheridan reports that as part of the British Army Warfighting Experiment, which is working with future technologies to prepare soldiers to fight on increasingly complex battlefields, the Army will trial new software that enables drones to capture near-real-time footage of areas of interest and processed it into a high-definition 3D map on a smartphone or tablet in less than 10 minutes. The Farsight software, made by the American cyber technology company Reveal, uses photogrammetry collected by drones to create 3D digital models.

Photogrammetry, made by overlapping photographs of an object, structure or space before converting them into 3D is "drone agnostic", so that it can work across any unmanned aerial vehicles. Previously, developing drone footage to this standard could take up to a week, meaning that troops lacked critical

situational awareness when deploying into contested areas. However, Farsight, which does not rely on an internet connection for cloud processing because it computes directly on a soldier's hand-held device, means maps can be available almost instantly. It also reduces the opportunity of footage being intercepted or having the drone jammed by adversaries. Read further at: <u>British troops to get new hi-tech drone software that 'improves safety of soldiers' (telegraph.co.uk)</u>

> **21 September 2023**

Ms Sheridan also advises that Japan, Britain and Italy plan to choose Britain as the headquarters for the Global Combat Air Programme (GCAP), a move that would put London at the forefront of a partnership that could expand to include other nations. The programme, announced in December last year as Britain and Japan agreed to merge their fighter jet efforts, builds on Team Tempest, which has been researching and evaluating a range of future combat air system capabilities since 2018.

Team Tempest, an industry group made up of BAE Systems, Leonardo UK, MBDA UK, Rolls-Royce and the UK Ministry of Defence, is creating a new aircraft which will enter the RAF fleet from 2033 to replace the Typhoon. The same industry group will work on GCAP. According to Reuters, four sources in Japan have confirmed that GCAP's headquarters will be in Britain. One source said: "The headquarters will be in Britain, but for the sake of balance, someone from Japan could head it." See: <u>Britain 'will be site of next-generation fighter jet headquarters' (telegraph.co.uk)</u>

> **October 2023**

In the October edition of AERO SPACE Tim Robinson FRAeS reports from the biennial DSEI (Defence and Security Equipment International) event in London held from 12 – 15 September 2023.

Also in that edition Dr David Sloggett discusses the likelihood of a future space war and what can be done to protect assets in orbit

> **28 October 2023**

The revival of conflict in the Middle East, combined with Russia's war in Ukraine, has created a race for countries to secure as many bullets and artillery shells as possible, reports Howard Mustoe. Unsurprisingly, the key beneficiaries of this surge in demand are defence companies, which have seen their valuations surge in recent weeks. In the UK, shares in leading weapons maker BAE Systems have risen 12pc since Hamas terrorists launched their attack on Israeli civilians earlier this month, boosting its value to £33bn. Read on at: <u>How the Israel-Hamas war propelled BAE Systems to record highs (telegraph.co.uk)</u>

> **29 October 2023**

Matthew Field advises that the chief executive of a key government AI supplier has urged that Britain build a rival to ChatGPT for the UK's security services. Marc Warner, whose company Faculty has been hired by officials to conduct research ahead of the AI Safety Summit, said such a system would be a "crucial capability for national security and defence".

Government advisers have been debating whether Britain should develop a sovereign capability to rival that of OpenAI's ChatGPT, rather than leaning on the services of US tech giants, which are

rapidly dominating the sector. Chatbots such as ChatGPT, built on a technology known as a large language model, have caused a surge in public interest in AI. Their current capabilities include rapidly analysing text and providing natural language responses to questions. Ever more powerful abilities, such as generating code, are advancing rapidly.

Warner, who provided advice to the Government during the Covid pandemic, said the UK would want to have "as much control as possible" over the technology in a defence context. In August, a report co-authored by GCHQ on ChatGPT said the technology showed "promising potential" for intelligence work, although currently would only be capable of replacing an "extremely junior analyst". US tech company Palantir, meanwhile, has demonstrated how chatbots could be used in warfare, providing real-time analysis and recommendations to commanders in the field. Read on at: Britain needs sovereign rival to ChatGPT for the nation's defence, says AI chief (telegraph.co.uk)

# CYBER



*Camaro Dragon - Checkpoint's latest illustration for an alleged Chinese group hacking European foreign affairs workers*

Image source: Checkpoint

Camaro Dragon, Fancy Bear, Static Kitten and Stardust Chollima - these aren't the latest Marvel film superheroes but the names given to some of the most feared hacking groups in the world. For years, these elite cyber teams have been tracked from hack to hack, stealing secrets and causing disruption allegedly under orders from their governments. And, as you can see, cyber-security companies have even created cartoon images of them.

With dots on a world map, marketeers at these companies regularly warn customers about where these "advanced persistent threats" (APTs) are coming from - usually Russia, China, North Korea and Iran. But parts of the map remain empty. So why is it so rare to hear about Western hacking teams and cyber-attacks? One reason for the lack of information on Western cyber-attacks could be because they are often stealthier and cause less collateral damage. "Western nations tend to conduct their cyber operations in a more precise and strategic manner, contrasting with the more aggressive and broad attacks associated with nations like Iran and Russia," the expert says. "As a result, Western cyber operations often yield less noise."

According to the International Institute for Strategic Studies (IISS), the US is the only tier-one cyber power in the world, based on attack, defence and influence. Tier two is made up of: China; Russia; the UK; Australia; France; Israel; Canada. The National Cyber Power Index, compiled by researchers at the Belfer Centre for Science and International Affairs, also deems the US the world's top cyber power.

Julia Voo, Cyber Fellow, Harvard Belfer Centre, says "Espionage is routine for governments and now it's so often in the form of cyber-attacks - but there's a battle of narrative going on and governments are asking who is behaving responsibly and irresponsibly in cyber-space. And compiling a list of APT hacking groups and pretending there are no Western ones is not a truthful depiction of reality", she says. "Reading the same reports about hacking attacks from only one side adds to a general ignorance.

A general education of the public is important, because this is basically where a lot of tensions between states are going to be playing out in the future." And Ms Voo praises the UK government for publishing its inaugural transparency report into National Cyber Force operations. "It's not super-detailed, but more than other countries," she says.

And with the UK in mind we now turn to news from the National Cyber Security Centre: CyberFirst overview - NCSC.GOV.UK

## CyberFirst overview

CyberFirst is designed to identify and nurture a diverse range of talented young people into a cyber security career. Activities are intended to inspire and encourage students from all backgrounds to consider a career in cyber security and apply for a CyberFirst bursary.

CyberFirst covers a broad range of activities: a comprehensive bursary scheme to financially support undergraduates through university; a girls only competition, thousands of free places on CyberFirst courses at UK universities and colleges and our new initiative CyberFirst Schools and Colleges. Each activity is designed to seek out diverse people with potential, offering the support, skills, experience and exposure needed to be the future first line of defence in our CyberFirst world.

## CyberFirst Bursary

CyberFirst is a student scheme inspired and led by the National Cyber Security Centre (NCSC) which aims to support and prepare undergraduates for a career in cyber security. NCSC partners with other government departments and selected industries to offer students £4,000 per year and paid cyber skills training to help kick start a career in cyber security.

You will need to have (or expect to have) 3 'A' levels in any subject at Grade B or above (or equivalent) and have an offer (or be applying) to study an Undergraduate Degree or Integrated Masters in any subject at a UK University from September 2024.

OR:

Already be studying for an Undergraduate Degree or Integrated Masters in any subject at a UK University, with a minimum of 2 years of full-time study remaining from September 2024 and have (or expect to have) attained a minimum 2:1 equivalent at the end of academic year 2023/24.

## The CyberFirst Girls Competition

The competition is a team event which aims to inspire girls interested in technology to pursue a career in cyber security. Each team – consisting of up to four girls in Year 8 (England and Wales), S2 (Scotland) or Year 9 (Northern Ireland) – tackles challenges from cryptography and logic to artificial intelligence and networking for the chance to be crowned cyber security champions.

Every girl from the winning teams will take a brand-new laptop home and have a chance to win prize money for their school. The rules and regulations for the competition can be found on the CyberFirst website.

**The CyberFirst Schools / Colleges Scheme**

The NCSC is formally recognising schools and colleges in Scotland, Wales, Northern Ireland and the North East, North West and South West of England, who are committed to providing a structured approach to excellence in cyber security education. The NCSC has appointed a home nation or regional partner who will manage the assessment and evaluation of CyberFirst School applications, the growth of the CyberFirst Schools community in the area, and help facilitate engagement between industry and schools in the region through events and cyber related activities.

The NCSC aims to recognise those schools and colleges whose approach to cyber and cyber security education is excellent. Schools and colleges that achieve this recognition can expect to be:

➤ formally recognised and promoted by the National Cyber Security Centre;
➤ provided with opportunities to engage with local and national companies seeking to invest time, expertise and resources in schools and colleges;
➤ provided with opportunities to engage with universities seeking to invest time, expertise and resources in local schools and colleges;
➤ a focal point for other CyberFirst activities;
➤ provided with an opportunity to be part of CISSE UK (the Colloquium for Information System Security Education).

The NCSC will present one of 3 certificates - Gold, Silver or Bronze - which reflect the current stage of the school's or college's cyber security teaching, strategic ambition and development plans. Schools and colleges interested in CyberFirst recognition should <u>contact the respective CyberFirst regional delivery partner</u>.

**Recent NCSC News**

Introducing PDNS (Protective Domain Name Service) for Schools

In today's digital age technology plays a crucial role in education. From online learning platforms to interactive educational tools, schools are increasingly relying on digital resources to deliver quality education. However, behind the scenes there is one essential component that often goes unnoticed - the Domain Name System (DNS). DNS allows users to access websites and digital services seamlessly. Unfortunately, DNS can also be used maliciously for malware distribution and control. To protect against DNS misuse and cyber threats like malware, the NCSC has developed the Protective Domain Name Service which can help prevent DNS enabled cyber-attacks. PDNS is already a tried and tested solution as it's been freely available to organisations like central government, local authorities and devolved administrations for several years.

The NCSC is gradually broadening eligibility of PDNS to the school sector under the banner of 'PDNS for Schools'. The service will be completely free, and the phased rollout will start now and will progress into next year. This timeframe will allow us to test capacity in the service and ensure we can deliver a PDNS offer to the different types of schools across the UK. Schools do not need to do anything until full rollout is announced in the first part of 2024.

Organisations that can now sign up to 'PDNS for Schools' are:

➢ **Local authorities** or **eligible public sector networks** from the devolved administrations of the UK (Scotland, Wales and Northern Ireland) that provide DNS to their schools.

➢ **Local authorities** in England that provide DNS to their maintained schools.

Individual schools or trusts do not need to make enquiries for now. We will be introducing 'PDNS for Schools' to the eligible organisations above under the first phase of rollout. We are working with our delivery partner, Nominet, to make sure other areas and types of school can benefit from the 'PDNS for Schools' offer. Please wait for communications on a full launch of 'PDNS for Schools' in early 2024.

The 'PDNS for Schools' offer will benefit education settings across the UK, protecting them automatically from a huge volume of malicious content which can cause huge disruption, remediation time and costs to schools. In the meantime, if you'd like to find out more about PDNS, please visit our PDNS web pages.

**Maidstone: Secondary school hit by cyber attack**

A secondary school in Kent has been hit by a criminal cyber-attack, with pupil and parental data encrypted. Jason Feldwick, Principal of St Augustine Academy in Maidstone, confirmed there had been "a serious IT breach". He told parents and carers the breach resulted in school systems and data being encrypted by an "outside criminal organisation". He said they will inform authorities and work on a back-up solution.

It is not known if so-called "ransomware" was used to demand cash from the school or the trust that the academy is part of. Mr Feldwick urged parents and carers to be "extra vigilant" if they receive any unusual emails and phone calls. Councillor Chris Passmore said: "It just goes to show that absolutely no one is safe from cyber-attacks and emphasises the need for vigilance against them."

And now we turn to national news.

➢ **24 August 2023**

Gareth Corfield explains in The Telegraph "Why LinkedIn is a snooper's paradise, with the social media platform being used as a tool for recruiting influential Britons to spy for Beijing. See: Why LinkedIn is a snooper's paradise (telegraph.co.uk)

➢ **29 August 2023**

As thousands of fliers were left stranded and frustrated on one of the busiest weekends of the year for summer getaways, the spotlight has been thrown onto the obscure organisation keeping planes in Britain's skies, writes Matthew Field.

NATS, or National Air Traffic Control Services, is the partly privatised company that manages air travel above the UK from command centres in Swanwick in Hampshire and Prestwick in Scotland. The company runs Britain's air traffic network, communicating with aircraft and monitoring airspace

with radar to make sure they do not crash into each other. In a typical year, it handles 2.5 million flights.

Monday's bank holiday outage, which grounded more than 1,000 flights, has been blamed on a technical mishap with the group's automated flight-planning technology which lasted several hours before being resolved by 3.15pm on Monday. On Tuesday, Mark Harper, the Transport Secretary, ruled out the possibility of a hack. However, the huge disruption caused by the incident highlights just how calamitous a cyber-attack would be.

The threat of a cyber-attack on critical national infrastructure (CNI), such as air traffic control, has long been feared. A 2018 report from the Department for Transport on cyber readiness of the aviation sector warned: "It is not a matter of if, but when, cyber-attacks or system compromises are perpetrated against or impact upon the aviation sector."  Now read on at 'Not if but when': How cyber attacks threaten Britain's air traffic control (telegraph.co.uk)

# AEROSPACE & THE ENVIRONMENT



One term that is continuously heard within the aviation and aerospace industries today is Jet Zero, but what does it mean? According to the UK government, Jet Zero is a strategy that aims to achieve net zero aviation by 2050. The strategy focuses on the rapid development of technologies that maintain the benefits of air travel while maximizing the opportunities that decarbonization can bring to the UK.

The strategy includes a suite of policies to support the aviation industry in reducing and, where possible, eliminating carbon dioxide emissions from aviation. These policies span five different measures that aim to improve the efficiency of the aviation system, accelerate the development and deployment of sustainable aviation fuels, support the development of zero-emission flight, ensure we use markets to drive down emissions in the most cost-effective way, and influence the behaviour of consumers.

To explain a little further, the following is an extract from a news story published by the UK Government on 19 July 2022.

Launched at Farnborough International Airshow, the strategy commits **UK domestic aviation** to achieving net zero emissions by 2040, and for all airports in England to be zero-emission by the same year. It also includes a plan for the industry to stay below pre-pandemic levels of carbon emissions through measures focused on everything from delivering system efficiencies to new technologies, with progress monitored annually.

Aviation is currently responsible for around 2.5% of global carbon dioxide ($CO_2$) emissions. With the sector contributing £22 billion to our economy and set to grow as it recovers from the pandemic, the Jet Zero strategy provides the tools to help future-proof the aviation sector, deliver guilt-free air travel and create thousands more green jobs around the country.

The whole economy will benefit as new, cutting-edge industries develop and new infrastructure is built to meet our ambitious targets, including the Government's commitment to having at least 5 commercial-scale SAF plants under construction in the UK by 2025.

Transport Secretary Grant Shapps said: "We want 2019 to be remembered as the peak year for aviation emissions. From now on, it should all be downhill for carbon emissions – and steadily uphill for green flights. The UK is setting an example of the ambition needed to tackle climate change, and the Jet Zero strategy provides a clear path to building a greener aviation sector for generations to come. Rather than clipping the sector's wings, our pathway recognises that decarbonisation offers huge economic benefits, creating the jobs and industries of the future and making sure UK businesses are at the forefront of this green revolution."

The six priority areas set out in the strategy are:

1. Improving the efficiency of our existing aviation system, from aircraft to airports and airspace. For example, we will improve fuel efficiency by 2% every year and are providing a further £3.7 million in 2022 to 2023 to support airports to modernise their airspace.

2. Increasing support for sustainable aviation fuels (SAF), by creating secure and growing UK SAF demand through an SAF mandate that will require at least 10% of jet fuel to be made from sustainable sources by 2030 and kickstarting a domestic SAF industry, supported by the new £165 million Advanced Fuels Fund.

3. Supporting the development of zero-emission aircraft, with the aspiration of having zero-emission routes connecting places across the UK by 2030.

4. Developing carbon markets and greenhouse gas removal technologies to drive decarbonisation and offset any residual emissions, including by enhancing the UK Emission Trade Scheme (UK ETS).

5. Providing consumers with better information so they can make sustainable aviation choices. We will publish a call for evidence on our proposal to provide consumers with environmental information at the time of booking air travel in autumn 2022.

6. Increasing our understanding of the non-$CO_2$ impacts of aviation, such as contrails and nitrogen oxides. The effects of these remain uncertain so we will work closely with academia and industry to monitor global developments in this area, increase our understanding, identify potential mitigations and explore a means of tracking these emissions.

The Jet Zero strategy builds on the Prime Minister's Net Zero strategy, **the UK's economy-wide plan for achieving net zero emissions by 2050**, as well as the Transport decarbonisation plan, which outlines the commitments and actions needed to decarbonise the entire transport system.

Kevin Craven, CEO of ADS Group, said: "A clear strategy for the UK that focuses on a broad range of measures through which aviation can decarbonise is a welcome step towards net zero aviation by 2050. The UK aerospace community is committed and ready to deliver on the promise of sustainable aviation. This will include the development and realisation of zero-emission technologies that will play a central part in the decarbonisation journey, alongside sustainable aviation fuels and improvements in system efficiencies. ADS and our members look forward to working with partners in industry, academia and government to solidify the UK's place as a world leader in green aviation."

Now read on at: jet-zero-strategy.pdf (publishing.service.gov.uk)

Continuing with our news reporting:

➤ **August 2023**

This month's edition of the RAeS AERO SPACE contains three items of particular interest to this section of the Newsletter: (1) French aerospace research agency, ONERA, reveals a design study for an eco-airliner involving ultra-high-aspect ratio wings, a non-circular 'double-bubble' fuselage, liquid hydrogen fuel, and open rotor engines to produce zero-carbon emission; (2) King Charles III launches Astra Carta, a sustainable space initiative; (3) Michael Mangano reports on the Tamarack Aerospace Group's focus on aerodynamic answers to the reduction of carbon emissions

➤ **September 2023**

And in the September edition of AERO SPACE, GKN Aerospace, the Marshall Group and Parker Aerospace announce a partnership to research and develop liquid hydrogen fuel systems for zero carbon emission aircraft; and Rob Coppinger reports on new advances in power storage solutions for safe electric aviation.

➤ **2 September 2023**

Edward Malnick reports that in one of the most significant moves yet of the Prime Minister's shift to approaching net zero in a "proportionate and pragmatic" way, the Government will reject the Climate Change Committee's formal advice that all airport expansions must be halted. The move comes days after Mr Sunak appointed Claire Coutinho, one of his closest political allies, as Net Zero Secretary, amid a growing backlash among Tory MPs over the Government's climate policies and the cost they are adding to consumer bills.

Ministers believe airport growth will have a "key role" in boosting the UK's global links and helping to grow the economy. Bristol and Southampton airports are among those preparing to significantly expand their capacity after legal challenges against their expansions failed, while London's Gatwick, City and Heathrow airports are also hoping to embark on major expansion projects. Read on at: Rishi Sunak to reject net zero demand to halt airport expansion (telegraph.co.uk)

- **7 September 2023**

A hydrogen-powered plane with the ability to fly as far as London to Rome has completed its first piloted journey in a move that could pave the way for zero carbon routes across Europe. The aircraft, which was developed by the German company H2FLY, is operated using liquid hydrogen which generates power for the electric motors turning its propeller. Liquid hydrogen is far lighter than batteries and needs smaller tanks than gaseous hydrogen – potentially giving aircraft a much greater range and more space for passengers and cargo.

Plane makers and engine developers such as Airbus and Rolls-Royce which have tested aircraft powered by gaseous hydrogen admit the large engines present the greatest challenges. H2FLY said the use of liquid hydrogen also doubles the range of its aircraft to 1,500km, the distance from London to Rome, compared with using gaseous hydrogen. However the fuel is difficult to manage. Hydrogen is a gas at normal temperatures and must be cooled to minus 253C to become a liquid, and then stored in insulated 'cryogenic' containers. Hydrogen is also explosive and can easily leak – so rigorous safety measures are essential. Read on at: Hydrogen-powered plane that could fly as far as London to Rome completes test flight (telegraph.co.uk)

- **October 2023**

Martyn Cartledge investigates in the October edition of AERO SPACE how the first generation of composite airliners now reaching the end of their lives can be safely and economically recycled.

Finally, now view Virgin Atlantic to Fly 100% Sustainable Aviation Fuels Flight (YouTube Dj'sAviation) at Bing Videos

# STEM RELATED CAREERS
# & USEFUL CONTACTS

Image: JP Bland for Brooklands Museum

Professor Brian Cox spoke to FINN editor Hazel King about how the Brooklands Innovation Academy connects young people with scientists, technologists, engineers and mathematicians from leading businesses to inspire the future workforce.

The Innovation Academy is part of the National Science Summer School programme, co-founded by Professor Cox CBE, Lord Andrew Mawson OBE and Well North Enterprises, which was set up in 2012 in a bid to help a failing school in Tower Hamlets, London.

"The idea was that the school was in the shadow of the city, but nobody in that school had any connection with the city – the financial institutes or the universities," Professor Cox explained. "The National Science Summer School Programme was created to inspire the students, with scientists and engineers coming in to talk about their work, but it was also about making connections. For people whose family have no connection with engineering or science or academia, it is important to create connections so they can see there is a pathway for them into those sectors."

**Following your dreams**

As a young boy who grew up in Oldham in the north of England with no connections to the world of physics, how did he end up becoming a famous physicist and astronomer? "When I was young, I loved

astronomy. At school, they steered me away from that because in the 1980s if you said to a careers teacher that you wanted to do astronomy, they wouldn't have known what you were talking about!" he said.

"I grew up in Oldham, which was surrounded by engineering companies, and it was a natural progression to go into that sector, but I accidentally joined a band and did music for a while. By the time I was 23 I had my own mind and the power to make decisions for myself, so I then went to do physics and astronomy. I wasn't really focused on whether there was a career path for me in astronomy, I just really wanted to study it. And there is an important message there – people should be encouraged to do what they enjoy, and if you do that then you will end up good at it."

**Inspiring the next generation**

Events such as the Innovation Academy provide a hands-on experience for young people to discover what they enjoy, and the almost unlimited career paths and opportunities available to them.

"As we continue to develop more technologies, the number of different avenues into engineering, for example, becomes broader," Professor Cox enthused. "For example, my research into black holes might not seem relevant to engineering but it actually has an intimate connection with quantum computing. So suddenly you have this subject that is ultimately about the fundamental nature of reality itself, which now has an engineering application. I think that whatever our imagination delivers in term of possible careers, the rate of innovation is so great that the range of careers will continue to grow."

As that rate of innovation continues to increase, especially in industries such as aviation and space, the challenge of growing the workforce will also grow. "If you say to a student today, do you want to build a space craft for a living, a lot of them will say yes," Professor Cox explained. "The fact that there are vacancies – we haven't got enough spacecraft engineers in the country – is an astonishing thing. You could walk into a career building satellites because there aren't enough people to do the job. In aviation, the development of supersonic airliners is a growing sector, and we have a shortage of people who want to build those new aircraft."

"The idea of the Innovation Academy and the National Science Summer School programme is to integrate industries with schools and provide feedback into those schools about what industry needs, so we can build the workforce of the future."

And with Professor Cox in mind, here is a video clip of him answering the question: "Is time travel possible?" Bing Videos

We turn now to our chronological news items:

➢ **September 2023**

In this month's edition of AERO SPACE Stephen Bridgewater asks CAE's Stella-Marissa Hughes, "with a global shortage of both airline pilots and maintainers expected to get worse over the years who is going to operate the raft of 'eVTOLs' that are promised to grace our skies within the decade?"

➢ **6 September 2023**

FINN reports that the future workforce continues to be a hot topic in the aerospace industry. Brooke Weddle, partner at McKinsey, has urged companies to explore new avenues to attract and retain talent. "We're seeing several challenges in the industry right now. First, we're seeing what we call a 'grey to green' transition – a lot of retirements are happening in the near future as well as the younger generations are demanding a new workforce and workplace experience. They want more purpose, they want more development, and they want more flexibility," she commented.

"We're also seeing a change in skills and capabilities required. The headline is 'from hardware to software' – as an example, we're seeing a greater demand for software engineers and there isn't enough pipeline for that."

So, how do we address these challenges? According to Weddle, it is important to diversify your sourcing strategy and look in new places for talent as well as moving beyond a degree being the minimum requirement for entry. "A lot of companies are moving towards skills-based hiring, so think instead of a qualification like a four-year degree, think 'I have this skill set and that can be validated', including with advanced technologies like gen AI," she explained.

Apprenticeships will continue to be a core part of how talent in the industry develops, but it requires a concerted focus on understanding skills and capabilities as they come into the workforce, and then having a strategy to drive those apprenticeships forward.

"The pandemic acted as an accelerant for greater flexibility, a better experience and an emphasis on wellness and wellbeing in the workforce, and an emphasis on diversity as a way to address some of these gaps and look for new solutions," Weddle confirmed.

➢ **2 October 2023**

We conclude this section with a full report on the result of FINN asking James Amor – licenced air technologist and lead architect for Falcon Works at BAE Systems - the question: "Are A-Levels the 'be all and end all' for getting a job within aviation?"

**Tell me about your educational background and the challenges you faced?**

I was never the most successful academic – I hated education and I struggled with GCSEs. The A-Level college I went to didn't offer any courses in Information Technology, so I settled for Chemistry, Biology and English Literature. Although I originally had an offer to study Chemistry at Keele University, I didn't do well in my A-Levels and had to take a step back to re-evaluate my plans. I had no general direction, but I loved computers and software – and seemed to be quite good at both. After a year's break working for the NHS, I went to Liverpool John Moores University; I'd finally found exactly what I wanted to do with my future.

**How did you feel failing you're A-Levels?**

I completed my A-levels in 1997, with results day being a real turning point in my life. I'd been trying to convince myself that I had a future as an Industrial Chemist – my results disagreed! I was forced to

reflect on what I wanted to do career-wise and reconsider the path I wanted to go down. I chose to leave education and took a job working for the NHS.

During the next few months I realised that when I wasn't at work I was always doing something with computers – teaching myself new programming languages, learning how to build them, helping friends with their IT problems. This realisation was a pivotal moment for me; I needed to turn my passion for technology into my career. At the end of my A levels I would never have thought I'd have made it to where I am now, in the aviation industry. I dread to think where I'd be now if I'd have pursued a career in Chemistry. Everything happens for a reason.

**Are A-levels the 'be all and end all' to success?**

I absolutely loved my time at University – it was exactly what I needed to get myself back on track. However, while higher education can provide a great foundation for your career, it's certainly not the be all and end all, nor is it the right path for everyone. I currently work with many early-careers engineers and see some absolute superstars coming into the business through alternative routes like our apprenticeships. Personally, looking back, there's nothing I would have changed in my career path as it got me to where I am today. If you have a passion for what you do then never give up – you'll get there one way or another, just don't give up.

The aviation industry particularly needs a far greater volume of engineers than we currently have. In terms of skillsets we look for potential across the board – and that does not solely come from traditional university backgrounds. We can bring someone on board who is a 70-80% fit, and help them build that last 20-30% organically. Mentoring and coaching are great ways to bring candidates out of their shell and exceed their potential. This part of my role is the most fulfilling, and really gives me a buzz. It's really rewarding seeing someone who didn't have the greatest start in life or didn't have enough confidence, throw themselves into something and watch them flourish and grow."

**What made you interested in the aviation industry?**

I spent a lot of my childhood doing woodwork and cabinet making with my Dad, that's where my love for designing and building things stemmed from. I moved onto software from there – the first system I ever created was programming a computer to ring my Grandparents, so that when they got near the phone it would hang up – so just a bit of fun, but I got in a lot of trouble! I have always had a massive interest in military aviation; two of my grandparents were in the RAF, with another being an engineer at Marconi. I grew up close to the British Aerospace site at Lostock (now MBDA), and I was a cadet in the Air Training Corps. My ambitions were clear – I either wanted to fly military aircraft, or work on them… Sadly my eyesight wasn't good enough to be a Pilot, but I think I've made a better engineer than a Pilot!

**Can you tell me about your climb up the ladder at BAE Systems?**

I applied to BAE Systems straight out of university and have been here ever since! I started at our Christchurch site working in the Land sector, before moving to the Air Sector just over 20 years ago. That's one of the unique opportunities that BAE Systems offers – you can move around the business, even around the world, and try new things. I've been really lucky to have been in a range of roles in that time – from Graduate Software Engineer, System Design Lead, Systems Architect, and all the way up to Lead Architect and Integrator and Licensed Air Technologist. I've worked in the UK,

Germany, Italy and Australia. My time at BAE has been incredibly varied, and I'm very grateful for that.

**What does your role involve now?**

My role as a Licensed Technologist is to ensure our technology planning meets the future needs of the business and to manage the roadmap for new and emerging technologies. This involves understanding what technologies inside and outside defence could help us meet our capability requirements as a business. I look across the technology arena for concepts that could be viable for the military industry – everything in the medical, gaming, automotive, civil aviation, and financial sectors, and ask "what are they doing with cutting-edge technologies that we could exploit and evolve?"

We also lead development of cutting-edge technologies ourselves, and are always keeping tabs on what the next big thing is, and asking ourselves if we need to be investing in these technologies and seeking to better understand them from a defence and security point of view. The FalconWorks mantra is 'what comes after next?' We maintain capability roadmaps covering business needs over the next 5, 10, and 20 years – essentially mapping out where we need to be, and what steps we need to take to evolve and mature our capability in the meantime to get there.

Essentially, our clients, or the wider business, come to us with a challenge, or a jigsaw, and we need to piece it together and find a solution. We identify and integrate the various technological capabilities we have – whether it's established technologies, or innovative ideas showcased just a month ago – and stitch them together to not only meet the capability expectations but pre-empt the future direction of what they may ask for next. We also have a virtual 'shelf' of fantastic ideas and concepts ready to be used. It's my job as a Licensed Technologist to continually restock that shelf, so that when we are set a challenge that we don't have an answer to, we can look to our existing innovations and concepts for inspiration.

**How does BAE Systems support the future generation?**

BAE Systems takes investment into future generations and early career opportunities very seriously. In fact, BAE Systems invests approximately £100m in education, skills and early careers activities in the UK annually and currently has almost 4,300 apprentices and graduates in training across its UK businesses, equivalent to more than 10% of its 35,000 strong UK workforce. There are a range of roles catering to different backgrounds and experience. Requirements for graduate or apprenticeship roles vary, but across the board having a passion for technology is a must!

**Is there an increase in females working in the industry?**

Although the industry has traditionally been male dominated, things are certainly changing. Personally, I work with some fabulous female colleagues, and it's great to see their numbers increasing. BAE Systems are huge advocates of levelling out that imbalance, and always seek to empower and advocate for women in engineering and aviation. Diversity is treated as a priority when building our workforce. It's great to see more women entering the industry each year, and bringing diversity of skills, perspective, and backgrounds with them – something that STEM careers, and BAE Systems, thrives on. There are some brilliant female engineers in my team; they are incredible at what they do and bring a lot to the table – hopefully they inspire more females to enter the industry.

**I understand you are a Fellow of the Royal Aeronautical Society and an award nominee for a flight safety innovation for the RAF. How does this make you feel?**

I'm incredibly proud of my accomplishments, and I absolutely love what I do. In fact, I don't see what I do as work. As a hobbyist, I apply the same passions at home too. I make sequenced Christmas lights, Remembrance Day displays, and Halloween displays with automated candy dispensers – everything has embedded computing. To paraphrase Top Gun, "Military aviation isn't what I do, it's what I am!" Given I work in such emerging technologies, you never quite know when the next big disrupter is going to emerge, which keeps things really exciting. I'm looking forward to seeing where else my time at BAE Systems will take me.

**What advice would you give a student today that is experiencing what you did when studying your A-Levels?**

In my career to date, not once has 'Plan A' worked out! It's about taking a step back and working out how you can get around it, adapt, and fix it. So, don't be put off if you don't get exactly what you want result and career wise – learn everything you can from the opportunities you do have, and channel it into what you do next. I'd recommend you find what you love, and who you are; do that as a job, and you'll never work a day in your life! Be true to yourself – follow a path that you know will motivate you and bring true job satisfaction. Most importantly, be kind to yourself. Throughout your career you'll be challenged, and that's ok, but make sure you look after yourself throughout the process.
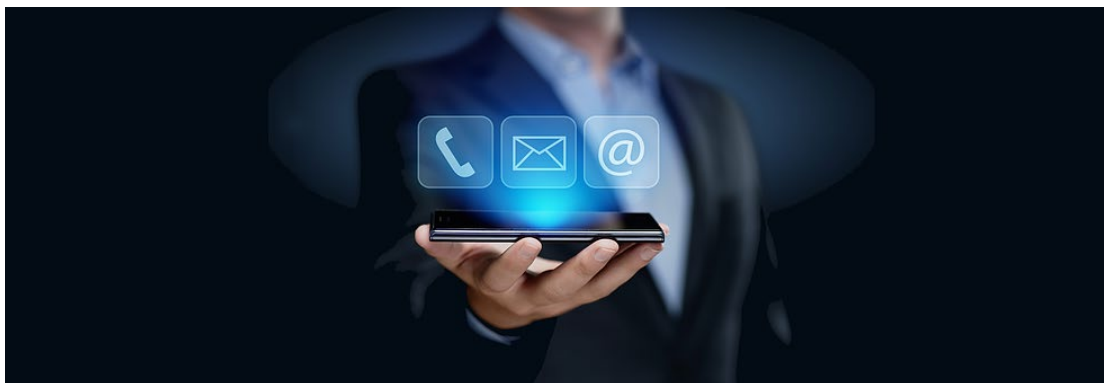


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