



*The Northrop Grumman B-21 Raider*

**The Schools’  
Aerospace Careers Programme  
Newsletter**

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**Spring 2023**

**The Schools’ Aerospace Careers Programme is a Registered Charity (#1190721)  
in accordance with the Charity Commission for England & Wales**

## COVER PICTURE

The Northrop Grumman B-21 Raider is an American strategic bomber under development for the United States Air Force by Northrop Grumman. As part of the Long Range Strike Bomber (LRS-B) program, it is to be a long-range, stealth intercontinental strategic bomber for the USAF, able to deliver conventional and thermonuclear weapons. The Air Force intends the B-21 to replace the Rockwell B-1 Lancer and Northrop Grumman B-2 Spirit by 2040, and possibly the Boeing B-52 Stratofortress after that.

The Air Force began planning for the B-21 in 2011 and awarded the major development contract in 2015. The B-21 is expected to make its first flight in 2023 and enter service by 2027.

Many aspects of the B-21 program are highly classified; the program is designated as a special access program. The Congressional Research Service noted in 2021 that the B-21's technical details and specifications, such as speed, enabling systems, size, required stealth, structure, number and type of engines, projected weapons, and onboard sensors, remain classified" although some information about various other aspects of the program have been made public since 2015.

The first photos of the aircraft were released on 2 December 2022, taken during a roll-out ceremony at Northrop Grumman's production facilities in Palmdale, California.

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# INTRODUCTION

Welcome to the Spring 2023 edition of the Schools' Aerospace Careers Programme Newsletter. Looking back over 2022 the year was, to quote the words of Harold MacMillan, our very patrician UK Prime Minister in the 1960's when asked "what was the greatest challenge for a statesman?" he replied: "*Events dear boy, events.*" Well, 2022 was certainly full of those – and in 2023 it continues to be so!

Nevertheless, we at the ACP are strongly of the view that 'the glass is half full, not half empty'. With that in mind, as we review the second half of 2022, and then provide comment on the first few months of 2023, we start with an Editorial article in the Daily Telegraph's 2022 New Year's Eve digital news:

*"As we stand on the cusp between the old year and the new, so the West – and Britain in particular – stands on the cusp between challenges met and those still to be faced. It has been a sobering 12 months, characterised latterly by soaring inflation, anaemic growth, creaking public services, strikes and political turmoil – a catalogue of ills that could give despots abroad the idea that the free world, with this island nation at its heart, is in decline. But Britain has much to be proud of. And this year's accomplishments are enough to give any autocrat pause.*

*Did China's President Xi Jinping, for example, really imagine at the outset of 2022 that the year would end not with the West buckling under Covid, but his own administration forced into a **humiliating policy climbdown** by public protest, his country scrambling to cope with soaring infection rates and death tolls that may be so large they are now covered up.*

*The scale of this reverse was yesterday underscored by **the announcement** that Chinese travellers would require a negative Covid test before they are allowed to depart for Britain. After years of China's zero-Covid policies which locked down tens of millions and subjected visitors to harsh quarantines when they were allowed in at all, it is tempting to relish the irony of this latest restriction. But it is probably caution that is behind it, fuelled by suspicions that Beijing – as throughout the pandemic – is not being transparent, and that its current outbreak may even be harbouring a new Covid variant.*

*Still, we should remember that it remains a restriction, and that in normal circumstances the bedrock of sensible Covid policy is to vaccinate and carry on, not shut down society. Widespread bans are an unwelcome reminder of a draconian approach to Covid which we thought was behind us – one that even China's autocratic leadership has now accepted cannot defeat a respiratory virus. The year that is now ending has relentlessly contrasted the freedoms our society has enjoyed with the appalling confinement in China. That is a triumph to be celebrated, not retreated from.*

*The year's response to war in Ukraine has also demonstrated Western strength to another autocrat who likes to think that freedom and democracy is a recipe for weakness. Did Vladimir Putin really imagine that launching his ruthless invasion of Ukraine would prompt not only a lion-hearted response from that country, but also enduring Western unity, even in the face of energy blackmail and nuclear bluster?*

*Recent years may have given Russia good cause to imagine that NATO was defunct, and that Western values would prove infinitely flexible as long as the cheap gas kept flowing from the east. Instead the West has now shown that it is not prepared to overlook dictators' attempts to redraw international*

*borders by force. It is a unified position that still has clout among non-aligned powers; China and India have both made clear their tepid enthusiasm for Mr Putin's invasion. Mr Xi also has a new calculus when it comes to his own military ambitions for Taiwan.*

*But if the Western response to Russian aggression, powered by America and led in Europe by Britain, has been formidable, it is only a foundation. Britain is still vulnerable to energy price swings. The expansion of renewables is laudable, but domestic oil and gas production needs to be increased, as does energy storage. Militarily, too, Britain is in a state of flux, our Armed Forces seemingly in permanent adjustment to the new age of digital warfare as review gives way to review and procurement programmes too often falter. The one role soldiers seem guaranteed to fill is that of **striking workers**. Yet their place is preparing for the threats that are proliferating, and not just from Russia. Iran remains a prime terror sponsor, China is determined to assert itself. Instability is fuelled as the certainties of yesterday – like cheap food and energy – fade.*

*Faced with all this, it would be easy to despair. But despite the turmoil at home, this has been a year in which Britain has shown strength more than weakness, helming a reinvigorated democratic alliance. In that signal achievement, and the resolve it exemplifies, there is purpose for the present and comfort for the future.”*

We sincerely hope all readers will find our series of *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](mailto:chairman@aerospacecareersprogramme.co.uk)

This *Newsletter* has been released on the News page of our new Schools' ACP website – [www.aerospacecareersprogramme.co.uk](http://www.aerospacecareersprogramme.co.uk). The next publication in the series will be the Summer 2023 *Newsletter*.

MS

30 April 2023



# INDUSTRY REVIEW OF 2022 & PROJECTIONS FOR 2023

To understand the outlook and perspectives of organizations across the aerospace and defence industry, Deloitte (an international professional services network) undertook a survey of nearly 50 US executives and other senior leaders in August 2022. The survey captured insights from respondents in four specific industry segments: commercial aerospace; defence and military; space; advanced air mobility. The following is the introduction to the report that resulted from that survey entitled ‘Deloitte: 2023 aerospace and defense industry outlook.’

*With the global economy gradually recovering from the COVID-19 pandemic, the aerospace and defense (A&D) industry has shown signs of a strong rebound in 2022, but supply chain and talent issues continue to limit the industry’s growth. According to Deloitte’s outlook survey, supply chain disruptions and talent shortages may be the biggest risks or challenges for A&D organizations in 2023. Furthermore, the Russian invasion of Ukraine (the invasion) disrupted global supply chains, especially for critical metals and rare earth elements, and exacerbated fuel price volatility. Inflation remains a challenge for the entire industry - 54% of respondents in Deloitte’s outlook survey report that price increases are one of the key risks in 2023.*

*As demand for passenger travel is correlated to ticket prices which, in turn, depend on jet fuel prices, a quick and sustained rise in jet fuel prices can affect traffic and increase market volatility. To address this challenge, aircraft manufacturers are investing in aircraft and engine design to make them more fuel-efficient, lower operating costs, and explore lower- and zero-emissions commercial aircraft for the future. The strong recovery in air travel is leading to increased aircraft orders and aftermarket activity. Domestic traffic levels registered about 81% of the pre-pandemic 2019 levels (in September 2022), and international traffic levels have shown strong growth with easing travel restrictions worldwide. Leading global commercial aerospace original equipment manufacturers (OEMs) estimate that global passenger traffic will return to 2019 levels by the end of 2023 or early 2024. This could, in turn, result in production ramp-ups to remediate the growing backlog and drive industry revenue in 2023*

*The defense segment remained stable through 2022 and is expected to outperform the commercial aerospace segment as an increase in defense budgets in the wake of the invasion is boosting demand for military equipment globally. The US defense budget for FY2023 emphasizes perceived strategic threats from China and Russia, with a key focus on electronic warfare and cybersecurity. European nations are modernizing armed forces with a planned increased budget to address rising geopolitical tensions. These nations have announced an increase of about \$204 billion in the defense budget in the first three months of the invasion focusing primarily on future military technologies.*

*Emerging markets such as space and advanced air mobility (AAM) gained further traction in 2022 with more electric vertical take-off and landing (eVTOL) flight tests, and aircraft and pilot certification. Worldwide, 347 entities are currently working on more than 700 eVTOL aircraft concepts and designs, highlighting the industry’s focus on the future of mobility. Meanwhile, private participation in space resulted in solid growth in the space economy in recent years. The segment witnessed 72 rockets launching 1,022 spacecraft into space in H1 2022, with the commercial sector accounting for about 94% of the launches.*

*According to Deloitte’s outlook survey, 88% of surveyed senior executives indicated that they believe the general business outlook for the A&D industry for the next year is “somewhat to very positive.” There are more reasons for this optimistic outlook. These include growth in new technologies and segments such as AAM, evolving business models in areas such as space, and the use of digital thread and smart factories. All these factors should help the industry grow and create new markets in the coming year. A&D companies focused on innovation and prepared to capitalize on new emerging opportunities could outperform their peers in 2023.*

In conclusion, the report states that business agility and digital transformation will be key to staying ahead. It suggests that 2023 could see increased competition in three areas in particular:

- Digitally skilled talent (from other industries).
- Material (due to the shift of supply chains through nearshoring).
- Customers (from new players entering the AAM and space markets).

And that some of the top signposts for A&D companies to watch will be:

- *Business agility.* Achieving agility could be critical for A&D companies seeking to operate through turbulence and compete in the next growth period.
- *Emerging technologies.* Investing in emerging technologies and smart factory solutions can help companies address supply chain challenges, optimize production capacity, progress towards sustainability goals, and improve employee retention.
- *Emissions reduction.* A&D companies can further reduce emissions in 2023 across the value chain, specifically by helping ramp-up the production capability of SAF.
- *Developing business areas.* The growing interest in space, supersonics, hypersonics, and AAM will likely generate more business and employment opportunities, and the value chain may further expand in 2023.

To read the full article see: [2023 Aerospace and Defense Industry Outlook | Deloitte US](#)

To conclude this section we turn to BENCHMARK’s ‘Aerospace and Defense 2023 Industry Trends: The age of advanced digitization’ by Rick Gronemeyer.

### ***The Age of Advanced Digitization***

*The 2023 Aerospace and Defense (A&D) industry’s shared goals focus on agility, productivity, growth, and sustainability. In order to meet these goals, however, the industry must focus squarely on digitization. To put this into perspective, for original electronic manufacturers (OEMs) to remain competitive within the A&D playground now and well into the future, digitalization is no longer an option - it’s a requirement. Welcome to a reimagined 2023 where digital advancements and technical innovation generate economic growth, strengthen productivity, and help to protect our global citizens and our shared environment for generations to come. To that end, here is a look at Benchmark’s top three A&D trends we see continuing to unfold in 2023 and beyond.*

### **Trend #1: Defense Digital Twinning**

*In the commercial space, digital twinning is hardly a new concept. In fact, the commercial industry's ability to digitally twin electronics has been around for at least 20 years allowing OEMs to test, debug, and refine their products well ahead of manufacturing. In the defense industry, while digital twinning has several roadblocks to overcome, it is gaining traction. Defense digital twinning even appeared in the United States' 2018 National Defense Strategy. As we move forward, we expect to see demand pick up for defense digital twinning implementation as more defense primes roll up their pilot projects using digital twin strategies.*

*However, along with regulations requiring digital twins for all new engineering undertakings - like many other U.S. Defense Procurement reforms - there come several challenges, including the ongoing debates over defense spending. Perhaps RealClearDefense (RCD), a reputable news outlet for military and defense professionals, puts it best, stating "congressional oversight needs to focus on incentivizing efficiency and sustainability at all levels of lifecycle costs. Industry has responsibility also to help government clearly appreciate practices over buzz words, results over rhetoric."*

*The Department of Defense (DoD) must also overcome additional organizational and technological obstacles. At the very basic level, digital twins require specialized sensors that support the virtual twin's ability to simulate the attributes of its physical counterpart. And, if electricity allows the product to function, these specialized digital twin sensors must also be able "to accurately detect and represent the product's electricity circuits." (RCD) The main driver will be efforts on the part of defense companies toward efficiency and reduced time to market. The question for many primes will be whether to invest in sizable in-house digital twin capabilities, develop partnerships, or consortia.*

### **Trend #2: Digitization of Training**

*In the coming years, specialized robotics used to train soldiers will only increase in number and advance in capabilities. One clear example is the application of robotics that do not require a rail system and the accompanying infrastructure to operate target dummies. This advanced technology offers realistic combat training opportunities in which soldiers are presented with real-life battle scenarios and aggressive human and vehicular robotic targets.*

*Since the training robots are not confined to a rail system, the training sessions are no longer highly repetitive and, therefore, are less predictable, strengthening a soldier's preparedness. Among the many sophisticated components these training robots require (control systems, actuators, power supply, etc.), sensors are of particular importance. Beyond acting as the robot's eyes and ears, some of the sensors control the robot's sense of touch and its movements. These specialized sensors quickly take in the robot's surroundings and swiftly process the most critical data, allowing the control system to send commands to all other components.*

*Outside of the training environment, AI-controlled robots can now autonomously negotiate a wide range of real-life combat environments. These advanced robots are fully aware of their surroundings and can effectively communicate with each other to successfully navigate and conquer complex tactical terrains. Overall, these advancements help to reduce risk, decrease costs, and increase combat success rate.*

### **Trend #3: Sustainability and Resilience**

*The more the world learns about the looming effects of climate change, the more ubiquitous - and the more stringent - green regulations will become. In fact, since the 2015 White House publication of “The National Security Implications of a Changing Climate” report, the Federal Government’s involvement in resilience measures has only intensified. As the United States Secretary of Defense, Lloyd J. Austin III puts it: “No country can find lasting security without tackling the climate crisis. Climate change will continue to shape the context for military operations -for the United States and for our competitors -which is why we must ensure that our combat forces are ready to respond to future risks and equipped to operate superbly no matter the changing conditions.” Climate Adaptation Plan 2022 Progress Report.*

*Sea levels continue to rise, storm surges are becoming more frequent, and flooding is intensifying, all impacting the security of our critical infrastructure and military installations along our coastal areas. The effects of climate change also impact arctic regions, limiting the nation’s ability to advance national security interests, pursue responsible stewardship of the land, protect local communities, and strengthen international cooperation.*

*As electricity consumption increases, energy production, transportation, transmission, and distribution will also be negatively impacted. Now, more than ever before, we need to embrace innovative, sustainable alternatives and execute effective action plans to directly address the growing energy crisis. Some of these promising innovations and action plans include:*

**Alternative Fuels.** *Sustainable aviation fuels (SAFs) at scale, and new propulsion technologies such as electric, hydrogen, and hybrid, can all lead to - at minimum -viable net-zero solutions (if not eventually, zero-emission solutions). “Electric propulsion could [also] be a potential zero-emission propulsion solution for decarbonization in the long term, particularly for short-haul flights and urban air mobility.” (Deloitte).*

**Advanced Air Mobility (AAM).** *Another growth industry gaining considerable attention involves Advanced Air Mobility (AAM) - fully electric, commercial air travel. Since these specialized aircraft can be manufactured much smaller - and cleaner - than traditional commercial aircraft, AAM technology will provide a more inclusive experience for commuters at large.*

**Sustainable Energy for Defense Facilities.** *Through its efforts in building effective partnerships and incorporating environmental justice into their recent initiatives, the DoD provides a clear example of how to develop and execute an effective sustainability strategy. In their 2022 Sustainability Plan, the DoD sets some impressive goals, including*

*100% carbon pollution-free electricity (CFE), 100% zero-emission vehicle (ZEV) fleet acquisition, and net-zero emissions buildings, campuses, and installations.*

**Urban Air Vehicles (UAVs).** *For cargo, UAVs offer a greener, safer, and more efficient commercial delivery alternative to delivery vehicles on the world's increasingly congested roads and highways. The application of UAVs for inspection and surveillance projects also continue to increase. While these growing technologies and initiatives are indeed promising, they do come with their own set of challenges. The cost of bio-SAFs, alone, can be as much as ten times that of conventional jet fuel.*

*Consumer acceptance also remains a significant challenge, especially in the areas of alternative air travel. However, with increased awareness, public perception is starting to shift across geographies. A&D OEMs all need to keep their end customers' sustainability goals in mind when setting strategies and developing new productions. The real trick to overcoming challenges lies in critical partnerships with key players within the A&D industry.*



# THE SCHOOLS’ AEROSPACE CAREERS PROGRAMME



Commencing this year, The Schools’ Aerospace Careers Programme (ACP) will provide the following services: UK-wide Presentations to groups of schools, each hosted by a ‘host school’; Digital Support via our new website and soon to be initiated range of social media; work experience industry placements; and an ACP Network which will bring young people and companies face-to-face on the latter’s premises.

Additionally, as part of our schools presentations we will include an increasing range of supporting equipment/exhibits such as the two items above: on the left, Boston Dynamic’s robot, ‘Spot’; and on the right, a museum quality replica of a NASA Space Shuttle EMU space suit. Both of these items will feature in the ACP schools presentations which commence at the beginning of the 2023/24 academic year this September, the programme for which is still under development, but so far includes the following host locations:

13 Sep 2023:	Bromley High School
14 & 15 Sep 2023:	Colchester County High School for Girls
? Sep 2023:	Bablake School - Coventry
2 Oct 2023:	St Albans High School
6 Oct 2023:	West Buckland School - Barnstaple
17 Oct 2023:	Wakefield Girls High School
? Oct 2023:	Oxford International College
7 Nov 2023:	William Perkin High School – Greenford

14 Nov 2023:	St Francis' College, Letchworth Garden City
23 Nov 2023:	Scarborough UTC
4 Dec 2023:	Sheffield School for Girls
? 2023:	Emanuel School - London
27 or 29 Feb 2024:	Queen Ethelburga's College - York
15 Mar 2024:	The Henrietta Barnett School - London
27 Mar 2024:	Wilson's School – Wallington
24 Apr 2024:	The Knights Templar School, Herts

In addition, the following host schools are likely to join us either in academic year 2023/24 or academic year 2024/25 which is already in the planning stage:

Beauchamp City Sixth Form - Leicester

Bolton Grammar School

Colyton Grammar School

Eton College

Fulham Cross Academy - London

Hymers College - Hull

Park School - Barnstaple

Ripon Grammar School

Silverstone UTC

St Olave's Grammar School - Orpington

Stowe School

The Brooksbank School - Calderdale

The Cedars Academy – Leicester

Truro School

Tudor Grange Academy, Worcester

Furthermore, additional equipment is being included in the presentations, such as Virtual Reality aids, portable 3D printers, drones and, quite possibly later, a humanoid inter-active robot. And then there will be the equipment and aids that industry bring with them. Regarding the latter, an increasing number of companies are joining the ACP and four will be part of the presentation team at each event with their individual attendance varying throughout the year as dictated by their business commitments, the intention being that all supporting companies will be able to attend at least twice throughout the course of each year. These presentations will now be a mix of individual presentations supported by audio-visual and physical aids, and a recruitment fare.

To provide the ACP with mobility, courtesy of a very generous donor, we have just acquired a brand new extra-long wheelbase Ford Transit Van:



*2023 Ford Extra Long-Wheelbase Transit Van*

Another area of change and growth will be the development of our Digital Services, and because you are reading this Newsletter which in future will be published on our revised [www.aerospacecareersprogramme.co.uk](http://www.aerospacecareersprogramme.co.uk), you will have seen the latter, shortly to be accompanied by our new social media platforms: Facebook; Instagram; LinkedIn; Twitter. Furthermore, as the months and years progress we will add a Media page to the website which will include appropriate video clips; we will also link our website and social media to those of our partners.

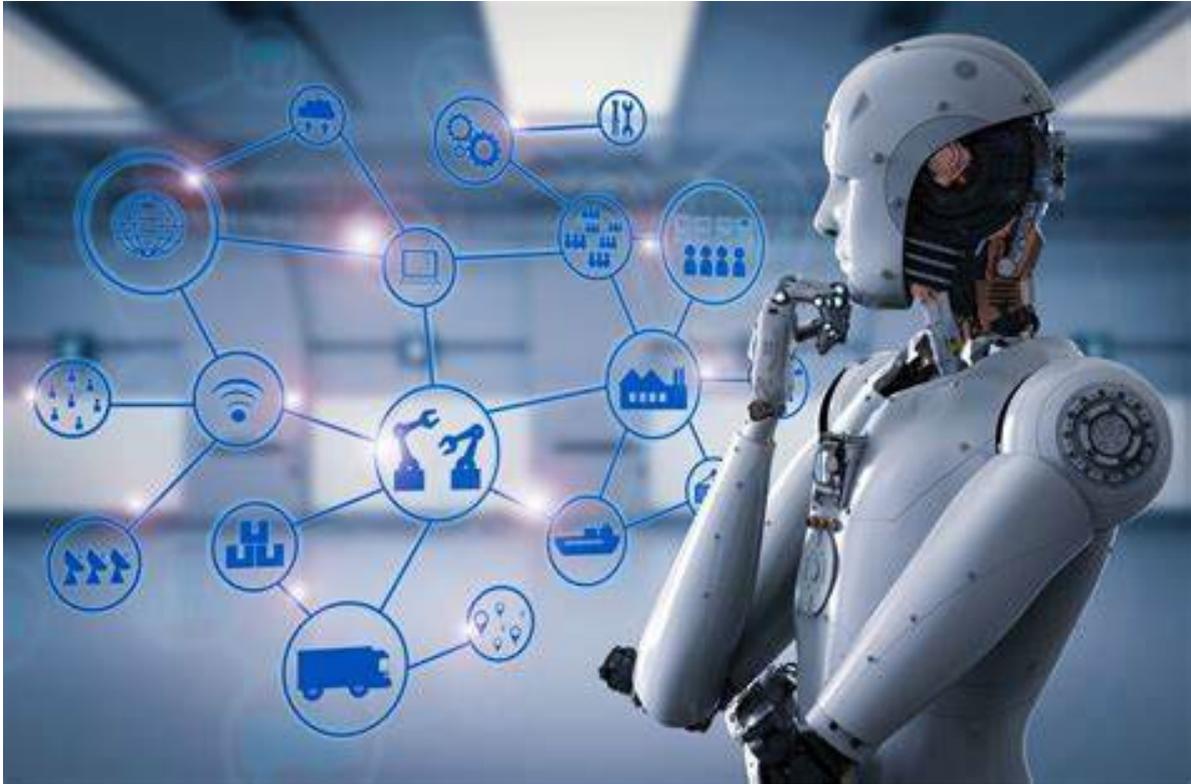
Moreover, this year we undertook our first ACP Network event with seven schools visiting Cranfield University's Digital Aviation Research & Technology Centre. A further event this year is being planned. The intention is that from 2024 there will be at least three events per year around the UK as our Network continues to grow. Details will be announced on the website and also direct to the schools concerned.

And with partners in mind, in 2024 the ACP will commence a facilitation service for Host Schools whereby we bring them and our industry partners together to provide work experience placements for young people during the most appropriate time of the year for both parties.

Finally, to aid these changes and developments we welcome on board Emma Versen, our new ACP Administrator, and DevelopMyWeb ([info@developmyweb.com](mailto:info@developmyweb.com)) who are assisting with our revised and growing digital services.

Companies interested in joining with the Schools' Aerospace Careers Programme should contact [chairman@aerospacecareersprogramme.co.uk](mailto:chairman@aerospacecareersprogramme.co.uk); and schools who are likewise interested should contact [emmaversen@aerospacecareersprogramme.co.uk](mailto:emmaversen@aerospacecareersprogramme.co.uk). **We would be delighted to talk with you and then visit.**

# TECHNOLOGIES OF THE FOURTH INDUSTRIAL REVOLUTION



For those of you who have not yet come across the term ‘The Fourth Industrial Revolution, 4IR, or Industry 4.0, it conceptualises rapid change to technology, industries, and societal patterns and processes in the 21st century due to increasing interconnectivity and smart automation. The term was popularised in 2015 by Klaus Schwab, the World Economic Forum founder and executive chairman, and has since been used in numerous economic, political, and scientific articles in reference to the current era of emerging high technology. Schwab asserts that the changes seen are more than just improvements to efficiency, but express a significant shift in industrial capitalism. A part of this phase of industrial change is the joining of technologies like artificial intelligence and gene editing to advanced robotics that blur the lines between the physical, digital, and biological worlds.

Throughout this, fundamental shifts are taking place in how the global production and supply network operates through ongoing automation of traditional manufacturing and industrial practices, using modern smart technology, large-scale machine-to-machine communication (M2M), and the internet of things (IoT). This integration results in increasing automation, improving communication and self-monitoring, and the use of smart machines that can analyse and diagnose issues without the need for human intervention.

It also represents a social, political, and economic shift from the digital age of the late 1990s and early 2000s to an era of embedded connectivity distinguished by the omni-use and commonness of technological use throughout society (e.g. a metaverse) that changes the ways humans experience and know the world around them. It posits that we have created and are entering an augmented social reality compared to just the natural senses and industrial ability of humans alone.

In essence, the Fourth Industrial Revolution is the trend towards automation and data exchange in manufacturing technologies and processes which include cyber-physical systems (CPS), IoT, industrial internet of things, cloud computing, cognitive computing, and artificial intelligence. The machines cannot replace the deep expertise in humans but they do tend to be more efficient in performing repetitive functions, and the combination of machine learning and computational power allows machines to carry out highly complicated tasks.

The Fourth Industrial Revolution embraces technological developments in: cyber-physical systems such as high capacity connectivity; new human-machine interaction modes such as touch interfaces and virtual reality systems; improvements in transferring digital instructions to the physical world including robotics and 3D printing (additive manufacturing); the Internet of Things (IoT); "big data" and cloud computing; artificial intelligence-based systems; improvements to and uptake of Off-Grid / Stand-Alone Renewable Energy Systems such as solar, wind, wave, hydroelectric and electric batteries (lithium-ion renewable energy storage systems (ESS) and EV).

The Fourth Industrial Revolution marks the beginning of the imagination age, the period beyond the Information Age, where creativity and imagination become the primary creators of economic value. In contrast the main activities of the Information Age are analysis and thinking. This concept holds that technologies like virtual reality and user created content will change the way humans interact with each other and create economic and social structures. A key concept is that the rise of an immersive virtual reality - the metaverse or the cyberspace - will raise the value of "imagination work" done by designers, artists, etc. over rational thinking as a foundation of culture and economics.

With that background we now continue our chronological reporting of news items concerning those technologies and relevant others:

### ➤ 2 August 2022

Howard Mustoe writes in The Telegraph that an Oxford start-up that claimed a major breakthrough in the quest for nuclear fusion is seeking £400m to fund the next stage of its research. First Light Fusion made headlines in April when it said it had achieved the reaction using its method of firing projectiles at fuel. It now needs cash to get to the next stage of development: a "gain" experiment where more energy is produced than put in. This is an important step towards commercialising the technology.

The process of nuclear fusion melds atoms together, which releases energy. It is the same reaction that generates energy in the sun. This is separate from nuclear fission, the reaction used in power plants where atoms are split to create energy. In fission, nuclear waste is generated as an unwanted by-product.

First Light Fusion hopes to reach its funding target in the coming months, according to people close to the company. Chief executive Nick Hawker, who founded the company in 2011, is understood to be gauging interest from investment houses and wealthy individuals. See: [Oxford nuclear fusion spin-out raising £400m after energy breakthrough \(telegraph.co.uk\)](https://www.telegraph.co.uk/energy/news/first-light-fusion-raises-400m-after-breakthrough/)

### ➤ 19 August 2022

*"The best economic investment that Britain can make over this parliament and the next is to sequence the genomes of the entire population, becoming the first major country in the world to break the health*

*barrier. There lies national renewal and the GDP accelerator. It would open the way to precision medicine for everybody as a matter of routine, with a high probability that it would slash the long-term costs of the NHS and reverse the current trajectory of an overwhelmed service heading for breakdown. It would cut debilitating sickness among those of working age, and extend the span of employment, with knock-on benefits for pension solvency and the national savings rate. I cannot think of any other outlay by the British state with such a high economic multiplier and with so many spin-off benefits.”* So writes Ambrose Evans-Pritchard today. Read: [Britain’s path to economic and national renewal is the genome revolution \(telegraph.co.uk\)](#)

➤ **3 September 2022**

Matthew Field suggests that Apple is rumoured to be launching mobile satellite connectivity. Read: [Apple plots to conquer one of the smartphone’s final frontiers \(telegraph.co.uk\)](#)

➤ **12 October 2022**

Sarah Knapton reports that brain cells living in a dish have learned to play the Seventies computer game Pong in a breakthrough that proves even small clusters of neurons can exhibit intelligence. The new research not only opens up a broader understanding of how sentience forms, it could also usher in a new era of biological computing and drug discovery.

For the experiment, scientists connected 800,000 brain cells to a bed of electrodes linked to the computer game using wires which allowed signals to pass back and forth. The team selected Pong because it was one of the first games conquered by artificial intelligence. Neurons generated small electrical charges when active and the team allowed these charges to move the paddle and also receive a signal back, depending on if the ball hit or missed it. The set-up effectively gave the brain cells the ability to act upon the game and learn the consequences of their actions. In just a few minutes, the neurons learned how to keep the ball in play. Read on at: [Watch: Lab-grown human brain cells learn how to play Pong \(telegraph.co.uk\)](#)

➤ **30 October 2022**

Andrew Griffin reports in The Independent that scientists from the University of Chicago have created an entirely new material that even they cannot explain. The material can be made like plastic, but conducts electricity like a metal. Read: [Scientists create entirely new material that ‘can’t be explained’ | The Independent](#)

➤ **4 November 2022**

Antony Ashkenaz writes in the Daily Express that the Government has announced a new £95million funding boost into research and development of "the super-materials of the future" which they believe are the key to accelerating the UK's growth. Grant Shapps, the Business Secretary, unveiled the funding which will be delivered to the Henry Royce Institute, headquartered in Manchester, for research and innovation in advanced materials. These materials, which include biomaterials, smart materials and nano-engineered materials, are ones that possess unique properties enabling superior performance compared with their traditional counterparts and are critical in a wide range of industries including health, transport, energy, electronics and utilities. See: [UK unveils huge £95million boost into 'super-materials' to 'turbocharge Britain’s growth' | Science | News | Express.co.uk](#)

➤ **5 November 2022**

Laura Donnelly writes in The Telegraph that brain-controlled bionic arms which can mimic natural movements will be offered to amputees on the NHS. The newly available bionic arms - controlled by electrical brain signals - have multi-grip capabilities, enabling a greater range of movements to make day-to-day tasks easier. Experts said they can be used by those as young as nine.

The NHS will make the technology available to every patient across England who needs it, following two independent reviews into their use and the successful rollout for veterans. Previously, the cutting-edge prosthetics were only available on the NHS to military veterans injured during service. See: [Brain-controlled bionic arms to be offered to amputees on NHS \(telegraph.co.uk\)](https://www.telegraph.co.uk/health/nhs/brain-controlled-bionic-arms-to-be-offered-to-amputees-on-nhs/)

➤ **6 November 2022**

Sir Richard Branson is preparing to sell off Virgin's stake in a US hyperloop start-up as interest in the technology envisioned by Twitter billionaire Elon Musk fades. A source said Virgin will begin stripping its branding from US business Hyperloop One over the coming weeks and will divest its equity stake at the same time. It has already removed its logo from the company's website. Sir Richard's company acquired a small stake in Hyperloop One in 2017, rebranding it as Virgin Hyperloop One. The Hyperloop is a theoretical alternative to high-speed rail, where pods fly through steel tubes at up to 760 miles per hour. The technology was first proposed by Mr Musk in 2013, prompting a clutch of start-ups to attempt to build one.

A Virgin Group spokesman said it had made the decision to remove its branding because Hyperloop One's business plan had changed from high-speed passenger transport to purely cargo. Virgin board member, Luigi Brambilla, will also step down. The spokesman said: "Virgin Hyperloop recently took the decision in response to market demand to focus its immediate efforts on cargo-based solutions. Due to Virgin Hyperloop's change in short-term priorities and having discussed it with the board of Virgin Hyperloop and its shareholders, Virgin Group has decided to work with Virgin Hyperloop's management team to remove the Virgin brand from the business." Read further at: [Richard Branson to sell Virgin's stake in Hyperloop project \(telegraph.co.uk\)](https://www.telegraph.co.uk/business/2022/11/06/richard-branson-sell-virgin-stake-hyperloop-project/)

➤ **24 November 2022**

In a Daily Telegraph article by Matt Oliver he writes that as he prepares to slash the number of managers running NHS England by as much as half, Rishi Sunak has proffered a potential solution to the crisis engulfing the health service - send in the robots. The Prime Minister has vowed to "radically innovate", using new technology to deliver healthcare reforms that will challenge "conventional wisdom". His suggestion conjures images of Arnold Schwarzenegger's Terminator carrying patients into A&E, or the sinister HAL 9000 overseeing hospital wards. However, experts say the reality is more prosaic – and ultimately more useful. Improvements can be made in digital record keeping, appointment management and analysis of X-rays that could yield huge improvements.

The overhaul proposed by Mr Sunak comes at a critical time with the NHS battling inflation, recruitment problems and an enormous patient backlog following the Covid crisis. A record 7.1 million patients are waiting for procedures in England, up from 4.2 million before the pandemic. This is contributing to the huge tally of 2.5 million people who are unable to work because of long-term sickness which is acting as a drag anchor on economic growth. Although automation cannot

completely fix the NHS's problems, there are hopes it can at least lighten the load. The ultimate goal of rolling out technology across the NHS is to enable staff to use their time more productively. See: [Dr Robot: How automation and tech could cure the crumbling NHS \(telegraph.co.uk\)](https://www.telegraph.co.uk/health/nhs/2022/11/27/dr-robot-how-automation-and-tech-could-cure-the-crumbling-nhs/)

### ➤ 27 November 2022

A year after its launch the Metaverse is still baffling to many, writes Gareth Corfield and Matthew Field. As Meta struggles with slowing sales amid founder Mark Zuckerberg's fixation with computerised virtual reality worlds, brands are wondering whether they too need to follow the 38-year-old tech whizz into his bizarre vision of the future. Many companies have piled their marketing millions into metaverse experiments, launching virtual worlds, cryptocurrency-inspired "non-fungible-tokens" (NFTs) and video game tie-ins to appeal to customers.

Sales reps from Meta have been touring Britain's boardrooms with the words of Zuckerberg's right-hand man Nick Clegg echoing in their ears: "The metaverse is a logical evolution. It's the next generation of the internet – a more immersive, 3D experience. "Its defining quality will be a feeling of presence, like you are right there with another person or in another place."

The reality, as told by a British executive on the receiving end of one of these pitches, is much more mundane. "A lot of it felt very Second Life, workplace meetings and all that," said the executive. Second Life is the original metaverse experiment. Created in the aftermath of the dot-com crash of the early 2000s, it had all the features of Zuckerberg's metaverse: virtual avatars, digital currency and real-world shops. Its popularity waned, although the site still exists today. Read on at: [Meta's sad quest to convince corporates to join the metaverse \(telegraph.co.uk\)](https://www.telegraph.co.uk/technology/meta/2022/11/27/meta-sad-quest-to-convince-corporates-to-join-the-metaverse/)

Also today, Rachel Millard reports in The Telegraph that Oxford-based First Light Fusion is examining sites across Britain for a facility that will use fusion to produce both electricity and tritium, an isotope of hydrogen needed to fuel fusion reactions. This facility would be used to supply First Light's commercial fusion reactor, which is still under development. Tritium is extremely scarce and currently costs around \$30,000 a gram, with much of the world's stock already earmarked for other reactors. First Light Fusion says producing it on site would help commercialise fusion technology, which has been in development for decades.

Nick Hawker, First Light Fusion's co-founder and chief executive, said: "One of the major engineering challenges of fusion is being able to produce enough tritium yourself. With our design approach, that's quite an easy thing to do. So with this pilot plant design we will maximise that strength. It will be designed to over-produce tritium. That will unblock the scalability of the technology, allowing us to scale out many more power plants much more quickly."

First Light hopes to get the 60-megawatt pilot plant up and running in the early to mid-2030s. Mr Hawker does not anticipate it will need to sell equity in First Light to fund the plant. See: [British nuclear fusion start-up plans \\$570m reactor \(telegraph.co.uk\)](https://www.telegraph.co.uk/technology/first-light-fusion/2022/11/27/first-light-fusion-60-megawatt-reactor-plans-570m/)

### ➤ 30 November 2022

Katherine Hay advises that ground-breaking research into a phenomenon called quantum entanglement could in future render communications impossible to hack. Scientists at Heriot-Watt University Institute of Photonic and Quantum Science made the discovery. The phenomenon is when

two particles – such as photons of light – remain connected, even when they are separated by vast distances. Quantum technology involves harnessing the physics of sub-atomic particles to develop ultra-high-performance applications, including more powerful computing, more secure communications and more reliable navigation systems.

With cyber-attacks and information leaks becoming more prevalent, quantum entanglement will allow future communications networks to be unhackable, the researchers said, even if devices are unsafe or in criminal hands. In the future, quantum networks will provide a way to have ultra-secure, high capacity communication

Problems that can jeopardise security in a quantum network include long distances, where entangled photons can be disrupted by noisy, real-world environments such as stormy weather, background noise, or signal loss in a communications network. But the new research by Heriot-Watt physicists, who have worked with colleagues at the University of Geneva in Switzerland, shows a new way for quantum entanglement to survive and remain robust even under extreme conditions of noise and loss.

Mehul Malik, an experimental physicist and professor of physics at Heriot-Watt’s School of Engineering and Physical Sciences, said: “Even the best optical fibres in the world will have a certain amount of loss per kilometre, so this is a big hurdle in making this form of quantum communication possible. “This is the first time it’s been shown that quantum entanglement can tolerate both noise and loss – and still survive in a strong form known as quantum steering.” Read on at: [Research paves way for communications that cannot be hacked, scientists say | The Independent](#)

#### ➤ 6 December 2022

*“For decades, scientists and engineers have been working to develop computer programs that can understand and generate natural language. This has been a challenging task, but recent advances in machine learning have allowed us to create powerful language models – like myself.”*

The above paragraph was not written by a human. It was generated by a chatbot called ChatGPT, an artificial intelligence technology designed to mimic human conversation and language while drawing upon a vast wealth of knowledge to answer questions and solve problems. The public release of the chatbot last week, developed by Silicon Valley scientists at OpenAI, has created a buzz among technologists. Predictions burst forth over social media of there having been a sudden leap forward in the science of creating seemingly human artificial intelligence tools.

What ChatGPT offers seems more capable – and is potentially even more of a threat to jobs – than existing AI chatbot technology. The release of OpenAI’s chatbot joins a growing trend in advances in artificial intelligence. Research on AI technology has been punctuated by a series of “AI winters” in the 1980s and 1990s, where the technology fails to keep pace with hype. Launching the chatbot last week, OpenAI boss Sam Altman said: “Soon you will be able to have helpful assistants that talk to you, answer questions, and give advice.” Now read further at [Meet ChatGPT, the scarily intelligent robot who can do your job better than you \(telegraph.co.uk\)](#) by Gareth Corfield and Matthew Field.

#### ➤ 11 December 2022

Ed Cumming in The Telegraph suggests that “It will disappoint fans of The Terminator, but the AI revolution is coming not in the form of killer robots or dystopian autocracies, but chat bots. We were

told it would mean the apocalypse. So far it looks a lot like customer service, albeit much better than usual.

The latest revolution in public-facing artificial intelligence is ChatGPT, a piece of software designed by OpenAI, a California-based research company. GPT is short for Generative Pre-trained Transformer. It was released last week. In the simplest terms, it works by scouring its dataset, which is most of what is written on the internet, finding the answers that best fit a given prompt, and rendering it in clear, if wooden, English. It's a bit like the autocomplete function on your phone or email, except on a much grander scale. Read on at: [We tested the latest AI – and here's why you should be worried \(telegraph.co.uk\)](https://www.telegraph.co.uk)

### ➤ 25 January 2023

Gareth Corfield and Matthew Field report today that Ministers are preparing to invest at least £1bn in Britain's computer chip industry in a challenge to China's dominance of the sector. They go on to say that the Government's long-awaited semiconductor strategy is expected to include proposals to subsidise early-stage electronic chip businesses and linked research activity. A Whitehall source said officials were eyeing at least £1bn as an initial investment in the programme, likely over several years and potentially drawn from the UK's enlarged £20bn R&D budget. However, any investment would require final Treasury sign off and no figure has been agreed.

The decision to support the chip industry comes amid a growing unease over Britain's reliance on Chinese made components. A national semiconductor strategy was initially drawn up last summer with oversight from Chris Philp, the then technology minister, before being put on ice for months amid the turbulent end to Boris Johnson's premiership. While the document still needs final sign-off from ministers, it is expected to include plans to invest in two key UK strengths. These are likely to include compound semiconductors, a novel type of computer chip that uses new, more efficient materials instead of traditional silicon. Britain has particular expertise in these chips within the so-called South Wales Cluster.

Within the Government's plans are increased funding for computer chip startups, help for existing companies to scale up, and new incentives for private venture capital to invest in the sector, Bloomberg reported. The UK is expected to set up a task force to address the industry. Funding could come via the British Business Bank or the £400m National Security Strategic Investment Fund. Read further at: [Britain to challenge China with £1bn subsidies for computer chip makers \(telegraph.co.uk\)](https://www.telegraph.co.uk)

### ➤ 10 February 2023

Rachel Millard advises that the Government is backing plans to build a new prototype nuclear fusion reactor in Oxford as it steps up efforts to crack the "holy grail" of energy production. Tokamak Energy will develop its cutting-edge reactor at the UK Atomic Energy Authority's fusion centre near Oxford, helping it access the authority's expertise and facilities. Chris Kelsall, chief executive of Tokamak Energy, said the planned prototype was a "major step forward in our mission to demonstrate grid-ready fusion energy by the early 2030s".

Fusion replicates the process that powers the sun, offering the promise of abundant clean energy. It is frequently referred to as the holy grail of energy production. The process is extremely difficult to achieve, however, as it requires massive amounts of energy to create the heat and pressure needed to

stimulate the fusion reaction. Tokamak's spherical reactor managed to create temperatures of 15m degrees Celsius in 2018, then broke through the 100m Celsius fusion threshold in March 2022. The company's reactor design uses magnets that can operate at exceptionally high temperatures, enabling smaller, more powerful reactors. This should make them faster and cheaper to build, helping to commercialise fusion technology. See: [Major step towards 'holy grail' of energy production made with Oxfordshire reactor plans \(telegraph.co.uk\)](#)

### ➤ 21 February 2023

The UK's quantum computing sector has been handed a major boost in the form of a £42m funding round for London-based Quantum Motion, a start-up using "chips similar to those in a phone" for quantum computers. The investment represents the largest-ever funding round for a UK quantum start-up, beating the £38m raised by Oxford Quantum Circuits last year. Like many other companies in the sector, Quantum Motion is looking to develop scalable quantum computers that can outperform the current standard of hardware.

Quantum computers use subatomic particles that can exist in more than one state, which means they can carry out multiple calculations at once compared to the linear calculations of classical computers. Quantum Motion is taking a different approach to many of its competitors by using silicon transistors. Quantum Motion said the high qubit density – a unit of measurement for quantum computers – of its silicon transistors gives its technology an advantage in processing speed.

"We've secured the support of leading technology investors, allowing us to realise our vision of a quantum computer built using standard foundry processes, said James Palles-Dimmock, CEO of Quantum Motion. This support, along with the continuing UK national quantum programme and European initiatives, provides a step-change in our capabilities. We have assembled a world-leading team and with the funding and support in place, we are ready to scale and deliver on our vision." The funding came from Robert Bosch Venture Capital (RBVC), which led the round. Other participants included Porsche SE and British Patient Capital.

"Quantum Motion has the potential to become one of the world's most important quantum computing companies by solving the problem of how to realise qubits using conventional silicon manufacturing," said Jan Westerhues from RBVC. "It has demonstrated that it can take quantum theory out of a lab into the real world to create a scalable path to a quantum future. We're excited to join the company and break new ground in the years to come." See [Quantum Motion raises £42m in record-breaking round \(uktech.news\)](#), an article by Oscar Horstein.

### ➤ 10 March 2023

Howard Mustoe and Szu Ping Chan report that the UK is preparing to invite international bids for next generation nuclear power projects, in a move that could imperil Rolls-Royce's plans to roll out mini-nuclear factories across the country. Insiders fear efforts to run a competitive tender mean Rolls-Royce could lose out on a government contract, despite the fact that £210m of taxpayer money has already been invested into the company's efforts to stand-up small modular reactors.

The engineering giant is advancing plans to churn out cheaper, mass-produced, standardised nuclear reactors that would generate carbon-free electricity. The project won the backing of Boris Johnson but his successor in Downing Street, Rishi Sunak, has been more reluctant to back the plans. It is now

understood that the Government is preparing to host a beauty parade of next generation nuclear proposals from around the world that could ultimately see contracts handed to other companies. Rolls-Royce insiders fear the process could derail its SMR efforts. Executives are concerned that losing the UK Government as a customer could threaten foreign orders, since many could interpret the move as a lack of confidence in the programme. Read: [Rolls-Royce mini-nukes project at risk \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2023/04/01/rolls-royce-mini-nukes-project-at-risk/)

➤ **2 April 2023**

James Ball in The Telegraph advises that big tech is making a huge bet on artificial intelligence: Microsoft has invested \$10 billion into OpenAI, the maker of ChatGPT, and has already integrated it into its Bing search engine. Google has its own AI, named Bard, which is about to be rolled out across almost all of its products. Meta, the company once known as Facebook, is doing the same, but has been unlucky – Meta’s AI leaked illegally onto the internet, for anyone to adapt.

These artificial intelligences don’t actually “think” in the way that humans do. They are what’s known as large language models (LLMs) – essentially they have read huge corpuses of data (equivalent to billions of documents) and calculate what patterns of words or images are plausible, almost like an email autocomplete on steroids. Even though what they do isn’t actual thought, the results are extremely impressive: current AIs can create photorealistic images, pass the US bar exams and postgraduate mid-terms, and write university papers with proper Harvard referencing. And every week they are getting even more advanced.

That is causing alarm well beyond the usual quarters of big tech’s critics. A list of luminaries including Tesla founder and Twitter owner Elon Musk – the world’s richest man, and himself the co-founder of an AI company – this week signed an open letter calling for a global six-month moratorium on the testing of any AI models more advanced than the current version of ChatGPT. The letter has no actual force, nor any realistic prospect of causing any kind of pause, but it does show an unprecedented level of alarm at a technological development.

Fears about the potential of AI are wide-ranging – it could eliminate millions of jobs across the world and lead to a new era of highly-advanced disinformation. As it gets more advanced it could even potentially turn against humanity and destroy us, whether by accident or malignant design. Given that doomster case, why are the world’s biggest tech giants so relentless in their pursuit of artificial intelligence? The short answer is that the technology’s potential for good is so enormous that it’s almost irresistible. AI is revolutionary in the way the printing press was – it heralds the biggest step change for society since the industrial revolution – it’s just that amid the current climate of doom and gloom, almost no one bothers to make the case in favour. Read the full article at: [‘As big as the printing press’: Why AI is the next tech revolution to change your life \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2023/04/01/as-big-as-the-printing-press-why-ai-is-the-next-tech-revolution-to-change-your-life/)

➤ **13 April 2023**

And with AI in mind, read [Inside Xi Jinping’s race to build a Communist AI \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2023/04/13/inside-xi-jinping-race-to-build-a-communist-ai/)

➤ **15 April 2023**

And Elon Musk, having recently warned about artificial intelligence’s threat to the future of civilisation, has set up a new company called X.AI. See: [Elon Musk creates new AI company called X.AI \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2023/04/15/elon-musk-creates-new-ai-company-called-x-ai/)

➤ **16 April 2023**

Have a look at [Is your smart car spying on you? \(telegraph.co.uk\)](https://www.telegraph.co.uk) if you value what is left of privacy in this world today!

➤ **17 April 2023**

Google chief executive, Sundar Pichai, said the rapid advancement of artificial intelligence keeps him awake at night as he admitted society is not fully prepared for its advancement. In an interview with CBS's Scott Pelley for the "60 minutes" programme, which aired on Sunday, Pichai said the technology could be harmful if it is not used correctly. "It can be very harmful if deployed wrongly, we don't have all the answers there yet and the technology is moving fast, so does that keep me up at night? Absolutely," he told the US broadcaster.

Pichai also called for greater governmental scrutiny of the technology, similar to the frameworks for regulating nuclear arms globally. The chief executive admitted that he did not fully understand the technology but added that it would impact "every product across every company." Pichai's comments come despite Google's recent launch of its own AI chatbot, Bard, following the success of Microsoft-backed ChatGPT.

Asked whether he thought Bard was safe for society, Pichai said: "The way we have launched it today, as an experiment in a limited way, I think so. But we all have to be responsible in each step along the way." He added that advanced versions of Bard would undergo further testing.

The UK-based AI laboratory, DeepMind, was also acquired by Google in 2014. Most recently, the New York Times reported that Google is working on a search engine powered by AI. Asked whether he felt AI technology could contribute towards the rise of disinformation, Pichai said: "It will be possible with AI to create, you know, a video easily. Where it could be Scott [Pelley] saying something, or me saying something, and we never said that. And it could look accurate. But you know, on a societal scale, you know, it can cause a lot of harm."

He added that he was "optimistic" people had started to express concerns about the technology, but warned that people were not fully prepared for its advancement. "The pace at which we can think and adapt as societal institutions, compared to the pace at which the technology's evolving, there seems to be a mismatch," he said. Read further at: [How AI is proving a virtual nightmare for Google boss who admits having 'sleepless nights' \(cityam.com\)](https://www.cityam.com)



# CYBER SECURITY



**We commence this section with an article by Jared Rubin from Alliant Cybersecurity  
2022: A Year in Review**

*“2022 was a tumultuous year for cybersecurity. The year proved yet again, that no industry is safe from cybercriminals. While the education and healthcare sectors were hit the hardest, every major industry experienced its fair share of breaches and attacks. As organizations scrambled to protect their systems from cyberattacks, new trends emerged that made it more difficult than ever before to ensure data security. Let’s look at what happened over the last year and how it affected cybersecurity measures.*

## ***Emergence of New Attack Vectors Made It Harder to Protect Against Cyberthreats***

*In addition to traditional cyber threats such as ransomware and malware infections, new attack vectors began emerging in 2022 which made it even harder for organizations to protect against cyberattacks. For example, AI-powered phishing campaigns became increasingly common as attackers used natural language processing algorithms to craft personalized messages that target specific individuals within an organization with convincing scams tailored toward their interests or job roles. These campaigns proved extremely efficient at bypassing traditional spam filters while also making it seem like the emails came from trusted sources instead of malicious actors. Understanding this, we’ll now take a look at the impact on several prominent industries.*

### ***Education***

*The education sector was particularly vulnerable to cyber-attacks in 2022, mostly being ransomware. Schools and universities were targeted due to the amount of sensitive data they collect, store, and share. In addition, many institutions had outdated systems that did not have adequate security protocols in place or had weak passwords that could easily be guessed. As a result of these attacks many students were unable to access course materials or submit assignments. This caused significant disruption to the learning process as well as financial losses for universities due to fines associated with data breaches.*

## **Healthcare**

*The healthcare sector was not far behind the education sector when it came to cyberattacks in 2022. Healthcare organizations are highly attractive targets due to their access and storage of a variety of valuable data, bringing with it considerable rewards for criminals in more ways than one. With this information comes great responsibility - as well as potential risks - for organizations who do not have proper security protocols in place. In addition, many healthcare providers still use outdated systems which can make them more vulnerable to cyberattacks such as ransomware or malware infections. Ransoms can be extorted as well as financial fraud committed through reselling ill-gotten personal information – making such info akin to digital gold dust. In response, hackers have redoubled efforts towards identifying any security vulnerabilities which exist within healthcare networks' infrastructures.*

## **Finance**

*This past year, there has been a dramatic increase the average cost per breach of financial institutions, now totalling \$5.72 million. Financial organizations are particularly vulnerable to cyberattacks because they house large amounts of customer information such as banking details and credit card numbers. If these types of data were to be compromised, it could have devastating effects not only on the organization itself but also on its customers - not to mention any regulatory fines that might be imposed if appropriate measures are not taken. Additionally, financial institutions may become targets for sophisticated ransomware attacks that can bring entire systems down for extended periods of time and cause significant losses in revenue.*

## **Agriculture**

*These days it can be tempting to think that the agricultural industry is exempt from cybersecurity risks. After all, many operations are still largely manual labour-based and have traditionally relied on pen and paper for keeping records. However, with the growth of technology in agriculture - from labelling to shipping, quality assurance to commodity trading - there is an increasing need for secure data management. As a result, agribusinesses are vulnerable to cybercrime, leaving critical operations at risk.*

*The FBI recently released a statement warning of cyber threats against the agricultural industry and their potential impact on businesses and consumers alike. They noted that attacks could slow down processing and interrupt email and website administration. Moreover, these attacks can create various supply chain problems as well as issues with commodity trading and stock prices. It's important to note that these threats don't just affect business operations; they can also have serious consequences for farmers. For example, if a protein or dairy facility were targeted by malicious actors, it could lead to spoiled products which would then have cascading effects all the way down to individual farms due to animals unable to be processed. As such, it's essential for agribusinesses of all sizes to have robust security protocols in place so as not to become a target for hackers or other cyber criminals.*

## **Retail**

*Retail has become one of the main targets for cyber criminals, experiencing more breaches than any other business sector. This rise in retail cybersecurity attacks may be due to a combination of factors,*

*including access to customer data, similar cybersecurity infrastructures, and a lack of awareness about social engineering. In this blog post, we will explore how these factors contribute to the higher risk of retail cybersecurity attacks and what organizations can do to protect themselves. Retailers often have access to personal identifying information (PII) such as names, addresses, phone numbers, credit card numbers, and Social Security numbers. This data is incredibly valuable for hackers who want to use it for identity theft or financial fraud. Therefore, retailers must ensure that they are taking steps to protect customer data from being stolen or compromised by malicious actors.*

*Another factor that contributes to the increased risk of retail cybersecurity attacks is the fact that many retailers have similar cybersecurity infrastructures. If an attack method works on one retailer's system, then it could very well work on another retailer's as well. This means that attackers can use their knowledge of one retailer's security vulnerabilities to gain access to another's with relative ease. As such, retailers must ensure that their systems are properly configured and regularly audited by independent security experts so as not to fall victim to these types of attacks.*

## **Conclusion**

*Overall, 2022 was a difficult year for cybersecurity with both the education and healthcare sectors experiencing significant disruption due to cyberattacks. Organizations need to take proactive steps now by investing in updated technological solutions, and training staff members on best practices when it comes to online safety, if they want to avoid further losses from future cyber threats. By taking these steps now, businesses can better protect themselves from malicious actors looking to take advantage of vulnerable systems for personal gain or financial gain in years ahead.”*

What follows are four pertinent articles that were released during the latter half of the year.

### **➤ 17 August 2022**

Giulia Bottaro reports in The Telegraph that the Government has blocked the takeover of a Bristol-based electronics design company by a Hong Kong rival in a fresh sign of Britain's increasing hostility to Chinese investment. The Business Secretary, Kwasi Kwarteng, who is tipped by some Conservatives to be the next chancellor, ruled that stopping the acquisition of Pulsic, whose software can be used to build circuits, by Super Orange HK, was “necessary and proportionate to mitigate the risk to national security”.

Pulsic's intellectual property and software “could be used to build defence or technological capabilities” said the Department for Business, Energy and Industrial Strategy (Beis). Its products could “facilitate the building of cutting-edge integrated circuits” used in a “civilian or military supply chain,” Beis added. Now read on at: [Chinese takeover of tech company blocked over security fears \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2022/08/17/chinese-takeover-of-tech-company-blocked-over-security-fears/)

### **➤ 7 November 2022**

Lewis Maddison writes in TechRadar Pro, that the UK's National Cyber Security Centre (NCSC) has confirmed it is scanning all of the Nation's internet-connected servers for any possible vulnerabilities in order to assess where the country lies in terms of its cybersecurity credentials. The NCSC is using a cloud-based system to run the scanning tools, which will be coming from the domain

scanner.scanning.service.ncsc.gov.uk. It will run scans that “will slowly increase [in] complexity,” similar to those commonly undertaken by cyber security companies.

The agency’s technical director, Dr. Ian Levy, stated the importance of having reliable data to make informed decisions about cybersecurity. He referenced the Microsoft Exchange vulnerability that went public in March 2021, and the information the NCSC gleaned from the incident, as part of the justification for carrying out nationwide scans, noting that, “understanding the risk to the UK from different vulnerability types, accessible over different vectors in a timely manner, requires a dedicated capability.” See: [The UK government is scanning all of the country's internet connections | TechRadar](#)

#### ➤ 24 November 2022

Martin Evans, Crime Editor of The Telegraph, reports that the Metropolitan police have smashed a global online fraud shop selling tools that allowed criminals to carry out phone scams on hundreds of thousands of unsuspecting victims. Detectives disabled the iSpooof website as part of the biggest anti-fraud operation ever mounted in the UK. Criminals using software purchased from the illegal site targeted victims around the world in order to steal hundreds of millions of pounds.

The subscription service, allegedly set up by 34 year-old Teejai Fletcher, who lived in a luxury flat in the Docklands, allowed heartless criminals to disguise their phone numbers and trick unsuspecting people into believing they were being called by their bank. Armed with details of their financial transactions purchased from the dark web, the fraudsters were able to trick victims into disclosing secret PIN codes allowing them to empty their accounts. The average losses suffered by those targeted is estimated at £10,000, but one person is known to have had £3 million stolen.

iSpooof was launched in December 2020 and at one stage boasted almost 60,000 criminal users across the world. Details of the website were advertised on fraudulent channels on the Telegram platform and criminals would pay up to £5,000 a month in Bitcoins to access the software tools. In the 12 months until August 2022 around 10 million fraudulent calls were made globally via iSpooof, with around 3.5 million taking place in the UK. The site was so popular among phone scammers that at one stage it was estimated 20 people every minute were being contacted using the illegal software tools.

Police have arrested 120 suspected phone scammers around the UK, with 103 of those in London. Other arrests are taking place across the world, including in Australia, France, Ireland and Holland. Read: [Police smash phone scam website in biggest anti-fraud operation ever in UK \(telegraph.co.uk\)](#)

#### ➤ 13 December 2022

Allison Pearson comments in The Telegraph on the most disturbing effect of smartphones on teenagers, something the ACP identifies in our roadshow presentations to schools. She writes:

*“If I told you there was something which is freely available and totally accepted, yet which poses a vast, insidious threat to millions of children, you’d probably think I was mad. Surely, if that were true, whatever it was would be banned? No government would allow our young people to be exposed to such a hazard.*

*I’m not talking about drugs. At least society disapproves of drugs. No such universal opprobrium attaches itself to smartphones (which should really be called dumbphones) although it becomes*

*clearer by the day that the damn things make kids sadder, lonelier, less inclined to study or to have fun and more inclined to end their precious young lives. How much more evidence do we need that smartphones are the nicotine of our age? Designed to be highly addictive, they are cool, pleasurable and rewarding at first, but eventually become ruinous of health.*

*A study by King's College London estimated that one in four children and young people use their phones "in a way that is consistent with behavioural addiction". Some 42 per cent of British children have a phone by the age of 10; by 12, that goes up to 71 per cent; by 14, it's 91 per cent. In 2021, 96 per cent of adolescents between 16- and 17-years-old owned a smartphone. Basically, if you don't have a smartphone you're either a freak or not bothered by peer pressure. That pretty much rules out most teenagers, who are ever-nervous creatures of the herd.*

*We should be seriously worried. Before they reach adulthood, all those children can see things that no child should see. Half of all 12-year-olds have viewed pornography online (some as young as eight), including cartoon-based porn designed to normalise extreme sexual activity.*

*There are around 14.3 million young people (children and adolescents) in the UK. If the King's College study is correct, then we have at least three million kids who are in the grip of a smartphone addiction. That might explain why we are living through an unprecedented child and adolescent mental health crisis, which was made markedly worse during lockdown when so many lived with a mobile as their only friend. In 2021, there were more than one million referrals of those aged 18 and under for specialist mental health help. One million children experiencing sufficient anguish to seek professional help." Now read on at: [Highly addictive smartphones are destroying teenagers – we need to ban them now \(telegraph.co.uk\)](https://www.telegraph.co.uk/technology/2021/01/23/highly-addictive-smartphones-are-destroying-teenagers-we-need-to-ban-them-now/)*

And now we continue our chronological news items as we progress through 2023.

### ➤ **23 January 2023**

Gordon Rayner explains how "microchips embedded in routine appliances post a 'Trojan horse' threat to national security".

China has the ability to spy on millions of people in Britain by "weaponising" microchips embedded in cars, domestic appliances and even light bulbs, ministers have been warned. The "Trojan horse" technology poses a "wide-ranging" threat to UK national security, according to a report sent to the Government by a former diplomat who has advised Parliament on Beijing.

The modules collect data and then transmit it via the 5G network, giving China the opportunity to monitor the movements of intelligence targets including people, arms and supplies, and to use the devices for industrial espionage. Millions of them are already in use in the UK. The report, published on Monday by the Washington-based consultancy OODA, says the potential threat to national security outstrips the threat from Chinese-made components in mobile phone masts which led to a Government ban on Huawei products being used in mobile infrastructure.

Ministers have completely failed to grasp the threat posed by the "pervasive presence" of the modules, known as cellular IoTs, the report says - a concern that has been echoed by senior MPs. It calls on ministers to take urgent action to ban Chinese-made cellular IoTs from goods sold in Britain before it is too late. Charles Parton, the author of the report, said: "We are not yet awake to this threat. China

has spotted an opportunity to dominate this market, and if it does so it can harvest an awful lot of data as well as making foreign countries dependent on them.”

Cellular IoTs - which stands for Internet of Things - are small modules used in everything from smart fridges to advanced weapons systems to monitor usage and transmit data back to the owner, and often the manufacturer, using 5G. Earlier this month it emerged that the security services had dismantled ministerial cars and found at least one of the devices hidden inside another component. There were fears that China had the capability of monitoring the movements of everyone from the prime minister downwards using the modules.

But the problem goes far beyond ministerial cars, the report warns. Three Chinese companies - Quectel, Fibocom and China Mobile - already have 54 per cent of the global market in the devices, and 75 per cent by connectivity. Like all Chinese firms, they must hand over data to the Chinese government if ordered to, meaning that the Chinese Communist Party can gain access to as many devices as it likes. Customers of the three Chinese firms include the computing firms Dell, Lenovo, HP and Intel, car maker Tesla, and the card payments firm Sumup.

Among the devices that contain the modules are: laptop computers; voice-controlled smart speakers; smart watches; smart energy meters; fridges, light bulbs and other appliances that can be controlled through an app; body-worn police cameras; doorbell cameras and security cameras; bank card payment machines, cars and even hot tubs. The potential for spying is vast. Coupled with artificial intelligence and machine learning to process huge quantities of data, the report suggests that China could, for example, monitor the movements of US weapons sales in order to work out if it was selling arms to Taiwan.

China could also monitor the movements of targets via bank card payment terminals, and even work out who they were meeting, and when. The report also suggests data harvested from the cellular IoTs could be used to identify potential intelligence sources, by working out who handles sensitive information, then finding ways to bribe or blackmail them into spying for China.

Now read on at: <https://www.telegraph.co.uk/news/2023/01/23/china-could-spy-millions-britons-household-objects-like-fridges/>

### ➤ **1 February 2023**

Trading in the City of London has been plunged into chaos after a Russian-linked ransomware gang attacked a company that plays a key role in Britain’s financial system. Lockbit, the group behind the cyber-attack against Royal Mail last month, targeted trading software provider Ion Group on Tuesday. The London-based company plays an integral role in the plumbing that underpins the trading of shares, debt and derivatives in the Square Mile and around the world. Ion said 42 clients have been affected by the attack as it faces disruption in its cleared derivatives division. Read: <https://www.telegraph.co.uk/business/2023/02/01/city-london-traders-hit-russia-linked-cyber-attack/>

### ➤ **14 March 2023**

Gareth Corfield reports that in an advisory note published on Tuesday the National Cyber Security Centre warns that companies such as ChatGPT maker OpenAI and its investor Microsoft “are able to

read queries” typed into AI-powered chatbots. GCHQ’s cyber security arm said: “The query will be visible to the organisation providing the [chatbot] so, in the case of ChatGPT, to OpenAI.”

The NCSC’s warning on Tuesday cautions that curious office workers experimenting with chatbot technology could reveal sensitive information through their search queries. Cyber security experts from the GCHQ agency said, referring to large language model [LLM] tech that powers AI chatbots: “Those queries are stored and will almost certainly be used for developing the LLM service or model at some point. This could mean that the LLM provider (or its partners/contractors) are able to read queries and may incorporate them in some way into future versions. As such, the terms of use and privacy policy need to be robustly understood before asking sensitive questions.”

Microsoft disclosed in February that its staff are reading its users’ conversations with Bing Chat, monitoring conversations to detect “inappropriate behaviour”. Immanuel Chavoya, a senior security manager at cyber security company Sonicwall, said: “While LLM operators should have measures in place to secure data, the possibility of unauthorized access cannot be entirely ruled out. As a result, businesses need to ensure they have strict policies in place backed by technology to control and monitor the use of LLMs to minimize the risk of data exposure.”

The NCSC also warned that AI-powered chatbots can “contain some serious flaws”, as both Microsoft and its arch-rival Google have learnt. Continue reading at: [GCHQ warns that ChatGPT and rival chatbots are a security threat \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2023/02/23/gchq-warns-that-chatgpt-and-rival-chatbots-are-a-security-threat/)

**We commenced this section with an article by Jared Ruben. To complete the sections we conclude with another one, only this time, concerning ten trends he suggests will shape 2023.**

*“As technology advances and cybercrime increases, companies need to remain vigilant about their cybersecurity strategies. With the rise of artificial intelligence (AI) and the Internet of Things (IoT), it is important to stay ahead of emerging cybersecurity trends to protect your business from cyber threats. Here are the top cybersecurity trends you should be aware of in 2023:*

### ***Artificial Intelligence***

*AI-enabled security solutions are becoming increasingly popular as they can detect and prevent threats more quickly and accurately than traditional security measures. These solutions are also capable of using predictive analytics to anticipate future threats and take proactive steps to mitigate them before they occur. Additionally, AI-powered solutions can learn from past mistakes and improve their performance over time.*

*For all the good things that AI provides, it can also be used by cybercriminals and perhaps be even more impactful. AI can be rapidly used to identify weaknesses, whether in software or security programs, that hackers may exploit and abuse for their own benefit. Thanks to this technology, cybercriminals can mass generate phishing emails, utilizing stolen personal information or public sources such as social media posts, with extremely high success rates. AI is also being leveraged to design malware that constantly evades detection, effectively rendering most automated defensive strategies ineffective. Unfortunately, cybersecurity efforts will need to keep up with the increasing sophistication of these attackers if they are going to stay one step ahead of them.*

### ***Increased Reliance on Cloud Computing***

*The use of cloud computing is growing rapidly in both the public and private sectors due to its scalability, availability, cost savings, and speed. However, with this increased reliance on cloud computing comes an increased risk for data breaches as sensitive information is stored in remote servers that may not be adequately protected from hackers or malicious actors. In 2022, **27% of organizations** experienced a cyber-attack on their cloud infrastructure. As such, organizations must ensure that their cloud storage infrastructure is secure against potential attacks or leaks.*

### ***Increased Focus on Identity Management***

*Compromised credentials have become one of the most common targets for cybercriminals to enter organizations' networks through various types of cyber-attacks, whether it be malware, phishing, or even worse, ransomware. To combat this threat, organizations are turning towards identity management solutions that allow them to better protect customer data by assigning unique IDs for each user accessing their system. Additionally, these solutions can help identify suspicious activity quickly so that appropriate action can be taken before any damage is done.*

### ***Automation***

*Automation has become indispensable for systematically and securely handling increasingly larger amounts of data. The need for automation is further heightened by the dynamic and demanding environment in which IT professionals are expected to deliver efficient and effective solutions. Consequently, providing security during the agile process has become essential in developing secure software tools. But given the increasing complexity of web applications, these developments also require automated defenses against cyber-attacks that have become an integral part of software development. Automation and cyber security are key concepts that help organizations create safe and robust information systems.*

### ***Rise in Mobile Device Attacks***

*Mobile device cyber-attacks are becoming increasingly prevalent, with cybersecurity trends pointing to a **50% increase** in mobile banking malware or attacks in 2019. Since then, these attacks have become even more commonplace, highlighting the potential danger of hackers getting their hands on our confidential data, including photos, emails, financial transactions, and messages. Furthermore, we must be prepared for the imminent growth of smartphone viruses and malware predicted by cybersecurity trends over the next few years. Individuals need to be vigilant when it comes to protecting themselves against these malicious threats.*

### ***Challenges with Remote Work***

*Remote work is not going anywhere. It has been a fixture of many businesses since its rapid popularity during the COVID pandemic. With new work environments come new challenges. A recent report noted that **20% of organizations** experienced a breach due to a remote worker in 2022. Working from home has increased flexibility and offered opportunities, but it has also brought its fair share of difficulties. The main concern is that remote work greatly expands the attack surface for any business. Other concerns also play a role, such as ensuring that employees are staying productive and*

accountable, as well as creating a sense of community in a remote environment. Because of this limited visibility and greater attack surface, cyber risk has drastically increased.

### **State-Sponsored and International Attacks**

State-sponsored and international attackers present a unique type of security risk due to the scale of their attack operations and the range of targets they can select from. They are often well-funded and highly organized, with a multitude of resources at their disposal. Stricter cybersecurity measures are necessary to limit their access to confidential data, as a loophole could lead to major information leaks that have far-reaching consequences. Different types of blocking software and firewalls can be used but must be updated regularly to stay ahead of potential attack vectors. Employing proactive cybersecurity measures like multi-factor authentication, regular penetration testing, etc. are also crucial for detecting gaps in security procedures and policies. Following these precautions will minimize such threats significantly and provide essential protection for any organization or individual user against malicious state-sponsored or international attackers.

### **Insider Threats**

Insider threats are a major issue for businesses, especially as cyber-security risks increase. Employees are the number one source of potential problems, making them a major area of concern. Insiders can obtain and share sensitive company data without authorization, sabotaging operational systems or installing malware through their organization's networks. Additionally, malicious insiders may exploit social engineering tactics to gain access to protected company information. It is essential that businesses recognize and address insider threats with effective security strategies, such as strengthening employee vigilance and implementing robust policy guidelines supported by an effective training program. Training your employees on cyber hygiene can often be the difference for businesses. By taking proactive steps to identify and mitigate these risks, companies can ensure the safety of their data and systems.

### **Targeted Ransomware**

Targeted ransomware attacks have taken the world of cyber security by storm. Such an attack is when a hacker steals sensitive data from individuals and/or businesses, holds it hostage and then demands payment in return for restoring access. These targeted attacks are difficult to protect against because the hackers often use sophisticated methods ranging from malware payloads to social engineering tactics that make detection a challenge. Oftentimes, bad actors can remain undetected in a company environment for roughly **212 days** on average, with an additional **75+ days** to remediate. While organizations have tried to counter such threats with employee education, rigorous firewall configuration, and proper patching, the increasing prevalence of such attacks worldwide has many worried about the effectiveness of existing countermeasures. To this end, individuals and organizations alike should take extra measures to ensure their data is secured from malicious actors.

### **Geo-Targeted Phishing Attempts**

Geo-targeted phishing attempts are becoming more frequent by the day, and companies must be prepared. Unlike traditional phishing attacks, these malicious emails will target specific users based on their location, some even using region-specific language and emojis in an attempt to make them appear more legitimate. Companies should ensure all employees are aware of the dangers by raising

*awareness through a training program, as well as having appropriate technical security measures in places like email filtering and malware scanning. Taking proactive steps now can save companies from costly data breaches later.*

### **Conclusion**

*As technology continues to evolve at a rapid pace, so too do the security risks associated with it. Companies must stay up to date on emerging cybersecurity trends in order to ensure their security against any potential threats or vulnerabilities that may arise in the future. From AI-enabled security solutions to an increased focus on identity management, there are a variety of tools and strategies available for organizations looking to bolster their online security posture in 2023 and beyond. By carefully considering these trends now, businesses can prepare themselves for whatever cyber threats come next year—and beyond!”*



## THE UK ECONOMY



**We commence this section with a Financial Times article by Valentina Romei reviewing 2022 published on 10 February 2023. She writes:**

*“The UK economy stagnated in the final quarter of 2022, narrowly avoiding a recession despite output shrinking by more than expected in December. Gross domestic product was unchanged between the third and fourth quarters of 2022, following a contraction in the previous three months according to data published on Friday by the Office for National Statistics. That was in line with analysts’ expectations but was weaker than the 0.1 per cent expansion expected by the Bank of England. The flat reading means the UK avoided a technical recession, usually defined as two consecutive quarters of falling output. Chancellor Jeremy Hunt said that “avoiding a recession shows our economy is more resilient than many feared”. “However, we are not out of the woods yet, particularly when it comes to inflation,” he added.*

*The quarterly figure was boosted by growth in October and November when output was supported by the rebound after the extra bank holiday in September and spending for the World Cup. However, the economy shrank by 0.5 per cent between November and December, worse than the 0.3 per cent contraction forecast by economists polled by Reuters. Darren Morgan, ONS director of economic statistics, said: “In December, public services were hit by fewer operations and GP visits, partly due to the impact of strikes, as well as notably lower school attendance.*

*Meanwhile, the break in Premier League football for the World Cup and postal strikes also caused a slowdown.” In the fourth quarter, the UK economy was still 0.8 per cent below the level in the same period of 2019, before the pandemic. In contrast, the US economy was up 5.1 per cent over the same*

*period and output in the eurozone grew 2.4 per cent. The UK is the only G7 economy not to have regained the ground lost during the health crisis.*

*The Bank of England expects the UK economy to contract this year and in the first quarter of next year, as high energy prices and higher borrowing costs weigh on spending. Output will not recover to its pre-pandemic levels until 2026, according to its calculations. Thomas Pugh, economist at the consulting firm RSM UK, said the combination of double-digit inflation, higher interest rates and less fiscal support means households' real disposable incomes are set to shrink sharply in the first half of this year. "The recession has just been delayed rather than cancelled," he noted.*

*But the outlook has brightened since the summer when gas prices were higher - the BoE now expects a shallower recession than it forecast in November. "Falling wholesale gas prices offer hope for households and the wider economy — with inflation on track to fall sharply later this year," said James Smith, research director at the think-tank Resolution Foundation. The detailed figures for the final quarter of 2022 also showed that households and businesses were "proving resilient", said Paul Dales, chief UK economist at Capital Economics. Real consumer spending marginally increased, and business investment rose 4.8 per cent. Government spending rose 0.8 per cent.*

*The expansion in those sectors was offset by a 3.2 per cent contraction in residential investment, resulting from the rise in mortgage rates, and by the drag from net trade as exports fell, while imports rose. "It seems as though the combination of the government's support and households and businesses using their cash reserves has so far cushioned the blow from the fall in real incomes," explained Dales."*

And now for our usual chronological news reports, this time from the beginning of 2023.

### ➤ 2 January 2023

Kallum Pickering writes in The Telegraph that "The debate around wages misses the point – Britain must push for growth at all costs".

He explains that "The UK cannot afford to pay workers higher wages. **Christmas spending was lower this year.** Energy costs are through the roof. The list of negative articles implying that we are somehow short of money goes on and on. But analysis that frames the problem as money worries completely misses the key point. The UK is not, nor will it ever be, short of money. The Government can always instruct the Bank of England to create any amount of sterling it desires. Of course, how much it is worth is a different story. What matters, therefore, is what you get for your money. It is a question of supply.

Let us start with some basics. The chief economic concern is not how much money there is, but what is produced and consumed and what is stored as productive wealth. Money is the side show that provides a medium of exchange, a store of value and a unit of account. But when we analyse the economy, we easily fall into the trap of mistaking money for output. This distortion orients our thinking towards the demand side of things and leads to misguided policy decisions.

The most serious present example of this kind of muddled thinking is the debate around wages - which have fallen dramatically in real terms since the Russian invasion of Ukraine. The whole argument is framed around how much money wages should rise to ease the cost-of-living crisis and how much

firms and the Government can afford to raise them. Any serious economist will tell you that arbitrarily increasing wages will not improve living standards.

What the UK needs is higher supply of essentials like housing, energy and food. Increased supply of these basics would lower aggregate prices, increase general living standards, and grow the economy. We would measure all this in inflation-adjusted money terms, but that is merely a reflection of what is happening in the guts of the economy. Through the accumulated impact of a series of bad policy choices, the UK suffers from serious supply misallocations. The result is that UK potential growth has slowed badly over the last two decades.”

Now read on at: <https://www.telegraph.co.uk/business/2023/01/02/failed-trussonomics-still-offers-answer-crisis-gripping-britain/>

### ➤ 13 January 2023

Ambrose Evans-Pritchard suggests that “The Pacific pact is a boon for Britain, and a big threat to EU trade supremacy”. He goes on to explain that:

“Step by step, the Pacific free trade pact is emerging as the epicentre of a new international trading order. It will increasingly set the tone and the rules of global commerce. If all goes well, the UK will be a full member of this Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) within months, becoming the first European country to join the eclectic club of "middle powers". They have one shared objective: to make trade as easy as possible, subject to basic civilised standards.

Japan’s Fumio Kishida was in London this week pushing British accession along with the Anglo-Japanese defence pact. The view in Tokyo is that UK membership brings G7 heft and free-market credibility, taking the project closer to critical mass. Today’s members are Japan, Vietnam, Malaysia, Singapore, Canada, Mexico, Peru, Chile, Australia, New Zealand, and Brunei. Britain lifts the fast-expanding group to 16pc of global GDP.

Several others have either applied or signalled an intent to join, including Taiwan, Korea, Thailand, Uruguay, Colombia, Ecuador, and Costa Rica. The Philippines may soon follow. China has also applied to join, and this is where geopolitics become unpredictable. There is an emerging competition between China and the US, each concerned that the other will penetrate the pact and gain a lock hold. Either would turn the CPTPP into the only trade bloc that really matters.

British accession is not a done deal. A snag has arisen and the December deadline was missed. “The UK was so generous on agricultural access to Australia and New Zealand in its bilateral deals, that others now want the same thing,” said Cambridge Professor Lorand Bartels, chairman of the UK’s Trade and Agriculture Commission. Rishi Sunak has abandoned the dash for post-Brexit trophy deals. He is taking his time, haggling harder and listening to UK farmers. “Sunak doesn’t feel such a need to keep signing FTAs (trade deals) to prove something about Brexit,” said Prof Bartels. Ultimately, the wrinkles are likely to be ironed out.

Kaewkamol Pitakdumrongkit from Singapore’s Nanyang Technological University says the overriding ethos of the CPTPP is to find ways to make trade flows easier rather than to obstruct them.

Self-certification and paperless trade drain the poison from the rules of origin requirements, which bedevil small British firms trying to export to the EU.

The pact's highly open character could hardly be further removed from the character of the EU, which uses trade as a forcing mechanism for European political integration, and which has ambitions as a regulatory superpower. Brussels rations access to the EU's single market according to how much of the EU's legal Acquis you are willing to swallow, and how far you accept the European Court as ultimate master. If you swallow almost everything – as Norway does through the European Economic Area – you enjoy a quiet life (plus fish) and the delightful status of an EU member without voting rights. Swallow a bit less like Switzerland, and you live with the threat that Brussels might suspend your bilateral deals at any time.

Continue reading at: <https://www.telegraph.co.uk/business/2023/01/13/pacific-pact-boon-britain-big-threat-eu-trade-supremacy/>

### ➤ **3 February 2023**

Today the FTSE 100 surged to an all-time high amid growing signs that the pace of interest rate rises by central banks has reached a peak. Britain's blue-chip index added as much as 1.1pc to reach a new intraday high of 7,905.52 on Friday, outstripping its previous record last reached in May 2018. It also managed to close at an all-time high of 7902, eclipsing the previous peak which was achieved on the same day in 2018.

Shares in the UK's biggest companies surged after the pound slumped as much as 1.3pc against a strong dollar. The US currency rallied following the publication of official payroll figures showing that hundreds of thousands more jobs than expected were added to the world's biggest economy in January. Andrew Hunter, senior US economist at Capital Economics, said: "Despite most leading indicators of recession flashing red, the economy is clearly not as close to recession as we had suspected."

See: <https://www.telegraph.co.uk/business/2023/02/03/ftse-100-markets-live-news-inflation-strikes-apple/>

### ➤ **8 February 2023**

James Titcomb suggests in The Telegraph that "Sunak and Bailey make a risky bet on Britcoin" – the digital pound. He goes on to write that:

"When Mark Zuckerberg unveiled plans for a global currency four years ago, alarm bells began ringing in central banks and state treasuries around the world. The prospect of a powerful multinational like Facebook promoting a digital alternative to pounds, dollars and euros was a threat to both economic and political sovereignty. It had to be taken seriously.

Libra, as Facebook's project was called, ultimately fizzled out as Zuckerberg became distracted with a new bet on virtual worlds rather than currencies. Yet fears that digital money could threaten national currencies lingered. Central banks including the Bank of England sprang into action, stepping up work on their own digital currencies. This week, the Bank of England and the Treasury said that a digital pound – unofficially but widely dubbed "Britcoin" – could be in use by the end of the decade. While

stressing that the project is still in the exploratory phase, officials are nonetheless pressing ahead with laying the groundwork for a potential launch.

Now continue at: <https://www.telegraph.co.uk/business/2023/02/08/why-sunak-baileys-bitcoin-risks-multi-million-pound-vanity/>

### ➤ 5 March 2023

Under the heading “Everyone is predicting a recession – but I just don’t buy it”, in The Telegraph today Liam Halligan disagrees with the majority of pundits. He goes on to write:

“In the early 1990s, having claimed to have spotted “the green shoots of recovery”, Norman Lamont was widely derided. But it turned out he was right. Soon after the then chancellor’s much-mocked comments, the UK climbed out of recession. But almost no one remembers that – recalling only the criticism he endured. That’s one reason economists of a certain vintage so rarely point to signs the outlook is improving. Panglossian words are met with rolling eyes.

So, it’s with trepidation that I’m declaring – drum roll – I see multiple green shoots. The commentariat has been too gloomy for too long – it’s time to cheer up. In early February, the influential Chartered Institute of Procurement reported the sharpest monthly rise in business optimism since November 2020. Then, late last month, a survey from data company GfK showed an unexpected bounce back in consumer confidence, with retail sentiment at its strongest in almost a year.

And on Friday, we saw evidence that the UK’s services sector – accounting for four fifths of GDP – is growing at its fastest pace for eight months. The closely watched Purchasing Managers’ Index, which surveys business leaders’ views, showed a reading of 53.5 in February, with figures above 50 indicating growth – sharply up from 48.7 the month before. Companies from restaurants, pubs and hotels to hairdressers and builders have grown more optimistic in recent weeks, amid signs broader inflationary pressures are easing. Interest rates, having soared from 0.5pc to 4pc during 2022, may now be close to their peak.

There’s plenty of bad news of course – with millions of households still enduring squeezed budgets, not least given sky-high utility bills. Countless businesses are also struggling, given pressure to raise wages amid ongoing labour shortages. Having said that, input cost inflation is now abating, as post-lockdown supply chain blockages finally ease and shipping costs keep falling. Drewery’s composite world container index, a global measure of seaborne freight charges, is now 80pc lower than this time last year.

These chinks of light explain why forecast business activity just hit an 11-month high. As such, the UK’s “composite PMI” – services and manufacturing combined – rose to 53.1 last month, the first 50-plus reading since August. That compares favourably with 50.1 in the US, 50.7 in Germany, Japan’s 51.1 reading, and 51.7 in France. Economists have been warning for a year and more that the UK faces its first non-lockdown recession since the 2008 financial crisis. The Bank of England, in particular, still predicts a prolonged contraction – but I just don’t buy it.”

See: [https://www.telegraph.co.uk/business/2023/03/05/everyone-predicting-recession-just-dont-buy/?li\\_source=LI&li\\_medium=liftniter-rhr](https://www.telegraph.co.uk/business/2023/03/05/everyone-predicting-recession-just-dont-buy/?li_source=LI&li_medium=liftniter-rhr)

➤ **10 March 2023**

As reported live in The Telegraph, “The Pound soars as Silicon Valley Bank fallout sends dollar into spiral”. The pound has surged against the dollar as a cocktail of factors, including the crisis affecting global banks, helped boost sterling. The currency surged by 1.5pc as fears about a UK recession subsided while jobs data from the US eased concerns about interest rate rises.

Meanwhile, a dash to withdraw funds at troubled lender, Silicon Valley Bank, has shaken confidence in world banking stocks, hitting markets and leaving investors nervous. Silicon Valley Bank shares plunged as much as 69pc before markets opened in New York and trading was halted.

Also this day, Ambrose Evans-Pritchard writes in The Telegraph that “Jeremy Hunt’s corporate tax raid is self-defeating and entirely unnecessary. Unless the Government changes course next week, Britain will tumble down the global league for business taxes, becoming one of the worst places to invest in the OECD bloc for the first time since the 1970s.

This will happen in recessionary conditions as the delayed effects of monetary tightening start to bite on both sides of the Atlantic. The policy is being driven by an austerity ideology that is hard-wired into the UK’s institutional structure, a culture with a bad habit of plundering business for quick cash to meet arbitrary and destructive fiscal targets.

It misreads the causes of last year’s gilts debacle. It implies that the UK faces a public debt crisis, which is not remotely the case. This country has a lower debt ratio than most G7 states. Inflation has already whittled away the Covid debt burden. The National Institute for Social and Economic Research estimates that the Government will be running a budget surplus in real terms over the coming fiscal year. The debt ratio will be falling. NIESR says Chancellor Jeremy Hunt has ample scope to limit the rise in corporate tax, and should do so.

Read: <https://www.telegraph.co.uk/business/2023/03/10/jeremy-hunts-corporate-tax-raid-self-defeating-entirely-unnecessary/>

➤ **11 March 2023**

Rachel Mortimer reports in The Telegraph that “Investors have been blocked from trading one of the world’s biggest cryptocurrencies after its parent company revealed it had billions tied up in the failed Silicon Valley Bank”. She went on to write:

US-based Circle Internet Financial confirmed it had \$3.3bn (£2.7bn) of reserves trapped with the beleaguered lender, which was shut down by regulators on Friday. The revelation triggered a run on the company’s virtual currency USD Coin – the second biggest “stablecoin” in the world – which fell from its \$1 peg overnight. The cryptocurrency is supposed to trade at exactly \$1, but on Saturday morning had fallen below 87 cents. It has since rebounded to 91 cents, but remains below its \$1 target. The fallout is likely to have a domino effect in the crypto market and on other virtual currencies. Circle holds a quarter of its USD Coin reserves in cash with six banks, of which SVB is one, and the remainder in short-dated US Treasury securities.

The company said it and its digital dollar would continue to operate normally while it waited for more information on SVB's future. Coinbase, the crypto exchange, said early Saturday morning that it had temporarily paused conversions of USD Coin into dollars while banks were closed over the weekend.

See: <https://www.telegraph.co.uk/investing/news/leading-cryptocurrency-has-trading-suspended-amid-silicon-valley/>

### ➤ 12 March 2023

Eir Nolsøe writes in The Telegraph that “Rishi Sunak and Jeremy Hunt have tried to allay fears of a new financial crisis after British start-ups were left on the brink from the largest bank collapse since 2008. The Prime Minister told reporters on a flight to the United States that there was “no systemic contagion risk” following the collapse of Silicon Valley Bank (SVB). The Chancellor said earlier on Sunday that the Treasury was working to find a solution for clients of its UK branch that “minimises, or if we possibly can, avoids” losses to companies caught up in the chaos.

### ➤ 13 March 2023

And James Titcomb in the same newspaper reports that HSBC has struck a last-minute deal to buy the collapsed Silicon Valley Bank UK, averting a crisis that threatened chaos across Britain's tech sector. The British bank will buy SVB UK's business for £1 after talks over the weekend between lenders, the Treasury and start-up representatives. The bank had loans of around £5.5bn and deposits of around £6.7bn, and made an £88m profit last year.

“The Bank of England, in consultation with the Prudential Regulation Authority, HM Treasury and the Financial Conduct Authority, has taken the decision to sell Silicon Valley Bank UK Limited, the UK subsidiary of the US bank, to HSBC UK Bank Plc,” it said. “This action has been taken to stabilise SVB UK, ensuring the continuity of banking services, minimise disruption to the UK technology sector and support confidence in the financial system. The Bank and HMT can confirm that all depositors' money with SVB UK is safe and secure as a result of this transaction. SVB UK's business will continue to be operated normally by SVB UK.”

### ➤ 31 March 2023

Ambrose Evans-Pritchard writes that “Rishi Sunak is on a roll. The Windsor Framework begins to put Britain's trade relations with Europe on a workable foundation, and without having to submit to European legal and political suzerainty. Britain's imminent **accession to the Pacific free trade pact** helps him finish the job. The accord instantly raises Britain's bargaining power in dealings with the EU, and sets in motion a process that shatters a host of Rejoinder shibboleths.” He goes on to write “It is not about immediate trade figures: it is about the geopolitical dynamic in world trade over the next 20 or 30 years. It raises the UK's status enormously in the global economy,” said Professor David Collins, an expert on world trade at City University.

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) comprises Japan, Canada, Vietnam, Malaysia, Singapore, Mexico, Peru, Chile, Australia, New Zealand, and Brunei. It jumps overnight to 16pc of global GDP once Britain joins, leap-frogging the combined EU. The Pacific bloc is heading rapidly for 20pc as a string of states in the Far East and Latin America signal an intent to join, at which point it becomes a stampede. By the end of this decade it will probably

be the world's largest trading system by a wide margin, increasingly able to set the tone and rules of global commerce.

This revenge of the 'middle powers' **demolishes the central catechism of Britain's pro-EU trade elites**: that the world is divided into three regulatory blocs – the US, EU, and China – and that the underlings must buckle under and accept the terms. “This is a seismic event. The EU and the US fully understand the geo-economic significance of this, and are utterly shocked that it could have happened,” said Shanker Singham, a UK trade adviser and a fellow at the Institute of Economic Affairs. “It is a wake-up call in Washington. It is now much more likely that we'll see a US-UK bilateral trade deal, and there is going to be a chorus of calls for the US itself to join the CPTPP,” he said.

As a practical matter, UK accession kills off any likelihood that it will ever rejoin the EU customs union or single market. There will be no 'dynamic alignment' with EU directives. The course is set irreversibly in a different direction. The CPTPP members have one shared objective: to make trade as smooth and easy as humanly possible, subject to basic civilised standards. It is governed by twin principles of mutual recognition and equivalence. This is entirely at odds with EU ideology. Brussels obliges supplicants to adopt identical laws, rules, and standards – under the writ of the European Court – in order to secure access to the European market. It does not accept reciprocity as a governing principle of trade.

The EU's neo-colonial ambitions have reached obvious limits. Its share of global GDP will drop to 14.6pc this year. It is losing roughly one percentage point every three years; however, Europe will remain a valuable market. Its regulatory apparatus will punch above its weight for a while yet. But the EU is undergoing a slow, comfortable, economic relegation, trailing badly in the Sino-US technology arms race, and politically captured by corporate vested interests wedded to the status quo - a reflex on display over the last week as the **German car industry won a (futile) reprieve for 20th century combustion engines**. “The EU's dream of being a global regulatory superpower was never what it was cracked up to be and from now on it is going into decline. I don't think it is going to be exporting its rules or precautionary principle for much longer,” said Prof Collins.

The tide is already receding over digital data. Japan, Singapore, and Korea are embarking on their own soft-touch regimes rather than swallowing the EU's rule-heavy GDPR (General Data Protection Regulation) – a nightmare for small business. The CPTPP has a “trade-driven” philosophy. Its chapter on small business is designed to promote easy access to information for start-ups and hi-tech firms, rather than seeking to restrict it. The pact reduces the burden of *rules of origin* in cross-border commerce to the absolute minimum with self-certification and paperless trade, unlike the bureaucratic overkill of the EU's customs regime - sheer torture for small British exporters trying to ship goods across the Channel.

The EU never delivered on free trade in services. National barriers proved intractable and Brussels failed to enforce its own laws. This was a chronic grievance for the UK as the world's second largest exporter of services. “The CPTPP goes much further in opening up e-commerce and financial services,” said Prof Collins. Now read on at: [Britain's accession to the CPTPP is the end of the Rejoinder dream \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/ukpol/eu-trade-deal/2020/07/20/britains-accession-to-the-cptpp-is-the-end-of-the-rejoinder-dream/)

➤ **10 April 2023**

With the above entry in mind, now read the much more detailed article by Matt Oliver which explains why “The real gains from joining the CPTPP go beyond the economic advantages.” [How Britain left Brexit behind with a new Pacific trade deal \(msn.com\)](#)

➤ **12 April 2023**

“Do I have to go on my knees?” Christine Lagarde asked in 2014 as she faced calls to apologise for underestimating the strength of the UK economy. The then head of the IMF faced pressure after her organisation took an overly pessimistic view of austerity’s impact on Britain. Nearly a decade later and the IMF, now led by Kristalina Georgieva, is in danger of repeating the same mistakes. New economic forecasts published on Tuesday saw Britain enjoy the biggest growth upgrade of a G7 nation writes Eir Nolsøe in The Telegraph. Read on at: [Britain is in the doghouse – but the establishment keeps getting its numbers wrong \(msn.com\)](#)

➤ **18 April 2023**

Jeremy Warner suggests in The Telegraph that members of the [Bank of England’s] Monetary Policy Committee appear as confused as the rest of us as to their policies’ end goals. Read: [Bank of England must come clean on how it so spectacularly lost the plot on inflation \(telegraph.co.uk\)](#)

➤ **25 April 2023**

And to conclude this edition on an upbeat note, Ambrose Evans-Pritchard writes that he believes “Our Prime Minister is quietly filling in the blank pages of the UK’s post-EU playbook.” He goes on to say:

*“Britain was conspicuously absent when a group of close neighbours issued the Esbjerg Declaration a year ago, unveiling plans to turn the North Sea into a massive green power plant for half of Europe. The exclusion made no economic sense since Britain is the world leader in offshore wind. Surplus electricity from giant wind parks on the Dogger Bank will be a lynchpin of European clean power by the early 2030s. It will be an integral part of Europe’s post-Putin energy security. That frosty and petulant stand-off already seems like another world. The UK reached an accord with the EU’s North Sea Energy Cooperation (NSEC) last December on a basis of sovereign parity. This week British ministers are taking part in the North Sea Summit in Ostend as full equals.*

*What has happened in the meantime is the invasion of Ukraine and a complete change in the political weather on both sides of the Channel. The UK’s import terminals for liquefied natural gas are the unsung heroes of Europe’s energy war. They have been a conduit for large volumes of LNG from the US and Qatar, either through the UK’s gas pipelines to the Continent or in the form of electricity via interconnectors. This additional supply has quietly covered a critical shortfall. It is a key reason why the EU survived the winter without blackouts, and was able to refill its gas storage sites. The UK is today shipping more gas to the EU than Russia. The British and Dutch governments this week announced a joint plan to build the LionLink cable, the world’s most powerful and advanced electricity interconnector.*

*It is perhaps a minor detail in the blossoming rapprochement between London and EU capitals, but such detail is more illuminating than the stale invective over Brexit in the Westminster media. The*

*larger story is that Britain is no longer being treated – or behaving – as a secessionist apostate. The logic of mutual interest is reasserting itself. The Windsor Framework has been the clincher, draining poison from relations with Brussels and Washington alike. This has turbo-charged a ‘rerating’ of UK Inc in the minds of global investors and economists that has already been underway for several months – even if the International Monetary Fund has yet to smell the coffee.*

*Standard & Poor upgraded the UK’s sovereign debt rating on Friday from negative watch to stable AA, citing both the Windsor accord and Rishi Sunak’s fiscal cleansing. It is becoming clearer that last year’s catastrophism was greatly overblown. The agency said the budget deficit will average 3.7pc of GDP over 2023-2025 rather than the earlier forecast of 5.5pc. The debt ratio will start falling from a peak of 97.7pc as soon as this year. It will not keep rising relentlessly through the 2020s as the IMF suggests. S&P said the energy price cap would cost nothing beyond mid-2023; and the Office for National Statistics said this week that government borrowing was £13.2bn lower than originally thought for the 2022-2023 financial year.”*

Now read on at: [It is a very long time since I felt so optimistic about UK’s economic future \(telegraph.co.uk\)](https://www.telegraph.co.uk)



# AEROSPACE MANUFACTURING



Following the Industry Review of 2022 and projections for 2023 on pages 6 - 10 we start this section with a picture of Hybrid Air Vehicles' Airlander. See: [HAV \(hybridairvehicles.com\)](https://www.hybridairvehicles.com). See also 'Airship Resurgence' by Alan Dron in the November 2022 edition of AERO SPACE. We are delighted to advise that HAV is a supporter of the Schools' Aerospace Careers Programme.

We continue now with our usual chronological report of relevant news items since our last Newsletter:

## ➤ 8 August 2022

Howard Mustoe reports in The Telegraph that Vertical Aerospace has built a functioning prototype of its four-engined VX4 aircraft which is designed to carry four passengers and a pilot at speeds of up to 200mph for trips of up to 100 miles, and is about to start a months-long programme of flight tests. The company, which is based in Bristol and was set up by the founder of green energy company Ovo, Stephen Fitzpatrick, said it has received more than 1,400 orders for the VX4.

The craft takes off vertically like a helicopter before tilting its engines forward to act more like a regular plane. Vertical Aerospace's customers include American Airlines, Virgin, and Japan Airlines. It will buy its electric engines from Rolls-Royce. See: [British flying taxis poised to take off for flight testing \(telegraph.co.uk\)](https://www.telegraph.co.uk/business/2022/08/08/british-flying-taxis-poised-to-take-off-for-flight-testing/)

## ➤ 16 August 2022

The world's biggest airline has announced a deal to buy a fleet of new high-tech jets dubbed the "son of Concorde", setting up the return of supersonic transatlantic flights by the end of the decade. American Airlines on Tuesday agreed to purchase up to 20 Overture aircraft from Boom Supersonic, with an option to extend the order to 40. Read: [American Airlines orders 30 'son of Concorde' supersonic jets \(telegraph.co.uk\)](https://www.telegraph.co.uk/business/2022/08/16/american-airlines-orders-30-son-of-concorde-supersonic-jets/)

The jets are expected to carry passengers from 2029 on routes such as Miami to London and Los Angeles to Honolulu. It would mark a return of supersonic transatlantic travel after a near-20 year hiatus, following the retirement of Concorde by British Airways in 2003. Boom says the Overture will carry 65 to 80 passengers and travel twice as fast as most commercial aircraft, boasting a cruising speed of Mach 1.7 - roughly 1,300 miles per hour. This will reduce journey times between London and New York from six and a half hours to three and a half hours.

#### ➤ 21 October 2022

Colorado-based start-up Boom Supersonic is developing an ultra-high-speed jet, known as Overture, that could catapult travellers from New York to London in less than four hours. So far, two of the largest US carriers United Airlines and American Airlines have ordered the aircraft, with an expected entry to service in 2029. But there is one problem - no engine makers want to help Boom create a supersonic engine.

President and CEO Gaël Méheust of CFM International told media at an industry forum on Sunday that the company doesn't "see a significant market for an engine that targets a very small potential niche," Aviacionline reported. Rather, he said CFM wants to put its time and resources into developing an engine "that improves emissions and performance compared to current engines."

The move comes after the joint venture's parent companies, GE Aviation and Safran Aircraft Engines, already said no to Boom in September. "As a practice, we avoid commenting on any ongoing and confidential negotiation with our suppliers, until both sides are ready to announce jointly," Boom told Insider in a statement. "However, we can reconfirm our intention to announce Boom's selected engine partner and transformational approach for reliable, cost-effective, and sustainable supersonic flight, later this year."

Without CFM as an option, Boom is left with no major manufacturers that could help it develop a supersonic engine, shining doubt on its 2029 timeline. Engine maker Rolls-Royce was at one point a contender, having signed an "engagement agreement" with Boom in 2020 to look into a supersonic engine. But, it has since pulled out of the project. The company told AIN Online in September that it has "determined that the commercial aviation supersonic market is not currently a priority for us and, therefore, we will not pursue further work on the program at this time."

Shortly thereafter, several other major manufacturers, including Safran, GE, and Honeywell, all told FlightGlobal that they do not have an interest in helping Boom at this time. Meanwhile, Pratt & Whitney chief sustainability officer Graham Webb told the outlet that supersonic travel is "tangential." Even before CFM announced its hesitancy to develop a supersonic engine, Henry Hartevelt, travel analyst and president of Atmosphere Research Group, told Insider in September that Boom may have to make its own. Read on at: [The world's largest jet engine maker confirms it won't develop supersonic engines for Boom, leaving the startup with few options \(businessinsider.nl\)](https://www.businessinsider.nl/news/2022/10/21/the-worlds-largest-jet-engine-maker-confirms-it-wont-develop-supersonic-engines-for-boom-leaving-the-startup-with-few-options)

#### ➤ 26 October 2022

The Drive reports that Lockheed Martin has provided new artwork showing a notional manned sixth-generation combat aircraft component of the Next Generation Air Dominance program, or NGAD, the multi-faceted U.S. effort to field next-generation tactical air combat capabilities. The stealthy tailless aircraft is shown in a picture below refuelling from Lockheed's LMXT tanker concept, which the

artwork was intended primarily to promote. You can read more about NGAD's potentially game-changing architecture below, but suffice to say, a manned tactical aircraft component is very much planned to be at its centre.

By showing an NGAD concept as essentially an adjunct to the new tanker aircraft it's promoting to the Air Force, Lockheed Martin appears to skilfully sidestep making any explicit references to what's a highly secretive program. However, there's no doubt that the tailless aircraft is intended to serve at least as a stand-in for NGAD.

As for Lockheed Martin's vision of a possible manned NGAD aircraft, this incorporates a diamond-shaped wing with straight leading and trailing edges. The wing is closely blended with the elongated fuselage, which features a single prominent chine line and tapers sharply toward the nose. It's perhaps notable that the aircraft features no distinct tail surfaces. Tailless designs have cropped up frequently in NGAD-adjacent concept art as they would provide very low observability (stealth), considerable internal volume for fuel, weapons, and sensors, and a high degree of efficiency.

The twin engines are buried in the fuselage and exhaust over the upper surfaces of the airframe — a known low-observable design tactic used to block the infrared plume and radar reflective exhaust areas from sensors on the ground and from most other aspects — with two-dimensional diamond-shaped nozzles. These are especially apparent in a rear-aspect view of the aircraft, seen below, in which it's also shown taking on fuel from an LMXT. There also appear to be two fairly shallow 'bulges' on either side of the centre section of the fuselage, which appear to relate to the propulsion system. The aircraft may be depicted as wearing a shiny or semi-reflective coating, which could be in line with similar experimental coatings seen on F-22s, F-35s, and F-117s as of late.



The engine air intakes are not visible, suggesting they are mounted below the airframe, something that has also been seen on previous sixth-generation concepts. It's also possible that the intakes have been omitted from the artwork entirely, to conceal the approach that Lockheed has taken here. A low-observable aircraft's intake design is among its most challenging and sensitive features.

The proportionally fairly long cockpit canopy is notably low-profile, suggesting limited visibility, especially to the rear, for the crew. This feature is not as important as it once was with the advent of distributed aperture systems and the garnering of extremely high situational awareness due to advanced sensor fusion and networking. Also, the manned element of NGAD is not really a traditional fighter. Range, payload, and low observability are certain to take priority over manoeuvrability. Now read further at: <https://www.thedrive.com/the-war-zone/new-next-generation-air-dominance-fighter-renderings-from-lockheed>

➤ **28 November 2022**

Howard Mustoe writes in The Telegraph that after more than a year of delays and infighting, it looked like Europe's largest weapons programme was finally getting off the ground. France, Germany and Spain had reached an agreement to build a supersonic warplane dubbed FCAS, Christine Lambrech, Germany's defence minister, triumphantly declared. Days later, however, cold water was thrown on her comments by the head of one of its lead contractors, French weapons prime Dassault. "There was a sort of pseudo-political announcement that was made...but it is not yet done," the company's chief Eric Trappier told RTL Radio.

It was yet another twist in an ever more complex saga that has threatened to weaken military ties between Europe's biggest economies. The Future Combat Air System (FCAS) aims to have a next-generation stealth jet in service by 2040 at a cost of €100bn (£87bn). It is competing with Britain's future combat fighter jet project, named Tempest, which is being led by BAE Systems in partnership with Italy and Sweden.

The jet will be a so-called sixth-generation fighter, which offers better radar-beating technology than the fourth-generation Typhoon and fifth-generation carrier-based F35. A pre-prototype Tempest aircraft is expected to fly within the next five years with the programme estimated to cost around £25bn. But as Europe teeters on the edge of recession, questions are being asked about the logic of two competing and, on the face of it, similar megaprojects. Read on at: [The battle to build Europe's next generation fighter jet \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2022/11/28/the-battle-to-build-europes-next-generation-fighter-jet/)

➤ **3 December 2022**

And with sixth generation aircraft in mind, Josie Ensor reports that America's newest nuclear stealth bomber, with the ability to disguise itself as another object, has made its public debut after years of secret development. The B-21 Raider, which is on track to cost nearly \$700 million per plane, is the first new American bomber aircraft in more than 30 years. The B-21 will gradually replace the B-1 and B-2 aircraft, which first flew during the Cold War.

The aircraft, which some observers likened to a flying saucer in shape, was unveiled in a spectacular reveal on Friday night at an Air Force facility in Palmdale, California. "The B-21 Raider changes everything," said Northrup Grumman CEO Kathy Warden whose company is behind the build. Unveiled today, the B-21 Raider will be a dual-capable, penetrating-strike stealth bomber capable of delivering both conventional and nuclear munitions. The B-21 will form the backbone of the future Air Force bomber force consisting of B-21s and B-52s.

Many specifics of the aircraft are being kept under wraps as classified information, but the plane offers significant advances over existing bombers in the US fleet. The B-21, which can carry both

conventional and nuclear weapons, boasts a futuristic flying-wing design and is intended to fly thousands of miles to strike targets deep behind enemy lines, evading detection by the most sophisticated air defences. It can fly about 6,000 miles before being refuelled and has a 15-ton payload.

Several defence analysts said changes would likely include advanced materials used in coatings to make the bomber harder to detect, and use of new propulsion technologies. Using new ways to control electronic emissions, the bomber could spoof adversary radars and disguise itself as another object. “Even the most sophisticated air defence systems will struggle to detect the B-21,” said Lloyd Austin, US Secretary of Defense who attended the preview. See: [US debuts B-21 stealth bomber as 'most advanced warplane ever built' \(telegraph.co.uk\)](#)

#### ➤ 9 December 2022

And remaining with sixth generation aircraft one more time, The Telegraph reports that Britain will work to develop next-generation fighter jets with Italy and Japan, Rishi Sunak has announced. The Prime Minister said the defence partnership will ensure the UK and allies are "outpacing and out-maneuvring those who seek to do us harm". Downing Street aims for the jets, called Tempest in the UK, to take to the skies by 2035 and serve as a successor to the RAF Typhoon.

The ambition is for the planes developed under the global combat air programme (GCAP) to be enhanced by capabilities including uncrewed aircraft, advanced sensors and cutting-edge weapons. They are being developed in response to military bosses' fears that air dominance is being threatened. Mr Sunak will launch the first major phase of the programme during a visit to RAF Coningsby, in Lincolnshire, on Friday. See: [UK to team up with Italy and Japan to build advanced fighter jet \(telegraph.co.uk\)](#)

#### ➤ 19 December 2022

Howard Mustoe writes that less than a fortnight after the final 747 rolled off the assembly line in the US, Rolls-Royce debuted its biggest ever jet engine – just about able to pass through a London Underground tunnel. As Boeing ditches the Jumbo Jet for lack of interest, Rolls-Royce is hoping UltraFan, unveiled on Monday, will help it to solve the problem of green air travel. While aviation accounts for about 2pc of carbon dioxide emissions, the industry is under pressure to move towards zero emissions by 2050.

Around the world, engineers are attempting to crack the seemingly impossible challenge of fuelling long-haul flying without generating large emissions. For smaller craft, top-end batteries can be used for the shortest, taxi-like routes and hydrogen at low pressure may be deployed for short-haul flights. For long-haul, the hardest to decarbonise, jet fuel offers an unbeatable package of stable energy storage and efficiency. Hydrogen can offer more energy and a lower carbon footprint, but must be stored at incredibly low temperatures for the longest routes.

A synthetic version of jet fuel can, with a few small modifications, power existing jet engines. As well as recycling carbon dioxide, Sustainable Aviation Fuel, known as SAF, produces less in the way of particles that are blamed for helping warm the earth. SAF is likely to be needed for long-haul flights until technology catches up. However, in current engines it costs five times as much as its fossil fuel counterpart. No business in their right mind would make the switch – or survive for long if they did.

Read on at: [How the biggest ever jet engine built by Rolls-Royce is paving the way for an era of low-cost green flying \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2023/02/01/how-the-biggest-ever-jet-engine-built-by-rolls-royce-is-paving-the-way-for-an-era-of-low-cost-green-flying/)

### ➤ February 2023

With our cover picture in mind, the February 2023 AERO SPACE edition includes an article by Stephen Bridgewater about the USAF's B-21 Raider stealth bomber unveiled last December. See 'Out of the shadows'.

Also in this edition the RAeS advises that Airbus and Boeing have announced their order and delivery figures for 2022: Airbus, 820 order and 663 deliveries; Boeing, 774 orders and 480 deliveries.

### ➤ 14 February 2023

Rolls-Royce and Airbus have signed a multi-billion pound deal to build 250 new planes for Air India, which is set to create hundreds of new jobs in the UK, writes Jack Mendel in CITYA.M. The wings will be designed in Filton and assembled in Broughton, creating 450 manufacturing jobs and bringing in more than £100m of investment to Wales. Meanwhile, the A350 aircraft are being exclusively powered by Rolls-Royce XWB engines, assembled and tested in Derby. Rolls-Royce announced it received the order, but financial details are not being disclosed. Tufan Erginbilgic, CEO, Rolls-Royce plc, said "the size and magnitude of this order reflects the level of ambition for the future.

Congratulating Air India on the "bold step towards becoming one of the world's greatest airlines" he went on to say, "With a dynamic and growing aviation industry, India is a strategically important market for us and we look forward to working with Air India as they connect their passengers across global communities and cultures."

Prime Minister Rishi Sunak and newly promoted business and trade secretary Kemi Badenoch welcomed the momentous deal, and the new jobs it will bring, this morning. Sunak said: "This landmark deal between Air India, Airbus and Rolls-Royce demonstrates that the sky's the limit for the UK's thriving aerospace sector. Read further at: [Rolls-Royce, Airbus pen deal with Air India for 250 planes in boost for UK manufacturing \(cityam.com\)](https://www.cityam.com/rolls-royce-airbus-pen-deal-with-air-india-for-250-planes-in-boost-for-uk-manufacturing/)

### ➤ 2 March 2023

Tom Pegden has advised in Business Live that Rolls-Royce has started testing its F130 engine for use in the US Air Force B-52 fleet, in anticipation of supplying 600 engines. The work is being undertaken at its outdoor test facility at the NASA Stennis Space Center in Mississippi as the US prepares to replace the existing powerplants in the bomber fleet. Rolls-Royce, which has its global base in Derby, England, said the multi-billion dollar order to supply the engines will be serviced by its production lines in Indianapolis. Rolls-Royce has invested \$1 billion modernising the manufacturing and testing facilities in recent years.

The F130 engine was chosen for the B-52 in September 2021 following a competitive selection process, and comes from the Rolls-Royce BR family of commercial engines, which have more than 30 million hours of operation. The current testing focuses on crosswind aerodynamics and the digital control system and early results are said to have been positive. Rolls-Royce said it was working closely with the USAF and Boeing which is managing the integration of the engines as part of a big B-52

overhaul program. The first B-52 first flew in the early 1950s and the new engines will extend the life of the aircraft for another 30 years.

Candice Bineyard, who serves as director of defense programs at Rolls-Royce in the US, said the engines would be more efficient and easier to maintain for the fleet. She said: “We are excited to begin this milestone testing program, the first step for what will be decades of successful engine operation for the United States Air Force B-52 fleet.” See: [Rolls-Royce B-52 engine testing gets under way for USAF - Business Live \(business-live.co.uk\)](#)

➤ **27 March 2023**

Greg Dickinson, senior travel writer for The Telegraph, records his experience at the controls of Hybrid Air Vehicles’ Airlander. Read: [Airlander: A new way of travelling is coming sooner than you might think \(telegraph.co.uk\)](#)

➤ **14 April 2023**

Howard Mustoe advises that aviation giant Boeing said it has discovered production errors in making its popular but troubled 737 Max planes, dealing a blow to the US manufacturer’s long recovery. Spirit AeroSystems, one of Boeing’s suppliers, was using a process to install fittings in the jets which did not comply with strict aviation regulations, it said. The production method “is not an immediate safety of flight issue” and will not affect jets already being flown, the plane-maker added.

Boeing’s 737 Max and rival Airbus’s A320 single-aisle jets are the workhorses of cross-continental flight, carrying passengers between European and North American cities for work and holidays. They have both been crucial in the nascent recovery of air travel after the pandemic. Any slowdown in production could hit airlines’ plans for expansion. Boeing is also struggling to recover confidence in the 737 Max after two fatal crashes in 2018 and 2019 claimed the lives of 346 passengers and triggered a grounding of the craft. Faulty software was found to be the cause.

The company said it had told its regulator, the Federal Aviation Administration, about the construction error, adding that it was “working to conduct inspections and replace the non-conforming fittings where necessary”. The problem also affects other craft in the 737 Max “family”, Boeing said, including the Max 7, Max 8 and Max 8200 planes, in addition to the P-8 Poseidon maritime surveillance aircraft. Although the 737 Max jets have now been signed off as safe by regulators, Boeing has been hit by supply chain problems and production delays. But airlines are keen to acquire the aircraft as it will cut carriers’ fuel costs and reduce emissions.

In February, it emerged Boeing would cut 2,000 office jobs in the US as the struggling plane maker battles to improve its stalling production line. Roughly a third of the roles being cut will be outsourced to India, The Seattle Times reported, with the remainder disappearing completely. Boeing said it will increase its overall workforce size by 10,000 this year, with a “focus on engineering and manufacturing” roles. The firm’s headcount grew by 15,000 last year. Read further at: [Boeing hit by new manufacturing delays for flagship 737 Max \(telegraph.co.uk\)](#)

## AVIATION OPERATION & MAINTENANCE



Airbus has delivered its first A330neo aircraft to Virgin Atlantic, it has announced. Sir Richard Branson's airline, which will become the first operator of the plane in the UK, has ordered 13 A330neo jets - six are on lease from the Air Lease Corporation - with the intention to expand the fleet to 16 in the coming years. The A330neo is Virgin's 50th Airbus aircraft and is powered by Rolls-Royce Trent 7000 engines.

The plane includes Airbus's high-tech Airspace cabin, which was first revealed in 2016. According to the company, the cabin has more personal space, larger overhead bins, a new lighting system and entertainment. The plane also features a state-of-the-art cabin air system and is configured to accommodate 262 passengers in three classes including 32 upper-class seats featuring privacy doors and two of the carrier's new Retreat Suites.

Earlier in October, Airbus said it expects the global commercial aircraft services market to double in value over the next 20 years - requiring millions of workers to join the sector. The aerospace giant - which has UK bases in Filton, South Gloucestershire and Broughton, North Wales - has forecast a "bigger than ever" demand for highly skilled workers, such as pilots or technicians, as the industry recovers following the devastating impact of Covid-19.

Earlier this year the company finished assembling a prototype eco-wing it hopes will make flying more sustainable. The Wing of Tomorrow programme is aimed at developing future technologies that could be used to make aviation more environmentally friendly. Airbus is also carrying out research into sustainable aviation fuels and hydrogen propulsion. See: [Airbus delivers first A330neo plane to Virgin Atlantic - Business Live \(business-live.co.uk\)](https://www.business-live.co.uk/aviation/airbus-delivers-first-a330neo-plane-to-virgin-atlantic-1.6111111)

Continuing now with our usual chronological news reporting:

## ➤ 16 August 2022

Matt Oliver reports in The Telegraph that Ryanair is adding hundreds of flights from London Stansted as the budget airline seeks to capitalise on an extended passenger limit at "hopeless" Heathrow. The Irish carrier, which is led by Michael O’Leary, on Tuesday said it will put on an extra 500 services during the October half-term school holiday, with capacity for 10,000 passengers. Its move comes just hours after Heathrow announced that a daily cap of 100,000 departing passengers – put in place due to concerns about staff numbers – will remain in place until the end of October.

That decision will have implications for several airlines, chief among them British Airways, which is Heathrow’s biggest customer. BA has said it is still assessing the impact. But in contrast Ryanair on Tuesday boasted that both it and Stansted had “more than sufficient staff to handle these additional flights”. Mr O’Leary added: “While hopeless Heathrow continues to cut flights and raise fares for families, Ryanair and London Stansted continue to add flights, and offer thousands of low-fare seats for the autumn mid-term break.”

Heathrow has repeatedly criticised airlines for a shortage of ground handlers at the airport, which has resulted in thousands of items of baggage not being put on to their owners' flights this summer. But Heathrow is likely to face a barrage of compensation claims from affected holiday firms and airlines, many of which have laid the blame for disruption squarely at the feet of airports instead.

The latest extension to Heathrow’s passenger cap raises the prospect of fresh flight cancellations and the curtailment of ticket sales for the popular October half-term holidays. The cap was originally due to end on September 11. A BA spokesman said: “We’ll continue to work closely with Heathrow Airport as we work out the implications of this extended cap so we can get as many of our customers away as planned.”

Virgin Atlantic said it was disappointed by the move and urged Heathrow to return to normal capacity “as soon as possible”. A spokesman said: "We are disappointed that Heathrow Airport has already decided to extend the passenger capacity cap until the end of October, as additional resources come online every week and the airport experience improves. "Airline customers have a right to expect their bookings will be honoured and we're doing everything in our power to minimise disruption, getting our customers to where they need to be smoothly. “We want to remove the cap as soon as possible, but we can only do so when we are confident that everyone operating at the airport has the resources to deliver the service our passengers deserve. "We urge Heathrow to provide a comprehensive plan for returning to normal operations as soon as possible."

Ross Baker, Heathrow’s chief commercial officer, said: "Our primary concern is ensuring we give our passengers a reliable service when they travel. "That's why we introduced temporary capacity limits in July which have already improved journeys during the summer getaway. "We want to remove the cap as soon as possible, but we can only do so when we are confident that everyone operating at the airport has the resources to deliver the service our passengers deserve."

## ➤ 1 September 2022.

Oliver Smith writes in his article *BA's decline – in numbers (telegraph.co.uk)* that “As we’ve reported on several occasions, BA has been among the worst airlines in Britain when it comes to both delays and cancellations this summer. A remarkable 3.16 per cent of all its services have fallen by the wayside

in 2022, and during the height of the chaos in July that figure stood at over 4 per cent. Furthermore, only 57.8 per cent of flights have left within 15 minutes of their scheduled departure times. But the airline's decline predates the pandemic – delays and cancellations were already becoming more commonplace between 2017 and 2019". Now continue with his article.

### ➤ **September 2022**

In AERO SPACE this month Sally Gethin looks at the continuing challenges faced by airports as they struggle to recover from the global Covid-19 pandemic.

### ➤ **27 October 2022**

"The major imperative for the UK economy today is growth." So writes Patrick McLoughlin in The Telegraph today. He goes on to say that is the central tenet of this Government and one that all sectors can and should play a role in. The aviation sector can be a major contributor to this: it is a crucial driver of the UK economy, with an estimated value of more than £28bn according to the Government, but it has been devastated by the coronavirus pandemic.

UK airport passenger numbers fell to 78pc of pre-Covid levels in 2021 according to the Civil Aviation Authority and now, with the removal of the majority of travel restrictions across the globe and passenger numbers returning again, the devastation on the sector is becoming evident. So for the aviation sector to demonstrably add to UK growth, some challenges need to be addressed.

Whilst the challenge for the sector appears to be attracting a new wave of recruits to satisfy the public's insatiable desire to travel, it will not be long before the age-old issue of "limited capacity" begins to bite and dent our ambitions. Now is therefore the time to plan and get ahead of the problem, thinking about how we support the sector to grow and expand as a crucial part of driving the UK aviation industry forward, boosting prosperity and improving domestic and international connectivity. Read on at: [Rishi Sunak must back airport expansion if he is serious about 'levelling up' \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/politics/2022/10/27/rishi-sunak-must-back-airport-expansion-if-he-is-serious-about-levelling-up/)

### ➤ **27 November 2022**

Oliver Gill reports that British Airways is planning to double its operations at Gatwick as a long-running row with Heathrow sours relations with bosses at Britain's busiest airport. The UK flag carrier is to increase flights from the Sussex airport instead of expanding operations at Heathrow. BA is understood to be planning to increase the number of aircraft based at Gatwick from 14 to between 24 and 28 in the coming years. The plans come amid discontentment among airlines operating out of Heathrow. The airport was forced to cap passenger numbers during the summer to prevent a repeat of the chaos that blighted many airports since the Easter holidays.

One senior BA source said: "Our growth will be at Gatwick rather than Heathrow for now." BA was among a number of airlines to retreat from Gatwick, Britain's second-busiest airport, during the pandemic. Arch-rival Virgin Atlantic moved its operations to Heathrow, turning its back on the base where Sir Richard Branson's maiden flight took off in 1984.

BA returned to Gatwick last year with the launch of Euroflyer, a cut-price short-haul subsidiary that would operate independently in a similar vein to Cityflyer, which runs BA flights from London City Airport. Euroflyer was BA's plan to avoid racking up big losses running short-haul flights and

included similar working practices to budget rivals, meaning some pilots would be paid less than those at EasyJet.

BA bosses, meanwhile, have clashed with Heathrow chief John Holland-Kaye both in public and behind closed doors. Heathrow is waiting on a final decision by the Civil Aviation Authority (CAA) on what it can charge airlines in take-off and landing fees. Charges are set to fall from £30 per passenger currently to £26 next year under proposals put forward by the CAA.

Heathrow wants to increase the charges to £42 per passenger. Failure to acquiesce to such demands would have a detrimental impact on passengers because the airport would not have the money to invest in vital upgrades and maintenance, Mr Holland-Kaye said. Airlines disagree. Luis Gallego, the chief executive of BA parent IAG, has accused Heathrow of “using its dominant market position to enrich shareholders at the expense of travellers, airlines and the UK’s economy”. Read further at: [British Airways to double operations at Gatwick Airport \(telegraph.co.uk\)](#)

#### ➤ 16 January 2023

Air travel will rebound to pre-pandemic levels by June after China reversed its zero-Covid policy, according to one of the world's biggest owners of aircraft. China's decision to reopen its borders will propel passenger numbers to 2019 levels for the first time in four years, according to Avolon, the world’s third-largest aircraft leasing company.

Andy Cronin, Avolon chief executive, said that although “geopolitical and macroeconomic risks remain... China’s reopening [will help] drive global traffic levels to pre-pandemic levels by June”. A resurgent Chinese market will put pressure on the skies above Europe, which are already congested because of Vladimir Putin's war, and may force carriers to fly over Russia and Ukraine. Most airlines also halted flying over Russia, Ukraine and Belarus in the wake of Mr Putin’s invasion 11 months ago. Now continue to read Oliver Gill’s article at: [Air travel to return to pre-Covid pandemic levels by June – but where will planes fit in the sky? \(telegraph.co.uk\)](#)

#### ➤ 7 November 2022

SimpleFlying reports that this year at the Bahrain International Airshow, Emirates fans will be treated to its four-class Airbus A380 aircraft attempting to take centre stage. The airline’s new generation On-board Lounge and Shower Spa will be on show. Plus, those eagerly waiting to try Emirate’s new premium economy class product will have their opportunity during a tour of the aircraft. Read on at: <https://simpleflying.com/bahrain-international-airshow-emirates-airbus-a380/>



## UK DEFENCE AEROSPACE & CYBER



**The following is an extract from a UK Ministry of Defence article dated 18 July 2022: UK builds momentum on combat air programme with demonstrator set to fly within five years - GOV.UK ([www.gov.uk](http://www.gov.uk))**

*“A new flying demonstrator will be unveiled within the next five years as part of the UK’s major next generation fighter aircraft programme, the Future Combat Air System (FCAS). It comes as the future combat air programme launches a new recruitment and skills initiative known as Generation Tempest, set to create thousands of new job opportunities across the United Kingdom. The demonstrator aircraft is already in development between the Government and Team Tempest industry partners, and the UK is actively progressing collaboration opportunities on the project with Italian industry partners.*

*The flying demonstrator will be a piloted supersonic aircraft testing a range of new technologies including integration of stealth compatible features. This is the first time the UK will have developed a new fast aircraft using 21st century technology. Work is rapidly gathering pace on this important part of the FCAS programme, with development of the demonstrator underway at BAE Systems’ facility near Preston in the north of England. This is being supported by hundreds of companies and thousands of engineers across the UK. The demonstrator is vital for ensuring our technology, skills and industrial capability are ready for the future. Designing and building the flying demonstrator will prove integration and test skills. It will also provide invaluable data and lessons to UK industry to support the introduction of a new FCAS aircraft from 2035.*

*Separately, the UK is now conducting joint concept analysis with close partners Japan and Italy to understand areas of shared interest and to explore potential Future Combat Air partnership options and continues to explore wider partnerships. Further decisions are expected to be made by the end of 2022. Like the UK, both Japan and Italy operate F-35 fighter jets and the nations have undertaken joint exercises together in the past.”*

And now, commencing on a financial note, we continue our chronological review of news reports:

### ➤ 11 August 2022

An article by Patrick Sawyer in The Telegraph advises that the RAF can now fly transporter planes thousands more miles without landing to refuel, significantly increasing its ability to re-supply British troops and their allies on the ground. One of its Atlas C1 (A400M) transport aircraft, which normally have a range of 4,100 nautical miles (4,700 miles) before landing, has been refuelled over the South Atlantic for the first time. The Air-to-Air Tanking operation was conducted by the RAF Voyager aircraft flying from the Falklands Islands. The Atlas was flown from RAF Brize Norton to Ascension Island, before then flying on to the Falklands.

During the flight, the transport aircraft was met 900 nautical miles south-west of Ascension Island by an RAF Voyager which had taken off from Mount Pleasant Airfield 2600 nautical miles away on the Falkland Islands. The Atlas aircraft was refuelled using what is known as the probe-and-drogue system, in which a probe extends from the front of the transport aircraft above the cockpit. The pilot then has to dock this probe into the basket of the drogue that has been extended from the Voyager to allow refuelling. See: [RAF boost flight time with first South Atlantic mid-air refuel \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/uknews/2022/08/11/raf-boost-flight-time-with-first-south-atlantic-mid-air-refuel/)

### ➤ September 2022

In AERO SPACE this month Tim Robinson and Stephen Bridgewater report from the RAF Global Air and Space Chief's Conference and the Royal International Air Tattoo and, in particular, on the UK's ambitions to field operational UCAV and swarming drones.

Furthermore, Richard Gardner reports from Middle Wallop as the UK's Army Air Corps takes delivery of the latest version of Boeing's Apache attack helicopter – AH64E.

### ➤ 9 October 2022

Inside a room about the size of a university lecture hall on the outskirts of Edinburgh, scientists are putting the latest radar destined for British-made fighter jets through its paces. It is sealed shut with 30-foot high metal doors and with walls lined with foam spikes in order to test the new equipment accurately. This is the testing hall for the European Common Radar System Mk 2, a £2.4bn upgrade to Britain's jet fighter fleet's eyes in the sky and a stepping stone to the next generation of radar which will be fitted in the nose of the planned Tempest fighter jet, writes Howard Mustoe.

Engineers aim to meld radar with various other electronic eyes and artificial intelligence to be able to detect and deal with threats, long before a pilot notices them, in encounters where every second counts. "The first time you'll know about a threat being dealt with is when the system tells you," Says Andrew Howard, director of major air programmes at Leonardo.

Capability like this will only be used defensively, for instance in destroying a missile, he adds. To get there, Leonardo will have to design a system that can manage vast amounts of information – traffic comparable to Edinburgh's internet usage at any given moment – and use huge processing power. Additionally the system must be able to gather enough information to map a battlefield with as few sorties as possible, from as far away as possible, minimising pilot danger, he adds. From a design perspective, the challenge is managing the energy it will need, as well as placing sensors on a stealth jet without ruining its stealthy nature. Read on at: [Inside the £2.4bn effort to hand British stealth fighter pilots the advantage in future wars \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/uknews/2022/10/09/inside-the-2-4bn-effort-to-hand-british-stealth-fighter-pilots-the-advantage-in-future-wars/)

➤ **18 November 2022**

[RAF completes first flight powered by used cooking oil \(telegraph.co.uk\)](https://www.telegraph.co.uk). An RAF Voyager makes a milestone 90-minute journey on sustainable aviation fuel made up of waste-based materials. The flight, which took place on Wednesday and replicated an air-to-air refuelling sortie, was the first time that a military aircraft of its size, or any aircraft in the UK, had completed such a feat.

The RAF Voyager required no modifications to handle the sustainable aviation fuel. A defence source told The Telegraph that if the RAF could replicate aviation turbine fuel, a form of paraffin that all jet engines run on, “then it could work on future fighter jets”.

➤ **December 2022**

In October the Royal Aeronautical Society hosted senior members of the Team Tempest consortium and MoD officials for an exclusive roundtable update on the Future Air Combat Air System programme. Stephen Bridgewater reports on the subject in the December edition of AERO SPACE.

Also, in the same edition, Dr Dave Sloggett asks, “Is increasing digitisation of aviation opening up a pathway to cyber risk?”

➤ **23 December 2022**

Ben Riley-Smith writes in The Telegraph that defence spending is set to increase by more than a billion pounds to avoid a real term cut over the next two years. The Treasury has accepted the argument that the Ministry of Defence (MoD) budget should not be falling relative to inflation while war rages in Ukraine. Jeremy Hunt, the Chancellor, is expected to announce the increase in his Budget this spring. He did similar uplifts for education and NHS spending in the autumn. Military experts estimate that to avoid real-term cuts the MoD budget in 2024/25 must rise from £48.6 billion to £50.1 billion, meaning an increase of at least £1.5 billion is expected.

The specifics of the budget increase are yet to be discussed in detail and signed off, with the exact amount set to be shaped by the financial situation come spring 2023. But the decision has been taken in principle. “We will avoid a real term cut in the defence budget,” a senior Government source told The Telegraph.

Boris Johnson announced the biggest programme of investment in British defence since the end of the Cold War in the early period of his premiership. However, the cash injection for the MoD was front-loaded, meaning most of the money was handed over in the early years of the period ending 2024. It has created a situation where the MoD budget between 2022 and 2024 is actually forecast to fall in real terms, given the soaring inflation that has emerged over the last year. On current plans, the MoD budget is due to rise from £47.9 billion in the 2022 financial year to £48 billion in 2023 and then £48.6 billion in 2024. Those rises are set to be outstripped by inflation.

The Treasury's new compromise in part reflects geopolitical changes. War in Europe has returned with Russia's invasion of Ukraine, with the conflict's duration hitting the year mark next February. Spending decisions are expected to be announced alongside publication of the Government's updated Integrated Review, which will warn of the return of geopolitical clashes. Continue to read at: [Defence spending to rise by more than a billion in victory for Ben Wallace \(telegraph.co.uk\)](https://www.telegraph.co.uk)

### ➤ 3 March 2023

The RAF will fly NATO missions with Germany over Estonia for the first time in a show of strength to Russia, writes Danielle Sheridan in The Telegraph. It will be the first joint air policing mission of its kind for the UK in the Baltic country as it works with German Air Force Typhoon jets.

Around 300 RAF personnel from the 140 Expeditionary Air Wing (EAW) will deploy to Estonia imminently as the RAF prepares to take the lead on the long-established NATO air policing mission from the German Air Force for four months. The jets will fly together on live NATO-controlled intercepts.

Ben Wallace, the Defence Secretary, said the mission would ensure the security of Europe's skies and bolster NATO's presence in eastern Europe. He said: "Joint operations of this kind demonstrate the strength and unity of the NATO alliance and our shared resolve to maintain peace and security across the region."

### ➤ 15 March 2023

The Daily Mail reports that Britain is to spend £10 billion on its next-generation fighter jet, which will incorporate 'deep learning artificial intelligence' and could fly without a pilot. The Global Combat Air Programme (GCAP) intends to take off in 2035 and combine British, Japanese and Italian technology to create the world's most advanced combat aircraft.

The Government announced a £5 billion uplift in defence spending over the next two years, but this has already been allocated for nuclear submarines and replenishing stocks given to Ukraine. In total there will be only an £11 billion increase in military funds between this year and 2028, despite the huge threat posed by Russia and China.

GCAP will be the RAF's replacement for its Typhoons which will be withdrawn from service by the mid-2030s. It will incorporate all the research and development already completed on the 'Tempest' future aircraft project. Japan will also provide all the technology it intended to use for its next-generation fighter as part of the collaboration. Italy has also joined GCAP, but is understood to be a junior partner.

Speaking in Japan, Defence Secretary Ben Wallace said: 'We will be investing £2 billion in GCAP up to 2025 and £10 billion over the next ten years. 'The overall development programme will be above £25 billion. We will hopefully get towards development by 2025 and in service by 2035 – a key milestone, a milestone we must all meet and deliver.'

The manufacturers involved in the project include BAE Systems and Rolls-Royce from the UK, Leonardo from Italy and Mitsubishi from Japan. Dozens of smaller British enterprises are also set to be included. The UK and Japan are expected to cover 80 per cent of the costs, with Italy picking up the remainder.

### ➤ 29 March 2023

The Royal Air Force is poised to be led by a non-pilot for the first time since the Service was formed in 1918, writes Dominic Nicholls. Speculation is mounting that the next Chief of the Air Staff will come from the RAF's engineering branch. Air Chief Marshal Sir Mike Wigston, the current chief, is due to step down in June. The process to appoint his successor is underway.

Although any nomination must be agreed by the Defence Secretary before final approval is sought from His Majesty the King, defence sources have suggested Air Marshal Sir Richard Knighton is in line for the top job. AM Knighton currently serves in the MoD as Deputy Chief of Defence Staff in charge of Military Capability. As such he has been exposed to defence programmes across all three services and has made regular appearances in front of the Commons Defence Select Committee alongside ministers. He earlier served in the finance department of the MoD, experience which has served him well when grilled by MPs.

One defence source with knowledge of the expected appointment told Sky News: “It breaks an important glass ceiling. We have never had a non-pilot before.” In 2013 the RAF was led by Air Chief Marshal Sir Andy Pulford, a helicopter pilot. All other chiefs have been fast jet pilots. Held in high regard by serving and former RAF officers, if appointed AM Knighton will be the first engineer to hold the top job, with experience on Nimrod, Tornado and Harrier aircraft. He commanded RAF Wittering, home to the Harrier force from 2009 to 2011.

The next head of the RAF will carry on the work of ACM Wigston in bringing into service Britain’s new F-35 stealth fighter, the Poseidon maritime patrol aircraft and Wedgetail Airborne Early Warning and Control plane. If appointed as Chief of the Air Staff, the formal title for the head of the RAF, AM Knighton is expected to continue ACM Wigston’s work to transform the service. The RAF has recently adopted a number of measures to appeal to a broader section of UK society, for example by using the term ‘aviator’ for RAF junior ranks instead of ‘aircraftsman’. Read on at: [Royal Air Force set to be led by non-pilot for first time \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/ukdefence/2023/03/30/raf-to-be-led-by-non-pilot-for-first-time/)

### ➤ 30 March 2023

Intelligence gathered by AI will be used to help identify enemy threats to the UK. The new plans will see AI used to sift through vast amount of data to catch intelligence that might otherwise be missed by humans. Lessons from Russia’s illegal invasion of Ukraine have shown how information from open sources can help identify threats ensuring analysts are not swamped by data, Mr Tugendhat said.

Writing exclusively in The Telegraph, the Security Minister said a new department will be set up to focus on publicly available information, adding to the work of MI5 and MI6. “Traditional spying will still lift the curtain on the plans of our enemies,” he said. “We will still need to listen and look where they want to hide.” However, “intelligence has changed,” Mr Tugendhat warned, adding “we live in a very different world to the one we inhabited a decade ago”. The new open-source intelligence (OSINT) hub will add “richness and detail” to the work of traditional spies as well as countering disinformation that seeks to “tear us apart”.

The size and budget of the new unit has yet to be decided, although plans are expected to be put to the Prime Minister in May. In his budget on March 15, the Chancellor pledged almost £3.5 billion to boost Britain’s science and technology sectors and make the UK a tech “superpower”. The Government has said it will set out further plans to stimulate research and development in emerging technologies in an AI White Paper. See: [Robots can work alongside spies to detect enemy threats to UK, Tom Tugendhat says \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/ukdefence/2023/03/30/robots-can-work-alongside-spies-to-detect-enemy-threats-to-uk-tom-tugendhat-says/)

## ➤ 9 April 2023

Vladimir Putin has often complained of the West waging a “proxy” war in Ukraine by supplying Kyiv with training and technology to fight back against Russian troops. Yet even as Russia's leader convinces himself that he is the injured party, the Kremlin has been waging its own shadow fight against Europe and its allies, explains Gareth Corfield in *The Telegraph*.

Cyber-attacks on NATO nations and their allies originating in Russia have been ramping up in recent months, forcing the public and private sectors alike to beef up their defences. “Europe was dragged into a high-intensity hybrid cyber-war at a turning point in the conflict,” says Pierre-Yves Jolivet, a senior cyber security executive at French defence giant Thales, who noted a significant increase in attacks at the end of last year.

Last summer there were 85 cyber conflict-related incidents in EU countries, according to Thales. Over the same time period its experts saw 86 cyber incidents take place in Ukraine itself. Nicolas Quintin, a cyber security researcher with Thales, says: “Starting in May 2022, we've seen attacks in all of Europe. “As soon as a country is, for instance, providing Ukraine with weapons or as soon as the country is blaming Russia’s actions, they react immediately in a very organised manner. Read on at: [Putin’s cyber shock troops turn their sights on Nato \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2023/04/09/putin-cyber-shock-troops-turn-their-sights-on-nato/)

## ➤ 14 April 2023

Gareth Corfield and Howard Mustoe advise that software updates delivered mid-flight to Typhoon fighter jets could see battlefield threats eliminated faster than ever before. New technology is paving the way for on-the-fly software updates to fighter jets, warships such as the Type 26 frigate, and battlefield drones. In trials driven by a partnership between BAE Systems and Microsoft unveiled on Friday, new software has been deployed in-flight to military surveillance drones, paving the way for the technology to be used on manned fighters such as the Typhoon.

BAE’s chief technical officer Julian Cracknell said rapid updates to battlefield technology were proving decisive in the ongoing war in Ukraine. “If you look at what is happening in Ukraine, they have adapted their technology really rapidly over the last year and that has served the Ukrainians really well,” said Mr Cracknell. “Think about Typhoon, particularly the sensors on that platform,” he added. “In the future we’d want to be able to update and adjust those as new threats develop and as new weapons systems are developed, and to do that at the pace that technology moves at.”

Traditionally, military aerospace is a slow-paced sector thanks to regulatory and safety requirements. The Eurofighter Typhoon contains 24 million lines of software code, meaning updating it is normally a time-consuming process. Microsoft’s Azure cloud computing service, normally associated with the US tech company’s internet hosting business, is being used to speed up the development of new software. The cloud service has also helped BAE create live updating “digital twins” of warships such as the Royal Navy’s incoming Type 26 class frigates to ease maintenance in port.

Clare Barclay, Microsoft’s UK chief executive, said: “This strategic agreement will enable defence organisations to use data more effectively. This will help them promote stability and security for residents, nations and multinational alliances.” It comes as investment in fighter jet technology continues to grow. The Ministry of Defence said it will release another £656m of funding for the £2bn next-generation Tempest warplane programme, led in the UK by BAE Systems.

The programme kicked off with £250m of funding in 2021 as BAE and partners including Rolls-Royce prepare a prototype for flight later this decade. The supersonic aircraft will offer next-generation radar together with the ability to control drone swarms and is expected to fly with the RAF from 2035. Tempest is expected to replace the Eurofighter Typhoon in RAF service. See: [Typhoon fighter jets to instantly tackle new threats with in-flight software updates \(telegraph.co.uk\)](#)

#### ➤ 19 April 2023

Gareth Corfield reports that Western nations are battling a surge in Russian hacking activity as Vladimir Putin's cyber troops set their sights on critical infrastructure, GCHQ chiefs have warned. Cabinet Office minister Oliver Dowden said Russian-aligned hackers want to "disrupt or destroy" critical infrastructure such as power stations. He added: "These are fringe state threats – the cyber equivalent of the Wagner group – and initially these groups focused their attacks on Ukraine and the surrounding region. "But recently, they have begun to turn their attention to the UK and its allies."

Criminal hacker groups in Russia have increasingly been targeting Western countries in recent months, especially NATO members supporting Ukraine. Experts say that "patriotic" young Russians are carrying out cyber-attacks against Western organisations and businesses. Paul Chichester, the NCSC's operations director, said: "From our tracking and understanding of the Russian cyber ecosystem, we're certainly seeing individuals and groups who are more on that edge between cybercrime and patriotic hacking. They're taking that interest and having those conversations around just how they can use those skills to pursue what they believe are patriotic aims."

NCSC bosses have issued a formal warning to critical national infrastructure operators to caution them about the renewed threat. Lindy Cameron, chief executive of the NCSC, said: "If the UK is to be the safest place to live and work online, then resilience must urgently move to the top of our investment shopping list." The warnings come after an investigation alleged that Russia has a programme to sabotage wind farms, gas pipelines and power cables in the North Sea. Public broadcasters in Denmark, Norway, Sweden and Finland reported that Russia was using disguised ships to carry out underwater surveillance and map key sites for possible disruption. Now read further at: [Russian hacking is surging as Putin targets Britain, warn spy chiefs \(telegraph.co.uk\)](#)

#### ➤ 26 April 2023

Jorg Luyken and Danielle Sheridan report that Eurofighters (Typhoons) have been scrambled to observe three of Putin's planes in international airspace. See: [British jets intercept Russian warplanes over Baltic Sea \(msn.com\)](#)

And Hamish De Bretton-Gordon and Tobias Ellwood write that "The Kremlin's army has been decimated. Beijing, meanwhile, is building a massive new force. We must deny China the economic access it needs." Read: [Politics: Latest news & updates - The Telegraph - The Telegraph](#)

Finally, with China in mind, see: [West must unite against China's autocratic AI, warns Clegg \(telegraph.co.uk\)](#)

# SPACE



*The UK seen from the International Space Station*

Space plays a critical role in our daily lives. Satellites orbiting the Earth from only 160 kilometres above our heads keep us connected with our friends, families, and colleagues. They support our present and future security and prosperity, enable us to navigate the oceans, keep our troops safe, monitor the climate and forecast the weather. And the space sector is a vital part of the UK's economy, worth over £16.4 billion per year and employing over 45,000 people in diverse and exciting roles as scientists, engineers, entrepreneurs, and innovators.

Space presents significant opportunities; the global space economy is projected to grow from an estimated £270 billion in 2019 to £490 billion by 2030. Constellations of satellites are being launched to deliver worldwide services. New state and commercial space stations are being planned and built. And space tourism operators are flying their first customers into space. However, as the opportunities have grown, so too have the threats; our potential adversaries are developing capabilities that will put our people, equipment and information networks at risk and make it harder to protect the UK. Space is changing - the UK must respond.

This first ever National Space Strategy brings together the UK's strengths in science and technology, defence, regulation, and diplomacy to pursue a bold national vision. This strategy identifies five goals and the activities that government, academia and industry will need to take to achieve them:

## ***The UK's Vision***

*We will build one of the most innovative and attractive space economies in the world, and the UK will grow as a space nation. We will protect and defend the UK's interests in space, shape the space environment and use space to help solve challenges at home and overseas. Through cutting edge research, we will inspire the next generation and sustain the UK's competitive edge in space science and technology.*

## ***The UK's Goals***

- *Grow and level up our space economy.*
- *Promote the values of Global Britain.*
- *Lead pioneering scientific discovery and inspire the nation.*
- *Protect and defend our national interests in and through space.*
- *Use space to deliver for UK citizens and the world.*

## ***How we will achieve the goals***

- *Unlocking growth in the space sector.*
- *Collaborating internationally.*
- *Growing the UK as a science and technology superpower.*
- *Developing resilient space capabilities and services.*

## ***The 10-point plan***

*Immediate key interventions in the highest impact opportunities and the critical cross-cutting enablers. The UK has built a thriving space economy with end-to-end support for space enterprises. We have a renowned science and technology sector, a strong talent pipeline, and leading satellite manufacturing and operations capabilities. Highly innovative British companies have built mature global supply chains. And from 2022 the first launches into space from the UK will take place. On the ground, British scientists and businesses have the skills and technologies to interpret and use the data we get from space, providing modern and innovative services to us all. And our broader strengths, from our modern regulatory regime to world-class financial and legal services, make the UK a fantastic place to start, invest in, and grow a space business.*

*The UK excels in the manufacture of satellites, spacecraft, highly complex payloads, end-to-end satellite service delivery, satellite communications, and high-end navigation systems. We have ambitious plans to build new leadership in high growth areas, such as Earth Observation, navigation applications and services, and satellite broadband. And we will work to establish early leadership in potential and emerging markets such as in-orbit servicing, space travel and habitation, and active debris removal.*

*We will take action to unlock growth in the UK space sector, using government to unleash the potential of our industry, entrepreneurs, and innovators. This will include:*

- *ensuring innovative space businesses can access private finance through space-oriented venture capital funds, such as Seraphim Space Investment Trust, supported by the British Business Bank*

- *leading the world in modern space regulation, and building new space trading partnerships with the world, building on the success of the UK-Australia ‘space bridge’.*

*We will collaborate internationally with our partners and allies to achieve our goals, including:*

- *maintaining our role in the European Space Agency whilst building new and enhanced bilateral relationships with countries such as the United States;*
- *working at the UN to deliver leadership on a safe, sustainable, and secure space environment, in particular to deliver a new resolution on space threats.*

*We will grow the UK as a science and technology superpower, participating in the most exciting research opportunities. This will include:*

- *returning samples from Mars to the Earth for the first time and monitoring the sun for space weather events like solar flares;*
- *collaborating on the NASA-led Artemis programme to return humans to the Moon.*

*We will upgrade the UK’s space capabilities, that are crucial to so many of our civil and defence functions. This will include:*

- *delivering the UK’s first Defence Space Portfolio, investing £5 billion over 10 years in the military’s satellite communications and £1.4 billion in new technologies and capabilities;*
- *becoming the first country to launch a rocket into orbit from Europe in 2022 with the aim of becoming a leader in commercial small-satellite launch.*

Continuing now with our usual chronological news reports:

#### ➤ **12 August 2022**

Matthew Field reports in The Telegraph that the European Space Agency (ESA) is in talks with Elon Musk’s SpaceX to take on launches for Brussels after the West was blocked from using Russia’s Soyuz rockets. The US rival to France’s Arianespace is in technical discussions with the bloc’s space authority to provide capacity for upcoming missions. The EU had been planning to use French-built Ariane 6 rockets for future space flights, but these have been repeatedly delayed, prompting talks with rivals to provide a stopgap.

Josef Aschbacher, ESA Director General, told Reuters that SpaceX, India and Japan were in the frame to provide launch services. He said: “One is SpaceX, that is clear, another one is possibly Japan. Japan is waiting for the inaugural flight of its next generation rocket. Another option could be India.” Work for the space agency would add another key client for SpaceX which was founded by Tesla billionaire, Mr Musk. The rocket company has repeatedly secured launch contracts from the US Department of Defence.

➤ **17 August 2022**

The US Navy has awarded British satellite operator Inmarsat a \$578m (£478m) contract ahead of its takeover by an American rival (Viasat). Inmarsat said it had secured the multi-million pound deal to develop and maintain a satellite communications network for the US Navy Military Sealift Command. The US Navy's Sealift division provides logistics, transportation and cargo capacity to its armed forces. This includes operating tankers that refuel larger vessels, running ammunition ships and cargo carriers, and crewing the US Navy's Mercy ships, which are supertankers converted into floating hospitals. Other services include tugs, salvage ships and floating naval radar platforms.

Under the 10-year contract, Inmarsat will maintain satellite and ground communications technology for the Navy branch. It will also upgrade its current communications technology to Inmarsat's more advanced "Xpress" network and L-band spectrum. Susan Miller, Chief Executive of Inmarsat Government, said the company planned "significant enhancements" to its satellite communications coverage and resilience. The deal provides a boost to Inmarsat's sales after years of stagnant revenue growth. Revenues at Inmarsat fell 7.9pc in 2020, due to a collapse in flight traffic, recovering 6.3pc in 2021 to just over £1bn, according to its accounts. Read on at: [Britain's biggest satellite company wins \\$500m US Navy contract \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2022/08/17/britain-s-biggest-satellite-company-wins-500m-us-navy-contract/)

➤ **31 August 2022**

Joe Pinkstone writes in the Telegraph that humans have moved a step closer to settling on Mars after oxygen was created on the planet for the first time. NASA has successfully generated oxygen through its instrument named Moxie. Mounted to the Mars Perseverance rover, the toaster-sized device works by splitting the carbon dioxide-rich atmosphere.

Any hopes to send humans to Mars in the next 20 years depend on the ability to make oxygen on the surface for the astronauts. Moxie has been turned on seven times since February 2021 and run at full tilt for an hour at a time, with each test done in different conditions, including various seasons, daytime and night-time. NASA found that about 50 grams worth of oxygen was made during the seven cycles, which the builders of Moxie at MIT say is akin to the productivity of a small tree.

Moxie stands for Mars Oxygen In-Situ Resource Utilisation Experiment and involves a high-quality air filter cleaning detritus from the atmosphere, and then compressing the wispy atmosphere - which is 95 per cent CO<sub>2</sub> - to the same pressure of Earth's air. It is also heated to 800°C before being transferred to a custom-built tool called SOXE. SOXE - solid oxide electrolysis - passes electricity from an anode to a cathode to convert CO<sub>2</sub> into carbon monoxide (CO) and oxygen. See: [Humans a step closer to Mars after Nasa creates oxygen from its atmosphere \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2022/08/31/humans-a-step-closer-to-mars-after-nasa-creates-oxygen-from-its-atmosphere/)

➤ **7 September 2022**

Howard Mustoe reports that Britain's top defence firm, BAE Systems, plans to launch a quartet of satellites into orbit featuring a suite of sensors designed to scour the skies for threats. The move comes amid a flurry of tests by Russia and China of hypersonic missiles, which travel more than five times the speed of sound. BAE is expanding its push into satellite engineering after buying In-Space Missions, which gave it the ability to design, build, launch and operate satellites.

The Azalea group of satellites will collect visual, radar and radio data to “boost the UK’s ability to understand the threats and hazards in, from and through space,” BAE Systems said. Heat signatures from rockets, missiles and jet engines can be detected by the satellites’ sensors and packaged with other local data for analysis by the military.

Also he writes, a Russian bomber fired a trio of Kinzhal Mach-12 hypersonic missiles at the port city of Odessa in May, the first known use of the weapon and the first claimed use of hypersonic arms in a war. It followed test launches in April and March. China last year reportedly test-fired a hypersonic projectile around the globe, while in May a Russian warship successfully fired a Zircon cruise missile that can travel for almost 1,000 miles.

Currently, typical missiles fly at about Mach 3. Hypersonics are defined as travelling at at least Mach 5, about 3,800mph, or five times the speed of sound in the upper atmosphere. There is a rush to find ways to detect their use. Read on at: [Britain to launch military satellites as China and Russia test hypersonic missiles \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/science/2022/09/27/britain-launch-military-satellites-as-china-and-russia-test-hypersonic-missiles/)

#### ➤ **27 September 2022**

NASA has successfully crashed a spaceship into an asteroid in the first ever "planetary defence test", clearing the way to perhaps one day save humanity from extinction. The mission was the first attempt to alter the movement of a celestial body. It was intended to prove that it is possible to change the course of any future space rock threatening Earth.

The historic test, which has been compared to the plot of the Hollywood movie 'Armageddon', involved sending a \$325 million spacecraft called DART [Double Asteroid Redirection Test] on a 10-month kamikaze journey. In the early hours of Tuesday morning DART, which was about the size of a large fridge and moving at 14,000mph, ploughed into an asteroid called Dimorphos, which is about the size of a football stadium. Lori Glaze, NASA's planetary science division director, said: "We are embarking on a new era of humankind." See: [Nasa's DART crashes into asteroid in historic defence test to protect humanity \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/science/2022/09/27/nasa-dart-crashes-into-asteroid-in-historic-defence-test-to-protect-humanity/)

#### ➤ **October 2022**

This month in AERO SPACE, as NASA’s Artemis 1 gets set to launch “with Space X’s Starship programme snapping at its heels” Stephen Bridgewater looks at a very 21<sup>st</sup> century ‘race for space’ pitting private versus government giant rockets against each other.

#### ➤ **12 November 2022**

Sarah Knapton writes in The Telegraph that a small Japanese spacecraft will launch and embark on a three-month journey to land on the Moon. Although the mission has gone largely under the radar, it is set to usher in an entirely new era of space use, marking the first time that a private company has done business on the lunar surface. The company, Ispace, will be collecting regolith – the grey sandy Moon dust which covers the surface of the satellite – and selling it to NASA. Although the contract is for a nominal \$5,000 (£4,200), it will be the first business transaction ever to take place off-Earth.

The mission raises important questions about who owns the Moon, or any other space resource, and who should be allowed to exploit it. Last year, Japan passed a law granting Japanese companies

permission to prospect for, extract and use, various space resources. Last week, it granted Ispace a licence to conduct business activity on the Moon.

The Ispace lander will collect regolith and will transfer ownership of its resources on the Moon to NASA. Sanae Takaichi, Japan's space policy minister, said: "If Ispace transfers ownership of lunar resources to NASA in accordance with its plan, it will be the first case in the world of commercial transactions of space resources on the Moon by a private operator. "This will be a ground-breaking first step toward the establishment of commercial space exploration by private operators." Read on at: [First private firm flies to the Moon to mine dust \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/science/space/2022/11/15/first-private-firm-flies-to-the-moon-to-mine-dust/)

#### ➤ 15 November 2022

Matthew Field and Oliver Gill report that Cornwall is to be given the green light to host the UK's first space rocket mission - but Sir Richard Branson faces a further wait before Virgin Orbit is given permission to blast off from British soil. Spaceport Cornwall, the converted airport in Newquay that will serve as the base for Virgin Orbit's mission, is expected to be granted a spaceport licence by regulators as early as Wednesday, according to multiple sources. The Civil Aviation Authority (CAA) is also expected to announce it is in the process of granting a second licence to launch spacecraft from a base in the Shetland Islands.

But Sir Richard's hopes of taking off from the UK remain bogged down in red tape after months of delays. The CAA is yet to grant the billionaire's satellite venture its own operating licence. Officials were last night putting the final touches to plans to approve Spaceport Cornwall. They have now asked for ministerial consent, which could be announced as early as Wednesday. A CAA spokesman declined to comment. The decision would clear a key hurdle in the way of the maiden satellite launch from the British Isles, more than 50 years after the British-made Black Arrow rocket reached orbit from the Australian outback.

Virgin Orbit plans to fly a converted Boeing 747, called Cosmic Girl, from Spaceport Cornwall to a height of 35,000 feet above the ocean, before a rocket, LauncherOne, is dropped from under its wing and blasts into orbit. Its current launch window runs until the end of December. Industry sources have bemoaned the slow progress of signing off the debut rocket launch, but the CAA has defended its process, arguing it was committed to securing a safe mission. Read on at: [Cornwall to win approval for first UK spaceport \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/science/space/2022/11/15/cornwall-to-win-approval-for-first-uk-spaceport/)

#### ➤ 19 November 2022

Humans could stay on the Moon for lengthy periods during this decade, a NASA official has told the BBC. Interviewed by Laura Kuenssberg from the BBC, Howard Hu, who leads the Orion lunar spacecraft programme for the agency, said humans could stay on the Moon for lengthy periods during this decade. He went on to say that Wednesday's launch of the Artemis rocket, which carries Orion, was a "historic day for human space flight".

Orion is currently about 134,000km (83,300 miles) from the Moon. The 100m-tall Artemis rocket blasted off from the Kennedy Space Center as part of NASA's mission to take astronauts back to Earth's satellite. Sitting on top of the rocket is the Orion spacecraft which, for this first mission, is uncrewed but is equipped with a manikin which will register the impacts of the flight on the human

body. Wednesday's flight followed two previous launch attempts in August and September that were aborted during the countdown because of technical problems.

Mr Hu told Laura Kuenssberg that watching Artemis lift off was "an unbelievable feeling" and "a dream". "It's the first step we're taking to long-term deep space exploration, for not just the United States but for the World," he said. Mr Hu explained that if the current Artemis flight was successful then the next would be with a crew, followed by a third where astronauts would land on the Moon again for the first time since Apollo 17, 50 years ago in December 1972.

The current mission was proceeding well, he told the BBC, with all systems working and the mission team preparing for the next firing of Orion's engines (what is known as a burn) at lunchtime on Monday to put the spacecraft into a distant orbit of the Moon. Read on at: [Artemis: Nasa expects humans to live on Moon this decade - BBC News](#)

### ➤ **December 2022**

Bella Richards reports from the 2022 RAeS President's Conference which this year themed around the fast growing and dynamic 'New Space' sector. See AERO SPACE, December 2022 edition.

### ➤ **3 December 2022**

Jacob Paul writes in the Daily Express that a UK rocket company that is developing ground-breaking space technology that could one day take humans to planets outside our Solar System has received a major boost after receiving Government funding. Pulsar Fusion is working on harnessing the same power as the Sun to create a nuclear fusion-powered rocket that could travel distances far surpassing any other space vehicle in operation today.

Having already completed flagship tests in Switzerland and the UK earlier this year, the firm is one of a number of rocket companies racing to take humans to Mars and beyond as the industry sets its ambitions high for the future of space travel. In an important step forward for the Bletchley-based firm, they have been awarded funding from the UK Space Agency (UKSA) to develop 'Integrated nuclear fission-based power systems for electric propulsion'.

Fusion rocket technology only works in the vacuum of space. Because of this, Pulsar has had to develop hybrid rocket engines which lay the groundwork for Pulsar's hyper-speed propulsion engines. Richard Dinan, CEO of Pulsar and the former star of the reality show Made in Chelsea, previously told Express.co.uk that this type of rocket technology could slash the time it takes to get to Mars and could one day allow humans to inhabit other planets outside of our Solar System.

### ➤ **12 December 2022**

Sky News reports that NASA's Orion spacecraft has successfully splashed down in the Pacific Ocean after a 25-day mission around the Moon. The uncrewed capsule, which is designed to carry astronauts during future trips, landed near Guadalupe Island shortly after 5.40pm UK time. The spacecraft approached Earth at 25,000 mph, slowed to around 325 mph after entering the atmosphere, before deploying eleven parachutes and dropping to less than 20 mph. It is part of the Artemis-1 mission which is ushering in a new era of lunar exploration.

Whilst the Artemis-I mission has been about testing systems, the Artemis-II flight test will include astronauts who will fly around the Moon. If successful, Artemis-II will pave the way to land the first woman, and the next man, on the Moon as part of Artemis-III. The Artemis missions are part of NASA's long-term plans to build a space station in lunar orbit called Lunar Gateway where astronauts will be able to live and work.

#### ➤ **21 December 2022**

Matthew Field reports in The Telegraph that “Sir Richard Branson was hoping for a Christmas miracle. His rocket company, Virgin Orbit, had been racing to launch the first ever space mission from British soil by the end of the year. Those hopes were dashed, however, after technical problems and delays in securing an operating licence.

At least one of those issues [however] has now been fixed. On Wednesday, the Civil Aviation Authority (CAA) finally gave Virgin a launch licence. “Everyone is working together - targeting a safe and successful mission in the coming weeks,” according to a Virgin Orbit spokesman.

Virgin aims to fly a Boeing 747 from Newquay Airport, now known as Spaceport Cornwall, at up to 35,000ft over the North Atlantic. The plane will return to the spaceport, while the rocket will ignite its engine and take multiple small satellites into orbit. Read on at: [Britain's space industry gets ready for blast off \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/science/space/2022/12/21/virgin-orbit-launch-licence/)

#### ➤ **January 2023**

Richard Lowe explains in this month's edition of AERO SPACE that 2022 was an historic year in space exploration and asks, “What is on the horizon for 2023?”

#### ➤ **16 January 2023**

Anthony Cuthbertson writes in The Independent that SpaceX has used its most powerful operational rocket to successfully launch a classified mission for US Space Force on Sunday. The USSF-67 mission lifted off from Launch Complex 39A at Kennedy Space Center in Florida at 5.56pm local time in what was only the fifth ever launch of the Falcon Heavy rocket.

The private space firm gave no details of the payload and cut the launch live stream after the boosters detached in order to not disclose its final orbital position. Officials at Space Force's Space Rapid Capabilities Office (SRCO) said the payload includes “two operational prototypes for enhanced situational awareness and an operational prototype crypto/interface encryption payload providing secure space-to-ground communications capability”. The main satellite will be positioned in a geostationary orbit 35,700km above Earth, the US government agency said, serving as communication relay to support “senior leaders and combatant commanders”.

The Falcon Heavy rocket, which consists of three modified versions of its Falcon 9 rocket, is capable of generating 5 million pounds (2.3m kg) of thrust at lift-off, making it the most powerful rocket ever launched before November last year when NASA's Space Launch System (SLS) overtook it when it lifted off for the Artemis 1 mission. SpaceX will get a chance to beat NASA's record as early as next month when it attempts the first ever launch of its Starship and Super Heavy Booster rocket stack from

its Starbase facility in Texas. The Super Heavy rocket is projected to produce 7.25 million kg of thrust – nearly double that of Nasa’s SLS – thanks to 33 Raptor engines firing simultaneously. Read: [SpaceX uses ultra-powerful rocket for mystery military mission | The Independent](#)

### ➤ February 2023

See “Did ‘start me up’ start something?” by Bella Richards, an article in February’s AERO SPACE which explores what the attempt by Virgin Orbit’s programme achieved for the UK space industry.

### ➤ 8 February 2023

Elizabeth Howell explains in Space News that Virgin Orbit is within reach of establishing what went wrong on its first U.K. mission. The debut Cornwall orbital launch of Virgin Orbit, called "Start Me Up" after a famous Rolling Stones song, had a rocket failure on 9 January 2023 after LauncherOne was fired from underneath the firm's modified Boeing 747. A problem in the rocket's second-stage engine may have caused the issue, officials said Tuesday (7 Feb.) in a conference attended by SpaceNews.

"Everything points, right now, to a filter that was clearly there when we assembled the rocket but was not there as the second stage engine started, meaning it was dislodged and caused mischief downstream," CEO Dan Hart said at the Small Sat Symposium in Mountain View, California. Investigation is ongoing and there might be other issues to solve as well. But if this is indeed the cause, "this is a \$100 part that took us out," Hart added.

Both Virgin Orbit and the U.K. Space Agency have launched investigations into the failure, which took down nine small satellites along with the rocket. The company's carrier plane, known as Cosmic Girl, was undamaged in the anomaly as the problem took place several minutes after the rocket was deployed from the aircraft once the rocket's second stage fired.

The Cornwall launch was an historic effort for Virgin Orbit, after five previous orbital flights originating from the Mojave Air and Space Port in south-eastern California. It was also very important for Spaceport Cornwall which is looking to attract space missions there amid stiff competition for the first-ever U.K. launch.

The U.K. announced in 2014 it would create infrastructure for small satellite launches in a fast-growing global space market, and is already host to such names as Airbus, Surrey Satellite Technology and Clyde Space. Furthermore, Cornwall is not the only site aiming for space: Vertical micro-rocket lift-offs are scheduled for later this year at SpaceHub Sutherland in the north of Scotland, and SaxaVord Spaceport on the Shetland Islands off the Scottish coast.

### ➤ 3 April 2023

The Guardian reports that NASA has named the first woman, and the first African American ever, assigned as astronauts to a lunar mission, introducing them as part of the four-member team chosen to fly as early as next year on what would be the first crewed voyage around the Moon in more than 50 years.

Christina Koch, an engineer who already holds the record for the longest continuous spaceflight by a woman, was named as a mission specialist, along with Victor Glover, a US Navy aviator, who was selected as the Artemis II pilot. Glover, who was part of the second crewed flight of a SpaceX Crew Dragon capsule, would become the first astronaut of colour ever to be sent on a lunar mission.

Rounding out the four-member crew are Jeremy Hansen, the first Canadian chosen for a flight to the Moon, serving as a mission specialist, and Reid Wiseman, an International Space Station veteran, named as Artemis II mission commander. See: [Nasa names first female and African American astronauts on a lunar mission | Nasa | The Guardian](#)

Additionally this day Sarah Knapton reports in The Telegraph that NASA may have collected the first evidence of life on Mars... but it will take us ten years to find out. Last week, NASA's Perseverance rover drilled down into a rocky outcrop - dubbed Berea - which likely formed from deposits carried downstream by an ancient river that flowed well beyond the Jezero crater that the rover has been exploring.

The rock is sedimentary and composed of carbonate minerals which, on Earth, often contain fossils. NASA is planning to bring the samples to Earth, alongside dozens of others that it is collecting from the Jezero crater - the site of an ancient Martian lake. But the samples are not due to arrive here until 2033, meaning scientists face an agonising wait to find out whether the precious cores really do contain proof that life once existed on the Red Planet.

Katie Stack Morgan, deputy project scientist for Perseverance at NASA's Jet Propulsion Laboratory in Southern California, said that Berea rock is one of the best hopes of finding life.

#### ➤ 4 April 2023

Matthew Field in The Telegraph writes that "Virgin Orbit crashes to earth as Sir Richard Branson loses patience." This morning Virgin Orbit confirmed it would place the company into bankruptcy. Sir Richard has agreed to spend \$10.9m to honour employee severance packages. A further \$32.6m in so-called 'debtor in possession' funding will keep a skeleton crew manning the company's operations while the bankruptcy goes through the US courts. Sir Richard wants to ensure an orderly transition in an effort to salvage something of the business. Read on at: [Virgin Orbit crashes to earth as Sir Richard Branson loses patience \(msn.com\)](#)

#### ➤ 9 April 2023

DNYUZ reports that SpaceX is on the cusp of sending its Starship – on the top of the most powerful rocket ever built – into orbit, in the key first test of the reality of life on Mars. The company is hoping to carry out a launch rehearsal on Monday, bringing founder Elon Musk one step closer to his dream of colonising the Red Planet.

SpaceX this week published photos of the massive Starship, which is designed to eventually send astronauts to the Moon and beyond, on its launch pad at the company's base in Boca Chica, Texas. "Starship fully stacked at Starbase," SpaceX said in a tweet. "Team is working towards a launch rehearsal next week followed by Starship's first integrated flight test ~ week later pending regulatory approval."

SpaceX will need a green light from the Federal Aviation Administration (FAA) before being allowed to carry out the test launch. Eagle-eyed space-watchers pointed out that the FAA planning document listed a launch April 10 with backup days of April 11 and 12. If all goes to plan, the orbital flight will lift off from Texas before landing off the coast of Hawaii.

The company conducted a successful test-firing of the 33 Raptor engines on the first-stage booster of Starship in February. The 230-foot Super Heavy booster, which out-performs even the massive Saturn V that first sent NASA astronauts to the moon, was anchored to the ground during the test-firing, called a static fire, to prevent it from lifting off. Read further at: [SpaceX poised for giant leap toward Musk's dream of colonies on Mars \(dnyuz.com\)](#)

➤ **14 April 2023**

The European Space Agency has launched its ground-breaking mission to Jupiter's moons on the second attempt on Friday. The six-tonne probe, named Juice, was launched on an Ariane 5 rocket from Europe's spaceport in Kourou, French Guiana, at around 1.15pm UK time. It comes after the first launch attempt was [cancelled on Thursday due to the threat of lightning](#), temporarily pausing the agency's first attempt to send a spacecraft to orbit another planet's moon. Scientists are attempting to determine whether Jupiter's ocean-bearing moons could support life. After lift-off, Juice is expected to separate from the rocket about half an hour later and embark on a 4.1 billion-mile journey that will take more than eight years. See: [Juice: Jupiter mission achieves lift off on second attempt \(telegraph.co.uk\)](#)

➤ **20 April 2023**

Alex Therrien reports for the BBC that “At the start of the day the question on the lips of those following Starship's planned test launch was whether lift off would even happen. On Monday, a first launch of SpaceX's rocket - the most powerful ever built - was halted because of a frozen valve. So when Starship's launch on Thursday was paused moments before blast-off, it felt like deja-vu. Then there was lift-off. Starship blasted off into the Texas sky, but minutes into its flight it exploded after its booster failed to separate.

Despite the explosion, SpaceX will still see the launch as a success that can be built on. SpaceX founder, Elon Musk, said there would be another test flight in a matter of months. We'll be here again when that happens”.

➤ **22 April 2023**

Tim Marshall explains [Why Elon Musk is really firing America back to the Moon \(telegraph.co.uk\)](#)



# AEROSPACE & THE ENVIRONMENT



**The Rolls-Royce Ultra Fan**

UltraFan is a demonstrator aero engine – the largest in the world – containing a suite of new technologies that deliver greater fuel efficiency, which in turn means lower emissions and greater sustainability. Those technologies are scalable, capable of being developed to create an engine with a thrust range of 25,000lb to more than 100,000lb, for narrowbody or widebody aircraft that may be developed from the 2030s.

In parallel, some of the technologies could be applied to Rolls-Royce’s current in-service engines to deliver even greater efficiency and sustainability in the nearer term. The UltraFan demonstrator is designed for the future – it will be ready to run on 100% Sustainable Aviation Fuel from day one of service. In addition, the company is actively exploring potential options for hybrid-electric and hydrogen power solutions.

In this Newsletter we introduce ‘Sustainable Aviation’, a long-term strategy which sets out the collective approach of UK aviation to tackling the challenge of ensuring a cleaner, quieter, smarter future for the aviation industry. The following is an extract from their website:

## *Cleaner*

*Sustainable Aviation is committed to delivering a cleaner future for our industry. Our goal is to reduce net CO<sub>2</sub> emissions by 50% by 2050 while accommodating a doubling of demand and play our part, alongside national and local government, in improving air quality around airports.*

## *Climate Change*

*We have de-coupled aviation growth from growth in emissions: between 2010 and 2016 passenger numbers in the UK grew by 27%, while total emissions only grew by around 0.2%. This is as a result of the development and introduction of new aircraft technology and improved air traffic management. SA airlines have improved their fuel efficiency by almost 12% whilst airports have invested in reduced energy use on airfields have further supported the de-coupling.*

*We expect further progress to be made in the coming years. A further 360 new aircraft are currently on order by UK airlines, which will improve the fleet-average fuel efficiency of UK aviation by 22% by 2050, and aerospace manufacturers are already investing in the next generation of engines and aircraft, with research into hybrid-electric and fully electric planes underway.*

*Sustainable aviation fuels are now supported by the UK Government and industry will start to commercialise these, delivering a reduction in emissions of up to 24%.*

*Airspace modernisation across the UK should be completed by the mid-2020s. This could deliver a reduction of up to 14% in emissions by 2050, including through more efficient operational procedures including greater use of continuous climb and descent operations.*

*Market-based measure will play a critical role. The UK Government, supported by industry, has achieved a world first with a global deal on aviation emissions (CORSIA) at the International Civil Aviation Organisation (ICAO). No other transport mode has an equivalent deal, which aims for carbon-neutral growth from 2020. This is a crucial step towards our objective of halving net emissions by 2050.*

## *Air Quality*

*In 2016, Sustainable Aviation examined aviation's contribution to air quality. We found that most of the impact near to airports comes from road traffic, of which only a part is airport related.*

*However, we are committed to playing our role to improve air quality. Airports, airlines and ground handlers are developing and trialling low-emissions vehicles airside as well as reducing emissions from airfield operations, for example through the increased use of on-stand electricity and pre-conditioned air.*

*We are also working with local and national government to improve surface access to airports and encourage sustainable transport use.*

*We are producing a Best Practice Guide on aircraft turnarounds, setting out practical steps to reduce emissions that impact air quality and urging the government to extend its support for low-emission vehicles to specialist airside vehicles.*

## **Quieter**

*Sustainable Aviation is committed to limiting and, where possible, reducing the impact of aircraft noise. Over the past 50 years aircraft have reduced their noise output by 75% and this progress*

*continues. Today's aircraft entering service have, on average, a noise footprint that is 30-50% that of the aircraft they are replacing thanks to new engine and airframe design and technology.*

*Quieter aircraft have been boosted by improved operating techniques, for example Continuous Descent Operations, which occur on 77% of UK arrivals.*

*Using current UK Government noise metrics, there were 12,000 fewer people living in areas where there is significant impact from aircraft noise around the five largest UK airports in 2016 compared to 2014, despite a 13% rise in passenger numbers.*

*Our Noise Road-Map outlines how we will ensure noise from UK aviation will not increase despite a near doubling in flights over the next 40 years. UK aerospace companies are working on 140 new technology projects worth £700 million with a target to reduce noise by 65% by 2050 and airlines will continue to upgrade to quieter aircraft fleets.*

*We also continue to work with communities to identify and trial new operating techniques, such as steeper approaches, to reduce noise footprints further. The modernisation of our airspace will allow further innovation in operating procedures to reduce noise, including routes designed to enable aircraft to avoid noise-sensitive areas and offer new opportunities for respite.*

*Also, how future building developments around airports are delivered in a way that prevents any extra aircraft noise issues for communities remains an active area of interest for Sustainable Aviation. Our local communities will play a critical role in the future of our industry and our airport members will continue to consult with them on specific local measures to mitigate the impact of noise such as insulation and compensation measures.*

### **Smarter**

*The UK has third-largest aviation network in the world, and the second largest aerospace manufacturing sector. The aviation sector has a turnover of over £60 billion, directly contributes over £22 billion to our GDP and supports almost one million UK jobs, and our aerospace manufacturing sector generates annual exports of £26 billion and employs over 100,000 highly skilled British workers.*

*Sustainable Aviation members invest over £1.7 billion every year on Research & Development and work together to develop sustainable aviation fuels. Our Road-Map\* sets out how these fuels can deliver a cleaner future for our industry whilst providing £265 million to the UK economy and the creation of nearly 4,500 jobs over the next 15 years. The UK's decision to support these through the Renewable Transport Fuels Obligation will enable their roll-out.*

*Sustainable Aviation has also been at the forefront of innovative operational procedures including the development of Continuous Descent and Continuous Climb operations. This world-leading innovation cuts noise significantly by reducing the need for engine use on approach and getting aircraft higher faster on departure. After being created in the UK, this is now being rolled out around the world.*

*Sustainable Aviation members are working with the UK Government on the implementation of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) which means aviation will fund further emissions reductions in other sectors where reductions can be achieved more cost*

*effectively. As a result, over £25bn will be invested in projects with significant socio-economic, health and environmental benefits in addition to carbon reduction.*

*More local environmental initiatives are also regularly considered in Sustainable Aviation, most recently how we can reduce the use of plastics on board aircraft and at airports.*

*\*Sustainable Aviation Carbon Road-Map: A path to Net Zero*

*Our Road-Map (see chart at: [Climate Change | Sustainable Aviation](#)) shows how we can accommodate a 70% growth in passengers by 2050 whilst reducing net carbon emissions levels from just over 30 million tonnes of CO2 per year down to zero through smarter flight operations, new aircraft and engine technology, modernising our airspace, the use of sustainable aviation fuels and significant investment in carbon reductions through smart market-based policy measures.*

Now read on at: [Home | Sustainable Aviation](#). And for the latest news: [News | Sustainable Aviation](#)

**And for further reading on aerospace and the environment see:**

- Aviation and the environment: clean, green and smart technologies for the future. Cranfield University. See: [aviation.environment@cranfield.ac.uk](mailto:aviation.environment@cranfield.ac.uk)
- Project MARTIN – fuel from the air. AERO SPACE, August 2022.
- Grasping the sustainable opportunity. AERO SPACE, October 2022.
- Electrifying, but challenging: The path to sustainability. AERO SPACE, November 2022.
- Net zero: Target 2050. AERO SPACE, December 2022.
- Airbus the view from the summit. AERO SPACE, January 2023.
- Rolls-Royce claims world-first in hydrogen engine run. AERO SPACE January 2023.
- Hydrogen Hurdles. AERO SPACE February 2023.
- Chasing net zero. AERO SPACE, March 2023.



## CAREERS



*GKN Aerospace has reached a major milestone in the ‘Wing of Tomorrow’ programme after designing, manufacturing, and delivering a 4-metre mid-scale demonstrator tool to the GKN Aerospace Filton facility.*

The Schools’ Aerospace Careers Programme is proud to be partnered with GKN Aerospace. Consequently, as we commence in this edition a series of quarterly articles about our partners and the careers opportunities they provide, we begin with GKN, or to give the company its original full name – Guest, Keen and Nettlefolds. Contact details will be found at the end of each article and on our revised website [www.aerospacecareersprogramme.co.uk](http://www.aerospacecareersprogramme.co.uk)

For decades, GKN Aerospace technologies have inspired and industrialized the aerospace industry, combining engineering excellence and technology leadership. Today the company is truly global with 15,000 employees at 38 manufacturing locations in 12 countries around the world. All major aircraft and engine manufacturers rely on their advanced technologies. Their aerostructures, engine systems and special products improve the performance of more than 100,000 flights every day. As they say on their website: “By working closely together with universities, knowledge institutes, suppliers and customers, we lead the industry in developing new technology to improve aircraft efficiency: lowering aircraft cost, weight and emissions.”

GKN Aerospace were among the first to implement lightweight materials like thermoplastic composites and fibre metal laminates in aircraft components 30 years ago, achieving comparative weight savings of around 25% for major passenger aircraft. Since then, they have equipped the

majority of advanced aircraft platforms worldwide with successive generations of the technology including the Airbus A350XWB, A380 and Boeing 737.

Additionally, they continue to highlight the unlimited possibilities of additive manufacturing (AM) - 3D printing - for the aerospace industry and are currently at the cutting-edge of technology leadership worldwide. They manufactured the Ariane 5 rocket engine nozzle and reinforced it with AM wire deposition technologies. Today, GKN Aerospace has five global centres of excellence that enable the most advanced aircraft to take to the sky with ground-breaking AM components.

GKN Aerospace's operational excellence and high-volume production capabilities are now helping drive their global development towards more automation, higher performance and smart industry solutions. The result is shorter production lead times and more affordability for their global customers. But where and when did this all start?

### **The Beginning**

To answer that question one has to go back over 260 years. The story of GKN was forged in the fires of the First Industrial Revolution. It is a story of change and innovation that takes in the birth of rail, the invention of the car, the development of flight, and man's adventures in space. And it started with the founding of the Dowlais Ironworks Co on 19 September 1759 in Dowlais, near Merthyr Tydfil in South Wales. Few could have imagined how this small business would develop during the two and a half centuries that followed.

The Dowlais Ironworks Co venture was capitalised at £4,000 by a group of merchants and ironmasters led by Thomas Lewis. Their venture involved constructing only the second coke-fired furnace in South Wales and taking over land leased until 1848. Eight years later, in April 1767, the Guest family involvement in the business began when John Guest became works manager.



*Dowlais Ironworks*



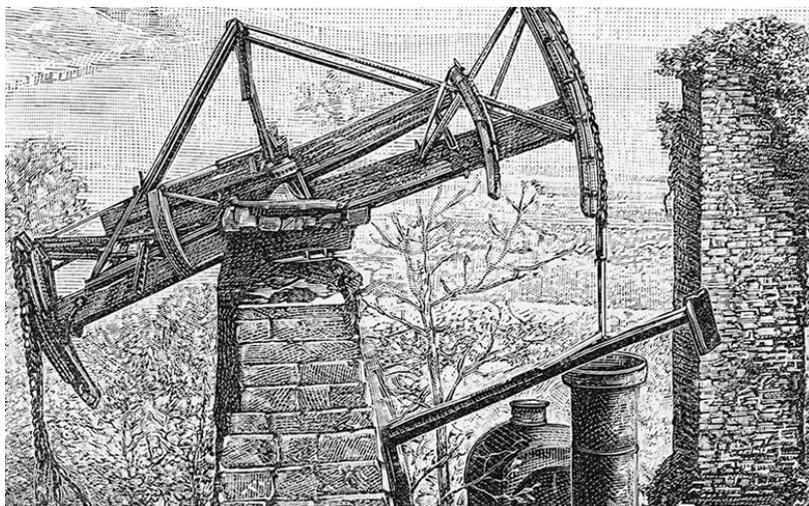
*Sir Josiah John Guest*

The Dowlais Ironworks developed rapidly to meet the thirst for iron as Britain charged through the process of industrialisation, particularly under Josiah John Guest – later Sir John Guest – who took over the running of the company in 1807. During the Napoleonic Wars, Dowlais Ironworks supplied cannonballs to the British army, and by the 1840s had more than 7,300 employees manning 18 blast furnaces and producing almost 90,000 tons of iron a year.

But even as Dowlais Ironworks prospered, a giant shadow loomed over the company. The lease was due to expire on 1 May 1848 and Lord Bute, who had inherited ownership of the land, was determined that Guest should have to pay a heavy price for continuing his business. The terms were so severe that Guest judged that they would make the company unviable and began to run the business down. But then Bute died suddenly at his home in Cardiff Castle. The trustees who took over his affairs entered into new talks and on 21 April 1848, 10 days before the lease was due to expire, a new lease was agreed and Dowlais Ironworks was saved.

GKN and its antecedent companies have endured their share of crises, but never in its long history has the company come closer to extinction than in those dramatic weeks in 1848.

### **The Industrial Revolution**



Dowlais Ironworks was at the forefront of the iron industry that helped build many of the Industrial Revolution's major achievements – from railways to bridges. From the mid-18th century there was a host of industrial innovations that would help revolutionise the world. For example, in textiles, cotton spinning was transformed: first by Richard Arkwright's water frame, then by James Hargreaves' spinning jenny and Samuel Crompton's spinning mule – leading to the development of the mass production factory system. And the new factories came to depend on the steam power provided by the engines developed by Thomas Newcomen, James Watt and Richard Trevithick.



### **A fast track to success**

The growth of the Dowlais works was closely tied to the dramatic development of the railways. In the process the GKN story became linked with many of the great Victorian engineers, the pioneers of the American railroads, and the transformation of 19th century life. The birth of the railways played a huge part in the Industrial Revolution, transforming the transport of goods and people and fuelling a host of supplier industries. Dowlais quickly became one of the industry's key suppliers leading to a huge surge in production and workforce in the first half of the 19th century.



*The opening of the Glasgow and Garnkirk Railway*

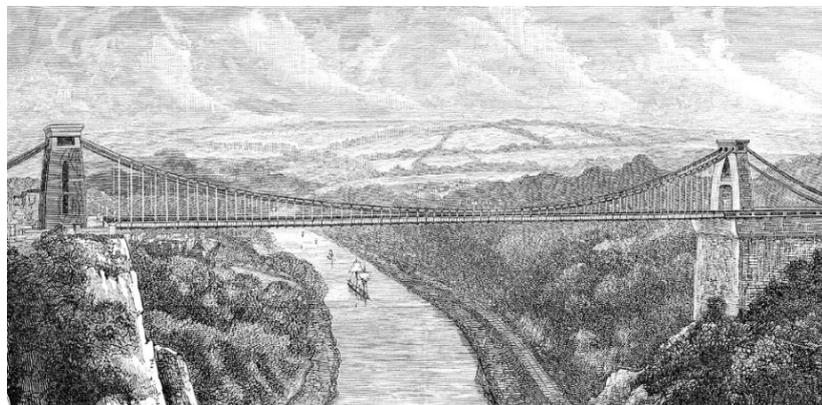
Sir John Guest was instrumental in this growth having worked hard to form close relationships with the emerging rail companies and the great Victorian engineers, most notably Isambard Kingdom Brunel. Dowlais iron was used in the construction of Brunel's most famous railway enterprise: the Great Western Railway linking London's new Paddington station with the west of England and South Wales. Brunel also used Dowlais as a supplier for many of his other projects, including the famous *SS Great Britain* – the first propeller-driven ocean-going iron ship.

Dowlais supplied iron rails to rail companies throughout Britain, but also exported them around the world. From the 1830s, rails were sold to the USA for use in the construction of the new railroads opening up America's frontiers. Then in the 1840s, markets in Europe began to expand with major sales to Russia and Germany, and smaller sales across the continent. Lady Charlotte Guest described a contract made in 1844 to supply 50,000 tons of rail to Russia as, "the largest contract of the kind ever made." As a result of the railway-led boom, Dowlais had, by 1845, become the largest ironworks in the world, and had helped transform the industrialising world.



*Isambard Kingdom Brunel*

Brunel was one of the world's greatest engineers. Despite building the world's first tunnel under a river – the Thames tunnel – it is for railways, bridges and ships that he is really remembered. His most famous railway was the Great Western from London to Bristol that boasted soaring viaducts and vast tunnels, including the famous Box Tunnel. Among his many bridges the Clifton Suspension Bridge had the longest span in the world. And he built the world's biggest iron ships – first the *SS Great Britain* and then the *SS Great Eastern*.



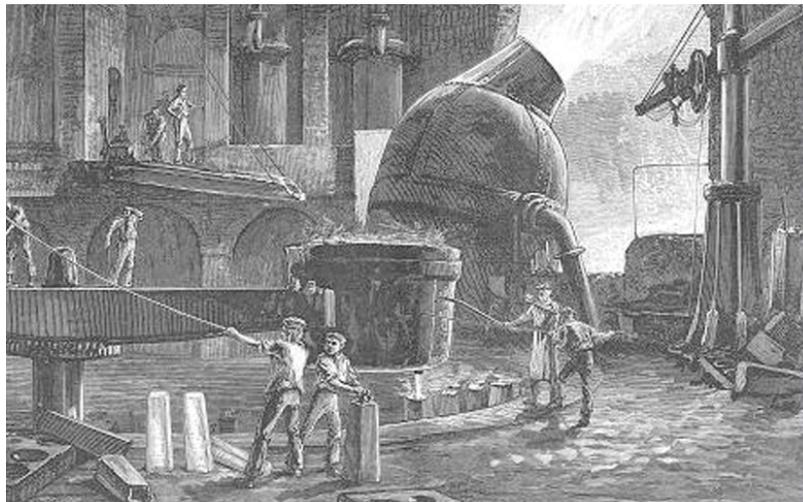
*The Clifton Suspension Bridge*

Lady Charlotte Guest was no eminent Victorian, but she should be. In an age when the business world was completely dominated by men, and when women were not allowed to own property or vote, her achievement was extraordinary. In 1852 Lady Charlotte's husband, Sir John Guest, died at the age of 67. He had been crucial to the development of Dowlais as a business, expanding production not just at the original Dowlais site, but also at plants such as Cyfartha, Plymouth and Penydarren.

Despite the expansion and success there was a range of problems facing Dowlais on Sir John's death. The business was becoming increasingly complex, working conditions in the growing plants were becoming an issue, and the complications over the lease had caused problems. At this crucial point, Lady Charlotte took the reins and led the business through three critical years. She was 40 years old when she became chairwoman of Dowlais – and the mother of 10 children. The advantage Lady Charlotte had was that she knew the business inside out, having immersed herself in it to support and advise her husband. She had drawn up the monthly accounts, been involved in planning and learnt the principles of iron production.

She set about assembling a strong management team to support her son and heir, Lord Wimborne, and oversaw a programme of renovations. Under her management, Dowlais became the world's largest manufacturing company and laid down plans for further expansion, including the sinking of coalmines to supply the works.

### **From iron into steel**



*Bessemer steel production*

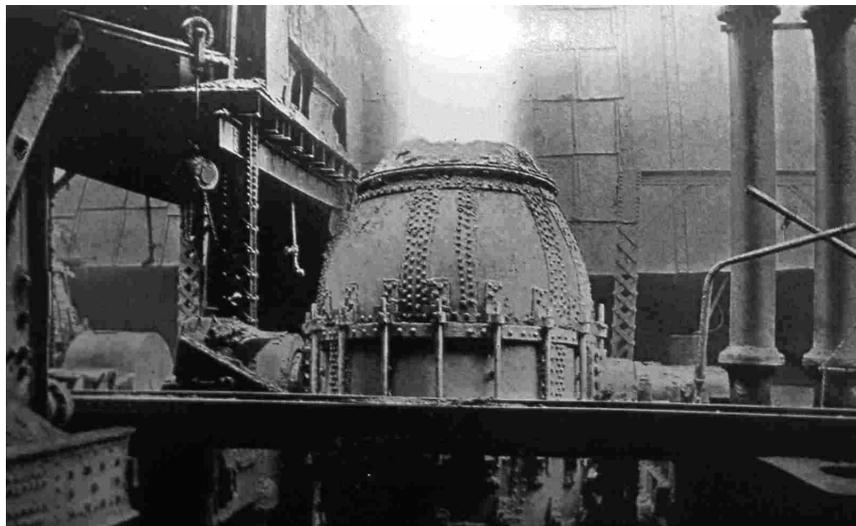
In the 1850s, Dowlais ironworks began the process of transforming itself in response to the evolving demands of the industrial age. The key development was in the shift to steel production – which would enable Dowlais to enhance its position at the leading edge of technological innovation. Iron had been central to the Industrial Revolution, but once the mass production of steel was developed it was soon superseded as the engineer's material of choice. Henry Bessemer made the initial breakthrough in 1856 when he developed the first inexpensive process for the mass production of steel from molten pig iron.

As ever, Dowlais was keen to adopt new methods and so became the first British company to acquire a licence to produce steel using the Bessemer process in 1856. However, it was to take the best part of

a decade of experimentation at Dowlais, under the guidance of William Menelaus, before a truly industrialised method for the production of steel was perfected.

Prior to its introduction, steel had been around 10 times more expensive than iron, making it far too expensive for use in railways, bridges or the frameworks of buildings. After the industrialisation of the Bessemer process, steel and wrought iron soon became similarly priced and most manufacturers quickly turned to steel. In 1871 Dowlais produced almost 26,000 tons of Bessemer steel; by 1884 it was producing more than 118,000 tons.

With steel production supplanting iron, Dowlais continued to grow through the second half of the century and in 1888 built a second steelworks in South Wales, this time in Cardiff. The company had successfully evolved its business and entered the 20th century as one of the largest ironworks in the world.



### **Mergers and re-birth**

Downstream of the iron and steelmakers, other industries and companies had been rising – and would soon become part of the developing GKN story. In 1834, in Birmingham, John Nettlefold had opened a woodscrew mill. And in 1856, just down the road, Arthur Keen had founded the Patent Nut & Bolt Company (PNB) with his American partner, Francis Watkins, which had become a major manufacturer of fasteners. Arthur Keen was to become the architect of Guest, Keen & Nettlefolds and was a classic Victorian entrepreneur. He was the son of a yeoman-farmer, who rose from being a railway clerk to become a leading figure in West Midlands' commerce and politics.

By the late 1890s Keen not only headed PNB but was also chairman of the Birmingham and Midland Bank. Keen believed that PNB had to integrate vertically up the production chain into steel, which was replacing iron as the raw material for fasteners. With his financial connections he was perfectly positioned for the financial engineering necessary to fulfil his objective. Through a contact, Keen learned that Lord Wimborne was ready to sell the Dowlais Iron Co. As Dowlais was larger than PNB this would be a reverse takeover. Stretching his resources to the limit, Keen agreed in September 1899 to pay Wimborne £1.53m for Dowlais. He told his shareholders that the deal would “give the company a position of complete independence...enabling it to hold its own in competition with the whole world.”



In July 1900, the combination of Dowlais and PNB was incorporated into a new group, Guest, Keen & Co. Two years later, Keen drove through the takeover of a reluctant Nettlefolds Ltd and the enlarged company became Guest, Keen & Nettlefolds. In 1905, GKN was the 15th largest British company – with assets of £4.54m – and the largest iron, steel and coal group in the country. In July 1912, it received royal recognition when King George V visited Dowlais.

#### **Munitions and motor cars**



*Women making munitions shells in 1918*

The first half of the 20th century saw GKN heavily involved in wartime production, while also seeing the company make its first move into the emerging motor industry. During the First World War GKN's plants became Controlled Establishments under the direction of the UK Ministry of Munitions. They produced steel for a range of military uses, especially shells, but with so many volunteers having joined the armed forces there were severe labour shortages. Women filled the gap, as they did again in the Second World War. At Dowlais, they worked in the brickyards as machine hands, moulders and clay grinders. Nettlefolds had always employed women, but during the war numbers soared.

After WW1 a new leader emerged from an unexpected source to give GKN fresh direction. H. Seymour Berry (later Lord Buckland) had built up a profitable coal-mining business with his business partner David Llewellyn. In 1919 they bought a controlling interest in the steel-making group John Lysaght Ltd and then acquired Joseph Sankey & Sons, which was established as a supplier of wheels, chassis frames and bodies to Britain's new motor industry.

Three months later they proposed a merger to the GKN board. Lysaght was merged into the larger GKN, but Berry and Llewellyn became the group's driving forces. This new GKN contained most of the elements that would sustain it through the Great Depression and propel it through the next half-century: heavy steel-making; steel-processing; fasteners and other steel products; and motor components. But it did suffer one historic casualty: in 1936, the Dowlais works closed, bringing an end to 170 years of iron and steel-making.

When war broke out in 1939, GKN again made a full contribution. The Hadley Works produced Spitfires, Lysaght assembled a specialised tank for the D-Day landings, and the company produced steel, forgings and fasteners for tanks and aircraft, as well as millions of steel helmets.



*A Hadley Works produced Spitfire*

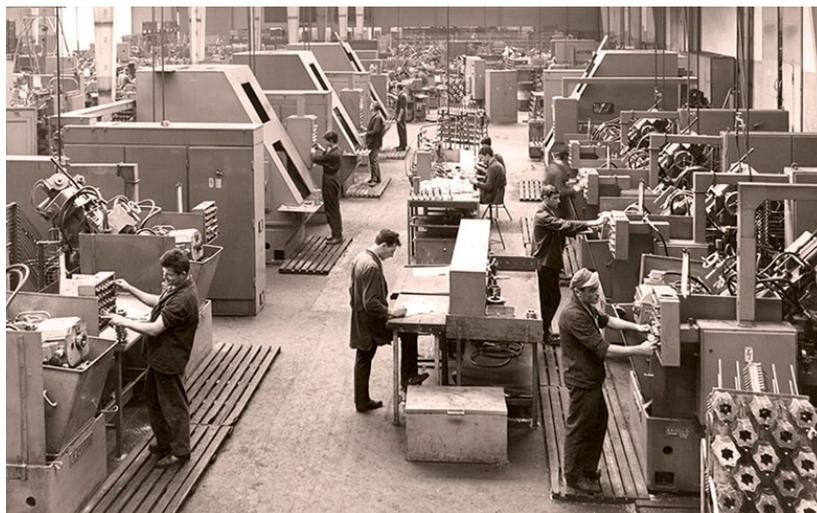


*The Model T Ford*

Around the turn of the 20th century a new industry appeared that was to transform the way people lived. The automobile industry spluttered into life in numerous countries, inspired by some now famous names: Benz, Peugeot, Citroën, Oldsmobile. But one car came to symbolise the dawn of the motor age – the Model T Ford. Between 1908 and 1927, Ford made more than 15 million Model Ts. Most were black, a result of the strict assembly line production process that saw each car made in just 93 minutes. The Model T was so successful that Ford did not need to advertise between 1917 and 1923.

### **Nationalisation and diversification**

GKN emerged from the war as Britain's largest steel producer. However, it was soon embroiled in a battle against the Labour government's determination to nationalise the steel industry – and so began a move into new areas of engineering and technology. Labour first nationalised the steel industry in 1951 paying GKN compensation of £18.7m for its assets. Four years later, the group bought them back for just under £12m from the Conservative government. But in 1964, Harold Wilson's Labour government was elected with a mandate to renationalise steel. When completed in 1967 this left GKN with some steel interests, but also led the company into a gradual withdrawal from its traditional industry over the following 20 years.



*GKN car components; Factory floor, 1950s*

The drawn-out nationalisation saga encouraged GKN to explore new business avenues. It expanded its involvement across the newly independent countries of the British Commonwealth and became involved in a host of steel-related businesses, including vehicle components such as crankshafts and propeller shafts. Building on wartime experience, the company began production of the famous Warrior tank for the British Army.

GKN also expanded into the industrial services sector. In 1974 the group and the Australian company Brambles formed the GKN Chep pallet pool in the UK. Four years later, the venture expanded into mainland Europe and the group's most successful industrial services business was on the road to international growth. The next major move was into waste disposal in 1981 when GKN and Brambles acquired Redland Purlé (now known as Cleanaway) – a venture that also proved to be highly successful. Chep and Cleanaway symbolised GKN's growing diversification, a process that by the

1980s had led to involvement in a huge variety of industrial services ranging from plumbing and roofing to locks and window latches.

### The drive to automotive



*The iconic symbol of the 1960s - the Mini:  
'Room for five in the back'*

In keeping with GKN's history of innovation and re-invention, the 1960s witnessed a hugely significant move into the automotive industry which would lead to its position at the forefront of the automotive components industry. In 1966, Raymond Brookes – who had become chairman of GKN the previous year – completed the takeover of the Birfield automotive components group. Birfield's main business was propshafts, but within its portfolio were two companies making constant velocity joints (CVJs): Hardy Spicer in the UK, and Uni-Cardan, based in West Germany but with interests in France and Italy.

CVJs were revolutionising the motor industry, enabling the new generation of front-wheel drive cars, including the iconic Mini. As a result, GKN's automotive business emerged for the first time as a major force in the group, accounting for approximately one-third of sales by the end of the 1960s. But most of these sales were to the UK motor industry, which limped into the 1970s bedevilled by strikes and falling competitiveness.

GKN fought through the downturn, laying down foundations for fresh growth: opening plants in the US, expanding in Europe and, crucially, forging close links with all of Japan's leading vehicle makers. A wave of global investments followed: in Brazil, Mexico, India, Australia, South Africa, Japan, Thailand, South Korea, Malaysia, Taiwan and, in 1989, China – as the driveline business created a global network and cemented its market leadership. A total of 5.4 million Minis were made between 1959 and 2000.

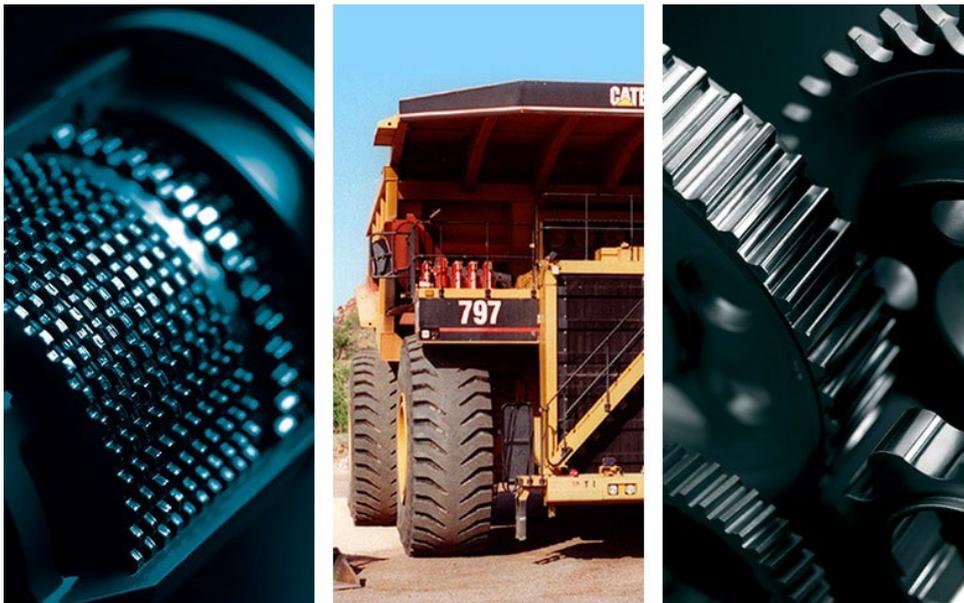
## Taking off in new directions



*Boeing 787*

With the company going truly global, but withdrawing from its historic steel business, Guest, Keen and Nettlefolds took a modernising step and officially changed its name to GKN plc. And it took historic steps into new business territories. In 1988 GKN acquired a stake in Westland plc, the British helicopter and aerospace manufacturer. Westland was known worldwide for its helicopters, but it had previously acquired Saunders Roe – the famous flying-boat maker (later renamed Westland Aerospace Ltd) – which was at the leading edge in aerostructures and composite materials.

The move into aerospace technology continued the shift away from heavy engineering that had begun in the 1980s and continued through the recession of the early 1990s. A host of non-core operations, notably in industrial services, were sold or closed cutting the global workforce from 93,000 in 1980 to 32,300 in 1990.



*Electro-magnetic coupling; Caterpillar truck; Precision engineering*

GKN was now focused on a few growth businesses: Driveline; Chep; Cleanaway; Aerospace/Defence; and Off-Highway which had developed from the original Sankey operation. Strategic moves expanded Chep into the potentially vast American market and Driveline into post-communist Eastern Europe. Powder Metallurgy and Sinter Metals were identified as a potential core activity and the company embarked on a rapid expansion through acquisition, mainly in the US, but later in Europe.

In 2001 an extraordinary few months of hyper-activity re-shaped the business for the 21st century. In a multi-billion pound deal – the biggest in the company’s history – Chep and Cleanaway were merged; Westland’s helicopter business was merged into a joint venture with Agusta, owned by the Italian group Finmeccanica; and Boeing’s military aircraft structures plant in St Louis was acquired in a ground-breaking outsourcing deal. It was the most fundamental re-shaping for a century and focused GKN on four world-leading businesses: Aerospace; Driveline; Powder Metallurgy; and Land Systems.



*Winglets*

The 1990s had witnessed the emergence of the environment as a major issue, with concerns over global warming gathering pace. As a result, a host of initiatives – from wind farms to recycling – have been developed to try to reduce human’s impact on the environment. Among other innovations, GKN has been at the forefront of reducing the carbon footprint of planes through the use of winglets. These near-vertical extensions to a plane’s wing tips reduce drag thereby improving fuel efficiency. Many planes now use winglets, including Boeing’s 737 and 767 – for which GKN is a major supplier.

### **GKN Aerospace today**



*GKN Aerospace plant in Filton*

GKN’s aerospace business has been built into the world’s leading independent producer of aerostructures; the purchase in 2009 of the Airbus wing manufacturing and assembly plant at Filton

near Bristol in the UK being a key milestone. The acquisitions of Volvo Aero, the aero engine division of AB Volvo in 2012, and Fokker Technologies Group B.V. in 2015 further reinforced its global leadership. In 2018 Melrose Industries Plc acquired GKN. In 2023 Melrose Industries completed the demerger of GKN Automotive, GKN Powder Metallurgy and GKN Hydrogen into the Dowlais Group, further enhancing GKN's focus on the aerospace industry.

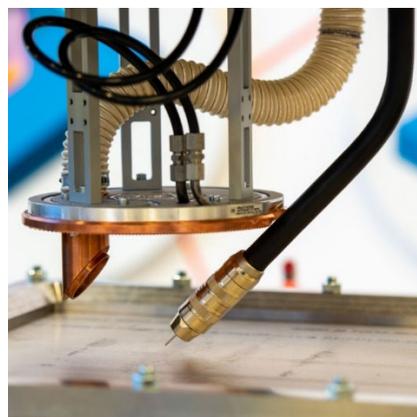


*Fokker is a leading player in design, manufacturing and support for electrical wiring interconnection systems*

For almost 260 years GKN has welcomed change, not feared it. It has never been afraid to innovate. It has always been practical, it has always been a proud company, but the pride has always been tempered by an immense realism. That is why it is still here. That is why GKN Aerospace occupies a unique place in global industrial history.

Now, how do you find out more? First of all go to [GKN Aerospace | Making Things Fly](#) and read about their **Markets and Solutions**: civil; defense; engines; aerostructures; propulsion systems; special technologies; aftermarket services and MRO.

Then have a look at **Our Technology** and after that **Sustainability**, followed by the **News Releases** and **Video Library** under the **News** section.



*4 October 2022:*

*GKN Aerospace acquires additive systems leader to make a step change in industry sustainability.*



*5 December 2022:  
GKN Aerospace and IAAPS to partner on development of hydrogen propulsion systems for aviation.*

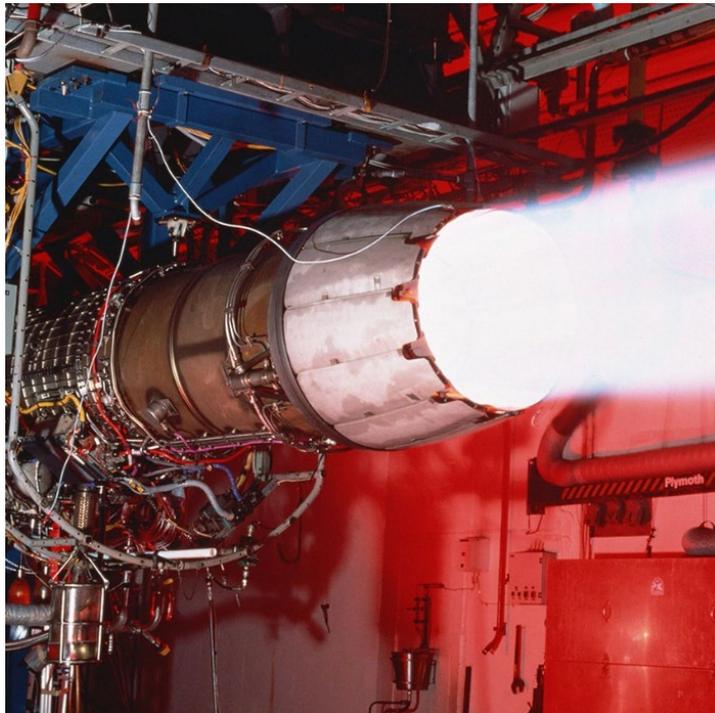


*16 December 2022:  
GKN Aerospace and ArianeGroup extend partnership on Ariane 6 rocket engine subsystems*



*31 January 2023:*

*Lilium joins forces with GKN Aerospace for Lilium Jet's electrical wiring interconnection system*



*1 February 2023:*

*Swedish Armed Forces invest £15.5 million in engine test facility at GKN Aerospace*

When you've done all of that go to: [GKN Aerospace Careers](#) and look at **Work with us** – in particular **Early Careers** – and read about Graduate Schemes, Apprenticeships, Internships, STEM and Work Experience. Also, scroll through **Your Questions Answered**.

Finally, have a look at the YouTube video clip: **GKN technology on board of the Lockheed Martin F35 Lightning II**.



Now contact the company!

To conclude this section we suggest you turn from the specific to the general and view: [Careers in Aerospace](#) produced by two more of our supporting organisations: The Royal Aeronautical Society and the trade association, ADS.



## USEFUL CONTACTS



### Academe

<https://aircharter.co.uk/about-us/news-features/blog/comparative-analysis-of-top-10-uk-aviation-courses-with-extensive-information-about-universities-and-their-aviation-degrees>

<https://aeroclass.org>

<https://bachelorsportal.com>

<https://edurank.org>

<https://hotcoursesabroad.com>

<https://spacecareers.uk>

<https://spaceuniversitiesnetwork.ac.uk/space-courses>

<https://studyin-uk.com/studyuk/aerospace-engineering>

<https://thecompleteuniversityguide.co.uk>

<https://topuniversities.com>

<https://tourismteacher.com>

<https://ucas.com>

<https://whatuni.com>

### Apprenticeships

<https://airbus.com/en/careers/apprentices-and-pupils/apprenticeship-in-united-kingdom>

<https://airtanker.co.uk/careers>

<https://baesystems.com>

<https://boeing.co.uk/working-at-boeing/graduates-apprentices-interns.page>

<https://careers.ba.com/apprentices>

<https://careerfinder.ucas.com>

<https://careersinaerospace.com>

<https://apprenticeshipguide.co.uk>

<https://e4s.co.uk/jobs/5-airport-apprenticeships.htm>

<https://findapprenticeships.co.uk/aerospace-apprenticeships>

<https://geaviation.com>

<https://instituteforapprenticeships.org>

<https://jobs.raytheon.com/uk-graduate-and-apprenticeships>

<https://martin-baker.com>

<https://prospects.ac.uk>

<https://qinetiq.com/careers/apprenticeships>  
<https://rolls-royce.com>  
<https://thalesgroup.com/en/apprenticeships-thales>

### **Aviation Training Organisations**

<https://airborneplatformsuk.com>  
<https://bestaviation.net>  
<https://caa.co.uk>  
<https://cranfieldflyingschool.com>  
<https://flightraininglondon.co.uk>  
<https://flyefg.co.uk>  
<https://www.fta-global.com>  
<https://goflyuk.com>  
<https://leadingedgeaviation.com>  
<https://resourcegroup.co.uk>

### **Employers with own, or links to, Education**

<https://baatraining.com>  
<https://baesystems.com/en/careers/careers-in-the-uk>  
<https://careers.ba.com/future-pilots>  
<https://careers.ba.com/emerging-talent>  
<https://cae.com>  
<https://careers.easyjet.com>  
<https://gknaerospace.com>  
<https://gradcracker.com>  
<https://heathrowacademy.co.uk>  
<https://meggitt.com/>  
<https://virgin-atlantic.com>

### **Government Bodies**

<https://theagp.aero>  
<https://ati.org.uk>  
<https://people1st.co.uk>  
<https://army.mod.uk>  
<https://nats.aero/careers>  
<https://raf.mod.uk>  
<https://royalnavy.mod.uk/careers>  
<https://gov.uk/government/organisations/uk-space-agency>

### **Industry Bodies**

<https://adsgroup.org.uk>  
<https://airlinesuk.org>  
<https://aoa.org.uk>  
<https://www.facebook.com/Aviationskillspartnership/>

<https://bbga.aero>  
<https://bestaviation.net>  
<https://britishhelicopterassociation.org>  
<https://farnboroughairshow.com>  
<https://pilotcareernews.com>  
<https://tomorrowseengineers.org.uk>  
<https://ukspace.org>

### **Professional Bodies**

<https://aerosociety.com>  
<https://www.balpa.org>  
<https://careersinaerospace.com>  
<https://ciltuk.org.uk>  
<https://engc.org.uk>  
<https://engineeringuk.com>  
<https://imeche.org>  
<https://raeng.org.uk>  
<https://theiet.org>  
<https://wes.org.uk>

### **Scholarship & Bursaries**

<https://aerobility.com/scholarships>  
<https://airleague.co.uk>  
<https://airpilots.org>  
<https://amazonfutureengineer.co.uk/bursary>  
<https://arkwright.org.uk>  
<https://boeing.co.uk/>  
<https://borntoengineer.com/resources/engineering-scholarship>  
<https://careersuk.virgin-atlantic.com/future-flyers-pilot-training-programme>  
<https://coachmakers.co.uk>  
<https://engineeringuk.com/our-work/inspiring-young-people/bursaries>  
<https://icadet.com>  
<https://kiiky.com/pilot-training-scholarships/>  
<https://theiet.org/impact-society/awards-scholarships/scholarships-and-bursaries/>  
<https://thescholarshipub.org.uk/engineering-scholarships>  
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