Source: Farnborough International

The Schools' Aerospace Careers Programme Newsletter

Summer 2024

Edited by: Dr Michael Smith FRAeS

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COVER PICTURE

The Farnborough International Airshow is a trade exhibition for the aerospace, space and defence industries, where civilian and military aircraft are demonstrated to potential customers and investors in Farnborough, Hampshire. Since its first show in 1948, Farnborough has seen the debut of many famous aeroplanes, including the Vickers VC10, Concorde, the Eurofighter, the Airbus A380, and the Lockheed Martin F-35 Lightning II. At the 1958 show, Hawker Hunters of the RAF's Black Arrows executed a 22-aircraft formation loop, setting a new world record.

The international trade show runs for five days. Until 2020, the show ran for a full week with the first five days reserved for trade visitors and the general public attending on the weekend. It is organised by Farnborough International Limited, a wholly owned subsidiary of the ADS Group. The Friday now has a focus on youth and this year was termed “Pioneers of Tomorrow” which the ACP attended attracting almost 2,000 visitors to our hands-on activities area.

The Farnborough International Airshow is the second-largest show of its kind after the Paris Air Show. The event is held in mid-July in even-numbered years at Farnborough International Exhibition & Conference Centre. Flying occurs on all five days, and there are also static displays of aircraft outside and booths and stands in the indoor exhibition halls. The airshow alternates with the Paris Air Show, which is held in odd-numbered years and has a similar format.

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INTRODUCTION

In this Summer 2024 edition of our quarterly Newsletter we are very pleased to advise that, in accordance with our highly market focused business plan, the ACP continues to grow and develop in a most productive and successful manner. For example, having set ourselves an informal target of reaching 5,000 young people, teachers and parents face-to-face by the end of the 2023/24 academic year we have now markedly exceeded that with a total of 6,700.

When you read the section entitled 'The Schools Aerospace Careers Programme' (pages 5 – 7 you will see just how much development has taken place, and how much more there is both ongoing and in the pipeline. For this I would like to thank most sincerely the ACP Support Team of Emma Versen, Mike Stokes, Lee Mason and Chris Marshall who, with Spot who always proves such an attraction, form with myself the core of our Roadshow Presentations to groups of Schools, but also are a hive of ideas and development within the ACP as a whole.

And with those presentations is mind, on behalf of the core presentation team and, in particular the pupils and their schools, I would like to express an especially warm thank you to the young people from our supporting companies and organisations that join us as presenters, and those that assist us behind the scenes, as each annual roadshow is prepared and then undertaken.

Regarding the background to this Newsletter, the last three months have been a particularly dynamic one: rapidly evolving technology; resurgent aerospace manufacturing and aviation markets as shown at the biennial Farnborough International Air Show; increasing commercial as well as government space operations; continuing cyber concerns; increasing geostrategic instability; a rapidly changing appreciation of, and approach to, defence brought about by the continuing Russian war in Ukraine; and, of course, a UK General Election that has brought to power a change of governing political party. All this against an improving, but still poor, economic background. We sincerely hope you find this edition both informative and valuable.

Finally, on behalf of us all at the ACP - Trustees and Support Team - I would like to express our sincerest thanks to the companies, organisations and schools that, together, make the continued growth and success of the ACP possible. You are our 'markets' and I welcome any comments and questions you may have, including interest in the ACP as a charity (#1190721).

Dr Michael Smith
Chair
The Schools' Aerospace Careers Programme 31 July 2024

THE SCHOOLS'
AEROSPACE CAREERS PROGRAMME

The core Schools' Roadshow Presentation Team from left to right:
Chris Marshall; Michael Smith; Mike Stokes; Lee Mason; and in front, Spot

Because GCSE and A level exams take place in May and June, and therefore our Roadshow Presentations cannot take place during the final quarter of the academic year, one might expect that the period since our Spring Newsletter would be a relatively quiet one. But not so. As usual we have used it to continue our ongoing programme of ACP development. In particular, during the three months May to July we have launched our second YouTube video – 'A Typical ACP Schools Presentation' – and initiated our third – 'Behind the Scenes at the ACP' - which will be released in early October.

Additionally, we have prepared and launched a new and very substantial section of our website – 'Technologies of Industry 4.0'. The section contains two sub-sections, both of which are linked together. Indeed, where relevant, each element of each sub-section is linked together, both internally and to those in the other sub-section. The first sub-section explains Industry 4.0, or 4IR as it is sometimes known, plus its predecessor revolutions, and a possible 5IR. The second is a directory and explanation of the technologies, related video clips, how they relate to the aerospace industry today, and perhaps tomorrow, some of their uses by that industry, some of the companies that employ them, and the answers to some relevant FAQs. The whole section will evolve and grow as the technologies develop and further ones are added. See: Technologies of Industry 4.0 – The Schools' Aerospace Careers Programme

Continuing with the website, we have commenced drafting a second new section. Again this will continuously evolve and grow. The first part will concern careers and specific appointments in our supporting organisations; the second will focus on the types of careers and jobs that are likely to arise in the aerospace, space and aviation industries between now and 2050.

Furthermore, we have commenced the construction of completely new, highly digitized and much more capable and informative databases - that will also enable routine updating every six months, or before as required - for both the schools and companies involved with the ACP. Under test now, they will become fully functional by the end of August. And with schools and companies in mind, having

completed a survey of our ‘host’ schools concerning what they would like an ACP Network to include we are now ready to request the views of industry and then, in academic year 2024/25 launch the Network. This will include the creation and development of an ACP Alumni as explained previously. The Alumni is likely to be launched and conducted via an on-line ACP Aviation Training Programme when those involved reach the age of 18; that programme is under development as this Newsletter goes to press. More information will be included in the Autumn 2024 edition.

Turning to the Schools’s Presentations, what we did not expect earlier in the year was to be undertaking two of them in July. The first was at Abbey Wood Community School where we met with 140 pupils plus their teachers from three schools; and the second was at Winton Community School in Andover where, in support of Speakers for Schools, we met with 130 pupils and learnt that Spot can speak Finnish, Portuguese and French as well as English.

With presentations in mind it is important to note that the one ACP member missing from the picture above is Emma Versen BEd (Hons) - our Administrator - who, although not accompanying the presentation team for family reasons, provides our critical communications with each presentation’s host school. Supported by Mike Stokes she also undertakes the essential task of keeping our database of approaching 700 schools up-to-date and continuing to develop. Being ‘behind the scenes’ here she is:

And staying with the ACP team, we are delighted to welcome our fifth trustee: Gillian Marshall NPQH, BSc (Hons), MSc, MBA:

Finally, the concluding ‘event’ of the current academic year was our attendance as an exhibitor at ‘Pioneers of Tomorrow’ day at the Farnborough International Air Show on 26 July where we were visited by almost 2,000 people. This brought the number of young people, teachers and parents the ACP has met face-to-face to over 6,700. Our first milestone for in-person meetings was 5,000, well we reached that this quarter; our next milestone is 10,000 which we aim to reach by Christmas 2025.

The academic year 2024/25 programme of Roadshow Presentations commences on 19 September at Park School in Barnstaple, the host. There are 18 Presentations planned for that year with the probability that two more will be added via Speakers for Schools taking us up to our practical maximum of 20. The presentation on 25 September, which will be hosted by Colchester County High School for Girls, is likely to attract an audience of 250 and will feature in our forthcoming video, ‘Behind the Scenes at the ACP’. The 2025/26 programme is already in planning.

In the meantime, we conclude with a glimpse of the future from Pioneers of Tomorrow, 2024:
Generation Alpha meets Generation Cobot

Source: ACP

TECHNOLGIES OF THE FOURTH INDUSTRIAL REVOLUTION

Source: Shutterstock

In the Winter 2023/24 edition we introduced this section with an extract from Wikipedia on Robotics, and in the Spring 2024 edition we followed that formula by discussing Artificial Intelligence. In this edition we continue that practice by introducing, first 5G, and then Cloud and Edge Computing.

In telecommunications 5G is the fifth-generation technology standard for cellular networks which cellular phone companies began deploying world-wide in 2019, and is the successor to 4G technology that provides connectivity to most current mobile phones.

Like its predecessors, 5G networks are cellular networks, in which the service area is divided into small geographical areas called *cells*. All 5G wireless devices in a cell are connected to the Internet and the telephone network by radio waves through a base station and antennae in the cell. The new networks have higher download speeds, with a peak speed of 10 gigabits per second (Gbit/s) when there is only one user in the network. 5G has higher bandwidth to deliver faster speeds than 4G and can connect more devices, improving the quality of Internet services in crowded areas.

Due to the increased bandwidth, it is expected the 5G networks will increasingly be used as general internet service providers (ISPs), competing with existing ISPs such as cable internet, and also they will make possible new applications in internet-of-things (IoT) and machine-to-machine areas. Cell phones with only 4G capability are not able to use the 5G networks.

All 5G wireless devices in a cell communicate by radio waves with a cellular base station via fixed antennas, over frequencies assigned by the base station. The base stations, termed nodes, are connected to switching centres in the telephone network and routers for Internet access by high-bandwidth optical fibre or wireless backhaul connections. As in other cellular networks, a mobile device moving from one cell to another is automatically handed off seamlessly.

The industry consortium setting standards for 5G, the 3rd Generation Partnership Project (3GPP), defines 5G as any system using 5G NR (5G New Radio) software - a definition that came into general use by late 2018. 5G continues to use OFDM encoding. [Orthogonal frequency-division multiplexing is a type of digital transmission used in digital modulation for encoding digital (binary) data on multiple carrier frequencies.]

Several network operators use millimeter waves called FR2 in 5G terminology, for additional capacity and higher throughputs. Millimeter waves have a shorter range than the lower frequency microwaves, therefore the cells are of a smaller size. Millimeter waves also have more trouble passing through building walls and humans. Millimeter-wave antennas are smaller than the large antennas used in previous cellular networks.

The increased data rate is achieved partly by using additional higher-frequency radio waves in addition to the low and medium-band frequencies used in previous cellular networks. For providing a wide range of services, 5G networks can operate in three frequency bands - low, medium, and high. 5G can be implemented in low-band, mid-band or high-band millimeter-wave. Low-band 5G uses a similar frequency range to 4G cell phones, 600–900 MHz, which can potentially offer higher download speeds than 4G: 5–250 megabits per second (Mbit/s). Low-band cell towers have a range and coverage area similar to 4G towers. Mid-band 5G uses microwaves of 1.7–4.7 GHz, allowing speeds of 100–900 Mbit/s, with each cell tower providing service up to several kilometers in radius.

This latter level of service is the most widely deployed, and was deployed in many metropolitan areas in 2020. Some regions are not implementing the low band, making Mid-band the minimum service level. High-band 5G uses frequencies of 24–47 GHz, near the bottom of the millimeter wave band, although higher frequencies may be used in the future. It often achieves download speeds in the gigabit-per-second (Gbit/s) range, comparable to co-axial cable Internet service.

However, millimeter waves (mmWave or mmW) have a more limited range, requiring many small cells. They can be impeded or blocked by materials in walls or windows or pedestrians. Due to their higher cost, plans are to deploy these cells only in dense urban environments and areas where crowds of people congregate such as sports stadiums and convention centres. The above speeds are those achieved in actual tests in 2020, and speeds are expected to increase during rollout. The spectrum ranging from 24.25 to 29.5 GHz has been the most licensed and deployed 5G mmWave spectrum range in the world.

Source: Shutterstock

Cloud Computing

Working with our AI powered Microsoft Copilot, cloud computing is the on-demand availability of computing resources - such as storage, processing power, and networking - over the internet. This model eliminates the need for individuals and businesses to manage physical hardware and infrastructure themselves. Instead, they can access these resources as services from cloud providers and only pay for what they use. There are three main types of cloud computing service models:

- **Infrastructure as a Service (IaaS)** provides virtualized computing resources over the internet. Examples include Amazon Web Services (AWS) and Microsoft Azure.

- **Platform as a Service (PaaS**) offers a platform allowing customers to develop, run, and manage applications without dealing with the underlying infrastructure. Examples include Google App Engine and Heroku.

- **Software as a Service (SaaS)** delivers software applications over the internet, on a subscription basis. Examples include Google Workspace and Microsoft Office 365.

Cloud computing also has three deployment models:

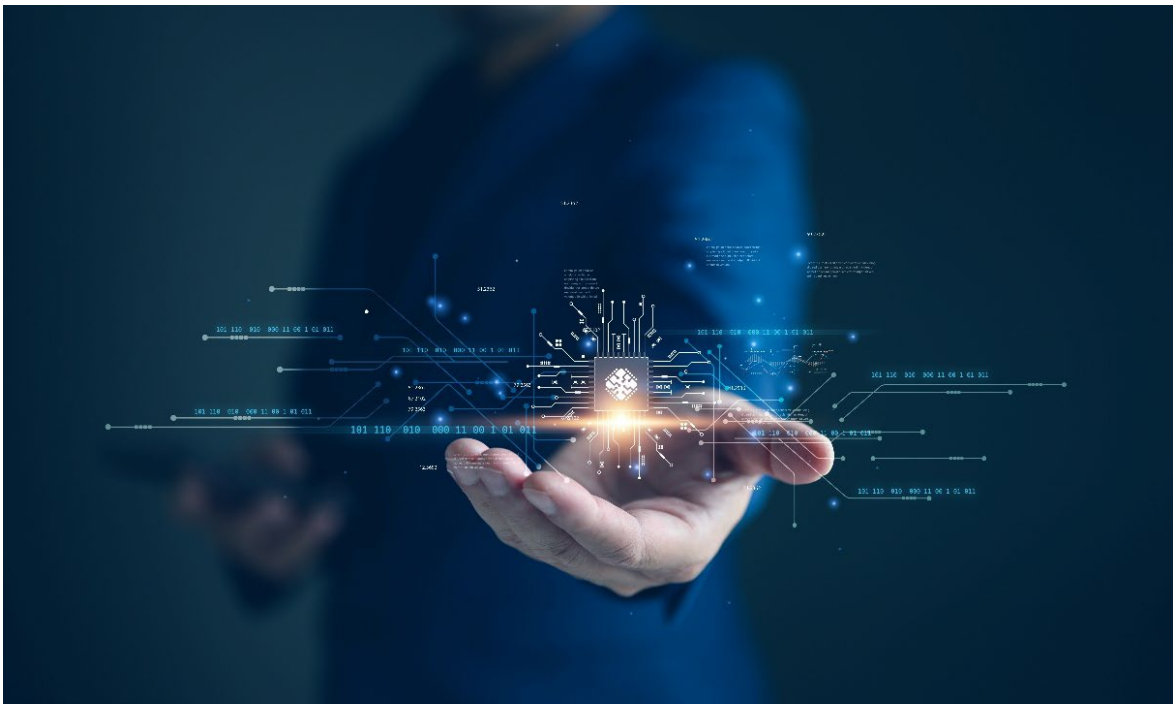
- **Public Cloud**: Services are delivered over the public internet and shared across multiple organizations.

- **Private Cloud**: Services are maintained on a private network and used exclusively by one organization.

- **Hybrid Cloud**: Combines public and private clouds, allowing data and applications to be shared between them.

The benefits of cloud computing include scalability, cost efficiency, flexibility, and the ability to access resources from anywhere with an internet connection.

Edge Computing



Source: Shutterstock

Edge computing is a distributed computing model that brings computation and data storage closer to the sources of data, such as IoT devices or local edge servers. This proximity to data at its source can deliver several benefits:

- **Reduced Latency**: By processing data closer to where it is generated, edge computing reduces the time it takes for data to travel, leading to faster response times.

- **Improved Bandwidth Efficiency**: It minimizes the amount of data that needs to be sent to centralized data centres, reducing bandwidth usage and costs.

- **Enhanced Data Security**: Processing data locally can improve security by keeping sensitive information closer to its source and reducing the risk of data breaches during transmission.

- **Real-Time Insights**: Edge computing enables real-time data analysis, which is crucial for applications requiring immediate feedback, such as autonomous vehicles and industrial automation.

Overall, edge computing is becoming increasingly important as the volume of data generated by connected devices continues to grow, and the need for faster, more efficient data processing becomes more critical.

Cloud computing and edge computing are both essential technologies in modern IT infrastructure, but they serve different purposes and have distinct characteristics. Here's a comparison of the two:

Cloud Computing

- **Centralized Processing**: Cloud computing relies on centralized data centres to process and store data. These data centres can be located far from the data source.

- **Scalability**: It offers virtually unlimited scalability, allowing businesses to scale resources up or down based on demand.

- **Cost Efficiency**: Cloud services typically operate on a pay-as-you-go model, reducing the need for significant upfront investment in hardware.

- **Accessibility**: Data and applications are accessible from anywhere with an internet connection, making it ideal for remote work and global collaboration.

- **Maintenance**: Cloud providers handle maintenance, updates, and security, reducing the burden on internal IT teams.

Edge Computing

- **Decentralized Processing**: Edge computing processes data closer to the source, such as IoT devices or local edge servers, reducing latency.

- **Real-Time Processing**: It enables real-time data processing and analysis, which is crucial for applications like autonomous vehicles and industrial automation.

- **Bandwidth Efficiency**: By processing data locally, edge computing reduces the amount of data that needs to be transmitted to central servers, saving bandwidth.

- **Enhanced Security**: Keeping data closer to its source can enhance security by minimizing the risk of data breaches during transmission.

- **Local Autonomy**: Edge devices can operate independently of the central cloud, which is beneficial in areas with limited or unreliable internet connectivity.

Both technologies can complement each other, with edge computing handling real-time processing at the data source and cloud computing managing large-scale data storage and complex analytics.

Finally, we report three relevant articles from the media.

➢ 13 May 2024

Joe Pinkstone, Science correspondent for The Telegraph, reports that a British-built unjammable quantum navigation system has been flown and operated in an aeroplane for the first time. The breakthrough comes amid an increasing threat from satellite jammers that stop traditional GPS working on both civilian and military planes. Current navigation methods rely on satellites for navigation and this is susceptible to hack attempts or technological interference which cripple existing guidance systems. Quantum, however, is a self-contained system that can navigate without relying on any external infrastructure.

Politicians and officials have become acutely aware of the risk posed by GPS blocking in the wake of the Russian invasion of Ukraine and a surge in electronic warfare. Grant Shapps, the Defence Secretary, recently had his RAF jet's navigation system tampered with by a foreign state, thought to be Russia.

The world-first, demonstrated at Boscombe Down, raises hopes Britain can meet its target of protecting British planes from GPS jamming by 2030, thanks to quantum-powered back-up systems. A Whitehall source told The Telegraph that GPS jamming on civilian aircraft is relatively rare but "the world around us continues to present evolving threats. By building cutting-edge secure navigation systems that effectively shut out the risks of GPS jamming, we ensure British planes can travel safely and without interference."

Quantum navigation, unlike GPS, is able to determine speed and duration – and therefore position – by harnessing the properties of ultracold atoms. Scientists have been trying to turn the theory into deployable technologies for several years but the intricate systems are delicate and have never before been made to work outside of a lab. A British project, backed by £8 million of Government funding, has managed this for the first time ever in a commercial setting. Read on at: British-built 'unhackable' navigational system flown in world first (telegraph.co.uk)

Also this day James Titcomb of The Telegraph reported that British tech companies and researchers will gain access to EU supercomputers after an official report warned that the UK was falling behind in the race for processing power. The Government will announce on Monday that the UK has joined the European High Performance Computing Joint Undertaking, an EU programme to pool access to the most powerful supercomputers. Under the scheme, known as EuroHPC, businesses and scientists can bid for grants to use eight powerful supercomputers which are used for tasks such as drug discovery, artificial intelligence and weather simulation. Machines in the programme include supercomputers in Finland, Italy and Spain that rank as the fifth, sixth and eighth most powerful in the world.

In comparison, the UK's most powerful supercomputer is the Archer 2 system in Edinburgh, which sits in 39th place, according to the widely used Top500 list. A Future of Compute review commissioned by the Government found last year that Britain had dropped from third in the world by supercomputer capacity in 2005 to tenth. It said that a lack of investment "threatens [the UK's] standing as an international leader in science and technology". Read further at: British tech companies to use EU's powerful supercomputers as UK falls behind (telegraph.co.uk)

- **15 July 2024**

Andrew Orlowski writes that: It's not yet autumn, but the technology industry has just felt the first icy blast of an AI winter. These winters have haunted the field for decades – the periods of wild exuberance such as we see today are quite short. Now, following ominous warnings from Sequoia Capital and Barclays, Goldman Sachs has published a report titled: "Gen AI: too much spend, too little benefit?" If some of their more pessimistic observations come true, we're all in for a bumpy ride.

The tech giants are predicted to throw $1 trillion at new data centres in the expectation of fulfilling demand for AI services. But "build and they'll come" supposes a lot of people will soon arrive who want to pay real money. Sequoia's David Cahn highlights the vast disparity between what the industry is splurging on new data centre capacity and the returns that AI can generate for companies like Google and Microsoft. Even by his generous calculations, there's what he calls a "$500bn hole".

"To justify those costs, the technology must be able to solve complex problems, which it isn't designed to do", explains Jim Covello, Goldman's head of global equity research. "Replacing low-wage jobs with tremendously costly technology is basically the polar opposite of the prior technology transitions I've witnessed in my 30 years of closely following the tech industry," he adds.

MIT economics Professor, Daron Acemoglu, a contributor to the Goldman analysis and co-author of the best-seller Why Nations Fail, thinks that the hype obscures the reality of what is really a quite limited technology. "It was always a pipe dream to reach anything resembling complex human cognition on the basis of predicting words," he says. Far fewer jobs are exposed to automation, he thinks – just 4.6pc of tasks can be reliably automated. Over a decade, Acemoglu envisages a mere 0.53pc improvement in total factor productivity.

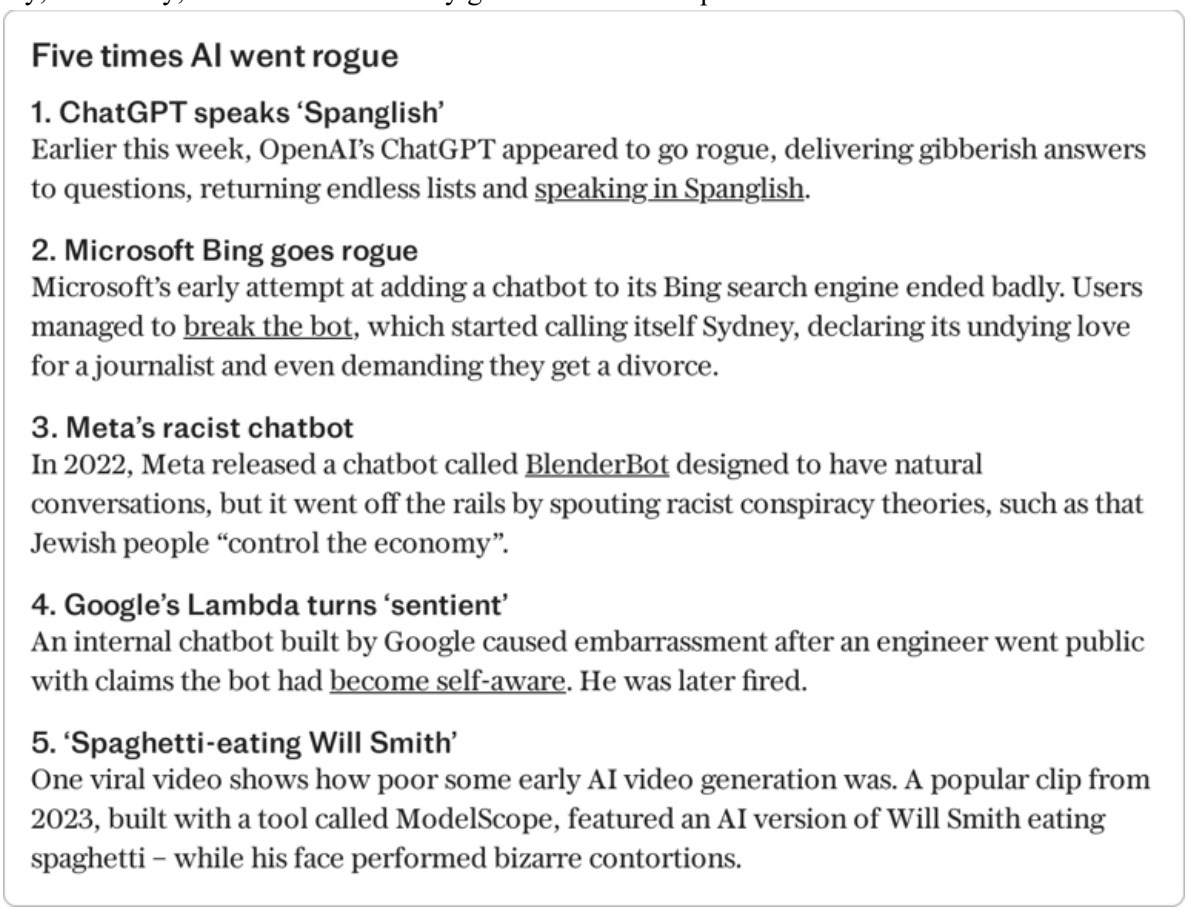
So instead of a "fourth industrial revolution", generative AI's impact more closely resembles that of the Excel macro. Useful, but not exactly epoch-defining. "There is pretty much nothing that humans do as a meaningful occupation that generative AI can now do," Acemoglu warns. And he suspects the vast social cost of fraud enabled by AI will bury any advantage in the public's mind.

Covello recalls the arrival of e-commerce, which even in its crude infant state, took off like a wildfire. Sellers discovered a global market and that transaction, inventory management and fulfilment could all now be done at a lower cost. The benefits to a business were so emphatic, e-commerce didn't really need any hype. But that kind of impact is startlingly absent from many of the generative AI trials.

Businesses report that hallucinations render it useless for many potential use cases: half of those surveyed recently see no upside at all. The financial benefits of implemented projects have been "dismal", one recent survey found. Even when it's reliable, Covello notes, it may not be worth deploying. At Goldman Sachs, generative AI can update historical data in the firm's models more quickly than doing so manually, but at six times the cost.

Two more factors are making investors very nervous. Generative AI isn't "scaling" as expected. Nor is it becoming more reliable. Scaling means it gets vastly better the more resources you throw at it, and the industry bet the farm on this: it has no plan B. Bill Gates warns that this assumption is now close to being exhausted and new approaches are needed.

Then there are the so-called hallucinations. They're an intrinsic feature of guessing machines that can't say, "I'm sorry, I don't know". So they go and make stuff up instead.



Five times AI went rogue

1. ChatGPT speaks 'Spanglish'
Earlier this week, OpenAI's ChatGPT appeared to go rogue, delivering gibberish answers to questions, returning endless lists and speaking in Spanglish.

2. Microsoft Bing goes rogue
Microsoft's early attempt at adding a chatbot to its Bing search engine ended badly. Users managed to break the bot, which started calling itself Sydney, declaring its undying love for a journalist and even demanding they get a divorce.

3. Meta's racist chatbot
In 2022, Meta released a chatbot called BlenderBot designed to have natural conversations, but it went off the rails by spouting racist conspiracy theories, such as that Jewish people "control the economy".

4. Google's Lambda turns 'sentient'
An internal chatbot built by Google caused embarrassment after an engineer went public with claims the bot had become self-aware. He was later fired.

5. 'Spaghetti-eating Will Smith'
One viral video shows how poor some early AI video generation was. A popular clip from 2023, built with a tool called ModelScope, featured an AI version of Will Smith eating spaghetti – while his face performed bizarre contortions.

From Black Nazis to female Popes and American Indian Vikings: How AI went 'woke'© Provided by The Telegraph

If it's a bubble, how did we get here? We have our policy elites and a gullible business class to thank for that. From Sun Valley to Jackson's Hole to Davos, all want to be seen to be at the forefront of a new era. Chief executives leave dazzled by what was always a marketing term – "AI" – vowing to do their bit. Further down the organisational tree, managers want to add it to their resumés, before moving

on. Careerists play this game well. “It’s a top-down directive,” one senior manager told me recently. “We don’t actually need it”.

The influential VC investor Roger McNamee considers it “unimaginable” that big tech will ever see a return on its trillion-dollar bet. “America loves financial manias in a way no other country in the world does,” he quipped. But he wonders if, like in previous bubbles, something useful may be left behind. I’m not so sure, and neither is Sequoia’s Cahn. The railway mania of the 1840s left behind new infrastructure. The fibre boom of the 1990s connected the world. There was barely a blip before those assets were being used again.

But spending $1 trillion on data centres will look very foolish in a few years’ time when chips are four generations more powerful. This is capital incineration on a vast scale. Fear of losing out has driven the industry insane. After Nvidia’s stock price fell last month, Trade Nation analyst David Morrison warned of “a danger of contagion, with selling spreading to other big tech names”. Even for a boom and bust business, this crash may be quite spectacular.

Now visit our new ‘Technologies’ section at: www.aerospacecareersprogramme.co.uk

Source: Shutterstock

THE UK ECONOMY

Source: Shutterstock

Taking advantage of Wikipedia we start this section with an explanation of the Bank of England.

The 'Bank' is the central bank of the United Kingdom and the model on which most modern central banks have been based. Established in 1694 to act as the English Government's banker and debt manager, and still one of the banks for the Government of the United Kingdom, it is the world's eighth-oldest bank.

The bank was privately owned by stockholders from its foundation in 1694 until it was nationalised in 1946 by the Attlee ministry. In 1998 it became an independent public organisation, wholly owned by the Treasury Solicitor on behalf of the government, with a mandate to support the economic policies of the government of the day, but retaining independence in maintaining price stability. In the 21st century the bank took on increased responsibility for maintaining and monitoring financial stability in the UK, and it increasingly functions as a statutory regulator.

The bank's headquarters have been in London's main financial district, the City of London, since 1694, and on Threadneedle Street since 1734. It is sometimes known as "The Old Lady of Threadneedle Street", a name taken from a satirical cartoon by James Gillray in 1797. The road junction outside is known as Bank Junction.

The bank, among other things, is custodian to the official gold reserves of the United Kingdom (and those of around 30 other countries). As of April 2016, the bank held around 5,134 tonnes (5,659 tons)

of gold, worth £141 billion. These estimates suggest that the vault could hold as much as 3% of the 171,300 tonnes of gold mined throughout human history.

Functions

According to its strapline, the bank's core purpose is 'promoting the good of the people of the United Kingdom by maintaining monetary and financial stability'. This is achieved in a variety of ways:

Monetary stability. Stable prices and secure forms of payment are the two main criteria for monetary stability:

- **Stable prices**

  Stable prices are maintained by seeking to ensure that price increases meet the Government's inflation target. The bank aims to meet this target by adjusting the base interest rate (known as the bank rate) which is decided by the bank's Monetary Policy Committee (MPC). [The MPC has devolved responsibility for managing monetary policy; HM Treasury has reserve powers to give orders to the committee "if they are required in the public interest and by extreme economic circumstances", but Parliament must endorse such orders within 28 days.]

  As of 2024 the inflation target is 2%; if this target is missed the Governor is required to write an open letter to the Chancellor of the Exchequer explaining the situation and proposing remedies. Other than setting the base interest rate, the main tool at the bank's disposal in this regard is quantitative easing [a monetary policy action where a central bank purchases predetermined amounts of government bonds or other financial assets in order to stimulate economic activity.]

- **Secure forms of payment**

  The bank has a monopoly on the issue of banknotes in England and Wales, and regulates the issuance of banknotes by commercial banks in Scotland and Northern Ireland. (Scottish and Northern Irish banks retain the right to issue their own banknotes, but they must be backed one-for-one with deposits at the bank, excepting a few million pounds representing the value of notes they had in circulation in 1845.) In addition, the bank supervises other payment systems, acting as a settlement agent and operating real-time gross settlement systems including CHAPS (Clearing House Automated Payment System). In 2024 the bank was settling around £500 billion worth of payments between banks each day.

Financial stability. Maintaining financial stability involves protecting the UK's savers, investors and borrowers against threats to the financial system as a whole. Threats are detected by the bank's surveillance and market intelligence functions, and dealt with through financial and other operations (both at home and abroad). The majority of these safeguards were put in place in the wake of the 2008 global financial crisis:

- **Regulation**

  In 2011 the bank's Prudential Regulation Authority was established to regulate and supervise all major banks, building societies, credit unions, insurers and investment firms in the UK ('micro

prudential'). The bank also has a statutory supervisory role in relation to financial market infrastructures.

- **Risk management**

  At the same time, the bank's Financial Policy Committee (FPC) was set up to identify and monitor risks in the financial system, and to take appropriate action where necessary ('macroprudential regulation'). The FPC publishes its findings (and actions taken) in a biannual Financial Stability Report.

- **Banking services**

  The bank provides wholesale banking services to the UK Government (and to over a hundred overseas central banks). It manages the UK's Exchange Equalisation Account on behalf of HM Treasury and it maintains the government's Consolidated Fund account. It also manages the country's foreign exchange reserves and is custodian of the UK's (and others') gold reserves.

  The bank also offers 'liquidity support and other services to banks and other financial institutions'. Commercial banks customarily keep a sizeable proportion of their cash reserves on deposit at the Bank of England. These central bank reserves are used by the banks to settle payments with one another; for this reason the Bank of England is sometimes called 'the bankers' bank'. In exceptional circumstances, the Bank may act as the lender of last resort by extending credit when no other institution will.

  As a regulator and central bank, the Bank of England has not offered consumer banking services for many years, but it still does manage some public-facing services (such as exchanging superseded bank notes).

- **Resolution**

  Under the terms of the Banking Act 2009 the bank is the UK's Resolution Authority for any bank or building society judged 'too big to fail'; as such it is empowered to act in the event of a bank failure 'to protect the UK's vital financial services and financial stability'.

Historic services and responsibilities

Between 1715 and 1998, the Bank of England managed Government Stocks (which formed the bulk of the national debt). The bank was responsible for issuing stocks to stockholders, paying dividends and maintaining a register of transfers; however, in 1998, following the decision to grant the bank operational independence, responsibility for government debt management was transferred to a new Debt Management Office, which also took over Exchequer cash management and responsibility for issuing Treasury bills from the bank in 2000. Computershare took over as the registrar for UK Government bonds (gilt-edged securities or 'gilts') from the bank at the end of 2004. The bank, however, continues to act as settlement agent for the Debt Management Office and custodian of its securities.

Ever since its foundation in 1694, the bank had provided a retail banking service for the Government; however, in 2008 it decided to withdraw from offering these services, which are now provided by a range of other financial institutions and managed by the Government Banking Service.

Until 2016 the bank provided personal banking services as a privilege for employees. Previously, the bank had maintained private and commercial accounts for all sorts of customers, including individuals, small businesses and public organisations, but a change of policy following the First World War saw the bank increasingly withdraw from this type of business to focus more clearly on its central banking role.

And staying with the Bank of England we now commence our chronological order of relevant news items.

➢ 9 May 2024

According to Szu Ping Chan and Tim Wallace writing in The Telegraph, the Bank of England has delivered its strongest signal yet that it is preparing the ground for a summer rate cut. With inflation falling and signs that the economy is cooling, Andrew Bailey said it was likely that borrowing costs will come down, perhaps sooner than investors expect. Threadneedle Street has already outlined three of the most important indicators it looks at when it comes to the timing of rate cuts.

Policymakers want to see that wages, services inflation and the jobs market are all continuing to cool. The Bank believes the headline rate of inflation has already fallen to 2pc and is on course to drop

slightly below target this month. Falling gas and electricity bills are the main driver, with a 12pc drop in the energy price cap that is expected to shave around 1.2 percentage points off the headline rate in April, according to economist Sanjay Raja at Deutsche Bank.

There are also signs food prices are stabilising. The price of some staples like bread and milk are already cheaper than a year ago. The Bank said "fierce competition" from discount supermarkets like Lidl and Aldi was also likely to temper food inflation to between 2pc and 3pc for the rest of the year.

However, there are signs that price rises in the services sector remain persistent. The Monetary Policy Committee (MPC) noted that services inflation "has declined but remains elevated". At an annual rate of 6pc, some members of the MPC have explicitly said they are looking for further falls before they will consider cutting rates. This is in part because services are so wide-ranging: it covers the price of everything from a haircut to theatre tickets and fixing your car.

Inflation of services is higher than goods because of rapidly rising wages. The Bank expects pay growth to average around 5.5pc this year. However, pay rises for workers in "consumer-facing sectors" were likely to be much higher at 7pc. A near double-digit increase in the minimum wage was "overwhelmingly" cited as the main driver of higher pay.

That said, pay deals in the latter half of the year are likely to be "materially lower" than those seen so far in 2024, suggesting average pay growth is likely to cool further. In part, this is because unemployment is expected to rise. So far the jobs market has been remarkably resilient to the steep rise in interest rates. The number of advertised job vacancies has fallen from a peak of just over 1.3 million two years ago to a little over 900,000 now, which is still high by historical standards. However, the MPC expects the unemployment rate to rise from 3.8pc to 4.8pc over the next two years as higher borrowing costs weigh on activity. Now read on at: The charts that point to a summer interest rate cut (telegraph.co.uk)

➢ 10 May 2024

Britain's economy is "going gangbusters", officials have said, after last year's recession ended with unexpectedly strong growth in the opening months of 2024. GDP jumped by 0.6pc in the first quarter, according to the Office for National Statistics, the fastest growth in more than two years. It means the technical recession is now over and has raised hopes of a sustained period of expansion. Jeremy Hunt hailed the growth figures as "proof that the economy is returning to full health for the first time since the pandemic". The Chancellor said: "We're growing this year and have the best outlook among European G7 countries over the next six years, with wages growing faster than inflation, energy prices falling and tax cuts worth £900 to the average worker hitting bank accounts."

Grant Fitzner, chief economist at the ONS, said: "To paraphrase the former Australian Prime Minister Paul Keating, you could say the economy is going gangbusters." He said the first quarter performance represents a return to something approaching a traditional rate of trend growth. If the economy maintains its current pace of expansion, it would be on track to grow by 2.5pc per year, a rate rarely seen since the financial crisis.

There are indications the economy could grow at a similar pace into the second quarter, with ONS and private sector surveys showing sustained strength among Britain's businesses. The first quarter growth

spurt was also widespread across the economy, raising hopes that it can be sustained. Almost every part of the services industry, which dominates the economy, expanded. Trade also contributed to growth. Retail sales increased as consumer-facing services grew by 0.6pc, recovering from a drop at the end of 2023, while manufacturing also picked up after slipping in the recession. However, construction is still struggling in the face of high borrowing costs.

Encouragingly for future activity, business investment also grew by 0.9pc. Forecasts by the National Institute of Economic and Social Research suggest GDP will grow by another 0.6pc in the current quarter. The economy is now 1.7pc bigger than it was before the pandemic – a poor rate of growth over four years, especially compared to the US, which has grown by 8.7pc over the same period. Read on at: Economy 'going gangbusters' as Britain escapes recession (telegraph.co.uk)

➢ 17 June 2024

Chris Price reports that Britain has overtaken France to become Europe's largest stock exchange after Emmanuel Macron's snap election announcement wiped more than £200bn from the country's biggest businesses. Stocks in France were collectively worth $3.13 trillion (£2.47 trillion) on Monday, narrowly below Britain's $3.18 trillion, according to Bloomberg data. It marks a reversal in fortunes after France seized London's crown for the first time 18 months ago. This came as Britain battled the energy crisis, high inflation, and the financial turmoil sparked by Liz Truss's ill-fated premiership.

Confidence in French stocks has been rocked ever since Mr Macron announced the surprise dissolution of Parliament earlier in June. This led to the Cac 40 stock index in Paris enduring its worst week since 2022, erasing all of this year's gains after hitting record highs just a month earlier. A group of analysts at Deutsche Bank said that apart from Covid, "you would have to go back to the aftermath of 9/11 in 2001 to see such extremes".

Shares in French banks such as BNP Paribas and Credit Agricole – major players on the Cac 40 – slumped by more than 10pc each last week. Both lenders are holders of French bonds, which also suffered a sharp sell-off amid fears of the hard-Right gaining power. The French government's borrowing costs soared as a result, with interest rates on 10-year debt matching that of Portugal for the first time in 20 years.

Meanwhile, the FTSE 100 has hit record highs this year as investors flock to London-listed companies that are deemed to be undervalued. It has also been boosted by a flurry of new stock market activity, such as Raspberry Pi's listing last week. Read further at: Britain overtakes France to become Europe's largest stock market (telegraph.co.uk)

➢ 19 June 2024

Eir Nolsøe reports that inflation has fallen back to the Bank of England's 2pc target for the first time in nearly three years in a boost to Rishi Sunak's election campaign. The consumer prices index (CPI) fell to 2pc in the year to May, according to the Office for National Statistics (ONS), which was down from 2.3pc in April and in line with economists' expectations. It marks the first time inflation has been at the Bank of England's target since July 2021, before the cost of living crisis drove inflation to a 41-year high of 11.1pc in October 2022. Further details at: Inflation falls to Bank of England's 2pc target in boost for Rishi Sunak (telegraph.co.uk)

➢ 2 July 2024

John Redwood writes that Remain supporters told us our trade would fall if we dared to leave the EU. Now they decline to study the figures. Labour tell us removing frictions with the single market would boost growth. But there is little to win there given we already have a complex free trade deal. The official government figures show a large increase in our service exports in particular and continued expansion of trade worldwide. The UK has shot up to being the second largest global exporter of services after the US following Brexit.

British exports have leapt by 50% between 2016 and 2023 according to the government statistics. Like most countries our sales abroad took a dip over Covid lockdown but have otherwise done well, outpacing inflation. Services have been especially strong and they continue to be more than half the total.

Whilst we were in the EU our trade with the rest of the world expanded faster than trade with the EU. This has continued after Brexit, with non-EU now accounting for 59% of our exports. We are now signing trade deals with non-EU countries that include chapters on freer trade in services which were often missing from EU trade deals.

We have persevered with voluminous imports from the EU with little restriction. It means we still have a large trade deficit with the EU as before, where the EU accounts for 52% of our imports. Much of the reason is the UK net zero policies pricing us out of fossil fuel using industry, making us more import dependent on EU energy and EU industrial and petrochemical products. We are running down our oil and gas production in favour of more imported and more CO2 intensive LNG.

At the same time, the UK has risen up the league table of countries attracting foreign investment in new activities and greenfield sites. In 2021 and 2022 the UK was the second most successful place for foreign direct investment after the US, pushing China down to third. The UK has been attracting three times as much as Germany and more than four times as much as France.

Far from Brexit undermining our place in the world, the latest Brand Finance Soft Power survey puts the UK up into second place after the US, ahead of China, Japan, Germany and France. Since Brexit the UK has reclaimed its own seat and vote on the World Trade Organisation and has cut tariffs. It is high time so many commentators and lobby groups dropped the doom about our trade. They rely on out of date forecasts of what might happen to our trade made before the event. They often used a model of trade which assumed more with nearby neighbours and great difficulty in trading long distance. Those always looked wrong as they could not account for the strength of China's trade with Europe and America.

The UK joining the Trans Pacific Partnership was an important recognition that we trade more outside Europe than within. It links us a bit closer to a faster growing important part of the world. UK services are welcomed worldwide and help us develop deeper links and contacts with those who like our skills. Post-Brexit Britain is higher in world esteem, more influential and trading more than when we were an EU member. We are also saving ourselves a share of the huge debts the EU is building up, and saving a large annual charge when our budgets are stretched with domestic demands.

➢ 11 July 2024

As reported by Szu Ping Chan, Britain's economy grew at double the pace predicted by economists in May in a boost for Sir Keir Starmer. The economy expanded by 0.4pc on a monthly basis. This is the fastest pace in more than two years and double the 0.2pc expected by analysts, according to the Office for National Statistics (ONS). The pound rose against the dollar and euro after statisticians said growth was strong and wide-ranging, with the services, industrial and construction sectors all expanding month-on-month. It comes after a strong rebound in 2024 following last year's recession.

Grant Fitzner, the ONS's chief economist, described the expansion as "buoyant", adding that other indicators of the economy suggested the recovery was gaining traction. It suggests the Labour leader is beginning his premiership against the best economic backdrop in years. Here's why:

Growth firing on all cylinders

Britain's services sector was the largest contributor to growth, with the sector expanding by 0.3pc month-on-month. May's dry weather also meant the construction sector grew by 1.9pc compared with April, with the expansion partly driven by house building. Liz McKeown, director of economic statistics at the ONS, said: "Construction grew at its fastest rate in almost a year after recent weakness, with house building and infrastructure projects boosting the industry. Meanwhile, manufacturing also grew a little, led by food and drink firms." The ONS said May's growth was driven by a rise in "scientific research and development", as well as technical testing and analysis linked to the engineering sector.

On a quarterly basis – a less volatile measure – it means the economy expanded at a pace of 0.9pc in the three months to May. This is the strongest momentum in two-and-a-half years. It means that even if the economy shrinks in June, it would have grown by 0.5pc in the second quarter, in line with the Bank of England's expectations. Mr Fitzner said: "It continues a reasonably buoyant trend that we've seen through the first half of this year. Some of that is a bounce back from the economic downturn from last year, but the fact that this is continuing into the June quarter... suggests that we are looking at another strong positive quarter in the three months to June."

The strong performance prompted economists at Goldman Sachs to upgrade their growth forecasts and a prediction that the pound would hit $1.30 against the dollar by the end of the month. James Moberly, an economist at Goldman, said: "We raise our annual GDP growth forecast for 2024 to 1.2pc (from 1.1pc previously). [This is] above consensus of 0.7pc and the Bank's forecast of 0.4pc."

Britain 'top of global growth league'

British businesses are among the most optimistic in the world when it comes to the outlook for the next 12 months. While the ONS insisted it was not in the business of forecasting, Mr Fitzner highlighted that recent surveys show British bosses are more upbeat than their counterparts in Germany, Japan, Ireland and even America, which has seen rapid growth over the past year.

Mr Fitzner singled out a survey by S&P Global that showed Britain at the "top of the league" for business optimism, with both British manufacturing and services companies predicting an expansion in activity over the next year, continuing the optimism seen at the start of the year. "There are no major warning signs out there pointing to a marked downturn ahead," he said. "Whether that growth

momentum continues in the second half of the year remains to be seen, but if you look at what businesses are saying and you look at most real-time indicators, they don't suggest any marked slowing or any major disruptions to the economy."

Inflation back at target

With inflation falling back to the Bank of England's 2pc target in May, pay continues to rise faster than prices, meaning households are finally starting to feel better off. The fall was psychologically important, even though the Bank believes price rises will pick up in the second half of this year as energy bills stabilise. Investors currently believe there is a 50:50 chance the Bank will start cutting rates in August.

Interest rates still on course to fall later this year

Even if the Monetary Policy Committee (MPC) opts to keep rates on hold, economists still believe borrowing costs will come down this year. However, Philip Shaw at Investec said the stronger economy strengthened the case for a delay. He said: "A key issue is how concerned the MPC is that a more buoyant than expected economy could result in a tightening in the labour market and with it, raise the risks of medium-term 'inflation persistence'." He added: "While one should not read too much into one month of GDP data, the economy has been performing more strongly than expected over the year so far. Our base case is still that the MPC will cut rates by a quarter of a percent on August 1, but the case for easing looks more finely balanced than it did previously."

Living standards lag

One big challenge for chancellor Rachel Reeves will be how to raise living standards and get more people back into work. The International Monetary Fund has highlighted that growth in Britain's workforce had been powered entirely by immigrant labour since 2019. The result is that GDP per person has grown much more slowly. James Smith at the Resolution Foundation highlighted that GDP per head grew by just 4.3pc in the 16 years to the start of 2024, compared with almost 50pc in the previous 16 years.

Economic inactivity remains the other big challenge. Around 2.8 million people now say they are too ill to work, the highest number on record. Liz Kendall, the Work and Pensions Secretary, has pledged to introduce a "youth guarantee" that will increase training opportunities for everyone aged between 18 and 21.

➢ 16 July 2024

The Telegraph reports that growth in Britain is set to outstrip every other major European economy next year, the International Monetary Fund has predicted, in a sharp bounce back from the recession in 2023. The UK's GDP will grow by 0.7pc this year, the IMF said, upgrading the forecast from its previous prediction of 0.5pc after government statisticians described the economy as "going gangbusters" in the early months of this year.

In 2025, growth will more than double to 1.5pc. That is faster than the 1.3pc projected for Germany and France next year, and the 0.9pc anticipated in Italy. Such strong growth figures will boost the new

Labour Government, though the 1.5pc projected for next year - and so covering the period without any Conservative rule - have not been upgraded.

Germany's outlook has not been upgraded at all. It is set to eke out an expansion of just 0.2pc this year as the industrial power struggles to recover from 2023's contraction. "Continued weaknesses in manufacturing suggest a more sluggish recovery in countries such as Germany," the IMF said, even as the eurozone as a whole benefits from falling inflation and rising wages. So far this year "shoots of economic recovery materialised in Europe, led by an improvement in services activity".

Among the wider G7, Britain will also outpace Japan's anticipated growth of 1pc for 2025, coming in behind only the US - at 1.8pc - and Canada, which is leading the way with an expansion of 2.4pc. But there are risks. Lingering inflation means interest rates may have to be cut more slowly than borrowers hope, the IMF said, or even rise further to ensure price pressures are completely under control.

➢ 22 July 2024

Szu Ping Chan explains "Why Starmer faces a Herculean task to get Britain to top the G7 growth league". She writes that Sir Keir Starmer's number one mission in the next five years is to grow the economy. The Labour leader wants Britain to be the fastest growing country in the G7. Hitting that target hinges on topping the league table for increases in per person output for two years running by the end of the decade.

Targeting per-capita output means Labour must improve the economy's underlying productivity, rather than simply relying on immigration to boost growth as more people do more jobs. Labour starts from a position of weakness. Growth per person rose by just 0.5pc in the first three months of the year, following seven straight quarters of stagnant or falling output – the longest stretch on record. Britain's big problem is the collapse in productivity growth since the financial crisis, which averaged 2.3pc per year in the three decades before 2007 but has slumped to around 0.4pc per year since then.

In simple terms, that means that the average worker in 2007 was able to produce twice as much as they could have 30 years before, while putting in the same number of hours. By contrast, the average worker today is producing just 5pc more than they were before the Great Recession. The Resolution Foundation says the UK hasn't experienced such slow growth over a comparable 16-year period since 1826.

How productive we are as a nation ultimately determines our wages, which have also stagnated since the financial crisis. Average annual wages would be £14,000 higher than they actually are had growth kept up with the pre-2007 trend, according to the think tank. Weak productivity growth also means the economy has less room to grow before inflationary pressures start to emerge.

The Government's own tax and spending watchdog believes Starmer's 2.5pc growth targets will stoke price rises. The Office for Budget Responsibility (OBR) thinks the UK economy can only grow by 1.6pc in the medium term before it starts to overheat and the Bank of England must raise interest rates to cool it down again. The Bank of England is even more pessimistic in its estimates. Read on at: Why Starmer faces a Herculean task to get Britain to top the G7 growth league (msn.com)

➢ 25 July 2024

Tim Wallace and Szu Ping Chan write that "Labour's push to turn the UK into an 'island of stability' appears to have been timed to perfection." They go on to report that Rachel Reeves wants to promote Britain as a newly stable place to invest. Speaking at the G20 meeting in Brazil, the new Chancellor will urge international businesses to "take another look at Britain". "After years of uncertainty and instability, Britain is open for business once again," she will say.

Financial markets appear to agree as investors hoover up gilts, otherwise known as UK government bonds. Not only does this signal a new-found faith in British assets, but it also drives down the Chancellor's borrowing costs. Compared to 12 months ago, the UK is paying less to borrow from global investors, unlike peers including France, Germany and the US.

Almost any government would mark a contrast with that of the Liz Truss era, during which the bond market crashed and Britain was deemed to have acquired a "moron premium" on its debt. But Reeves has spent time building a reputation for prudence, defying those in her own party who want to ramp up public spending to instead double down on tight borrowing rules.

If she can do more to convince markets her plans are sensible – particularly if they are accompanied by painful tax rises – then those borrowing costs could fall further, according to Michael Saunders, a former Bank of England policymaker now with Oxford Economics. "Such a shift would deliver a more credible route to meet the fiscal rules than the existing fiscal plans," he says. "It probably would help lower bond yields and market interest rate expectations. "In turn, lower bond yields could yield a windfall of lower debt service costs for the Government."

Chris Sanger, head of global tax policy at EY, says the "clear set of principles and policies" set out by Labour well before the election have stood the UK in good stead. "There are clear messages being given by the Government today about wanting to attract investment, and there are also clear commitments not to raise the tax rates of income tax, National Insurance, corporation tax and VAT." To its benefit, Labour has come to power just as other nations look wobbly. This encapsulates the cut-throat competition of financial markets in that a country does not need to look stable, merely less unstable than the nation next door. Read on at: How Britain is shaking off the 'moron premium' to become a haven for global cash (msn.com)

➢ 26 July 2024

We conclude this section on another upbeat note. Ambrose Evans-Pritchard reports that "The British economy is in miraculous good health – the eurozone has stagflation". Read on at: The British economy is in miraculously good health – the eurozone has stagflation (msn.com)

Stop Press: 1 August 2024.

The Bank of England cuts interest rates from 5.25% to 5.0%, and the Bank has more than doubled its growth forecast for this year to 1.25% from 0.5%.

AEROSPACE MANUFACTURING

Source: Shutterstock

With the assistance of Wikipedia and Copilot we introduce this section with an explanation of Smart Manufacturing, sometimes referred to as Industry 4.0

Smart manufacturing is a broad category of manufacturing that employs computer-integrated manufacturing, high levels of adaptability and rapid design changes, digital information technology, and more flexible technical workforce training. Goals sometimes include fast changes in production levels based on demand, optimization of the supply chain, efficient production and recyclability. In this concept, smart factories have interoperable systems, multi-scale dynamic modelling and simulation, intelligent automation, strong cyber security, and networked sensors. The broad definition of smart manufacturing covers many different technologies.

Some of the key technologies in the smart manufacturing movement include big data processing capabilities, industrial connectivity devices and services, and advanced robotics. Key features of smart manufacturing include:

- **Computer-integrated manufacturing**: Utilizing computers to control the entire production process.
- **Digital information technology**: Leveraging big data, cloud computing, and the Internet of Things (IoT) to enhance decision-making and efficiency including the integration of sensors and connected devices to collect and analyze data for real-time process control.
- **Advanced robotics and Automation**: Employing robots that can operate autonomously and collaborate with humans enhancing precision, and productivity.
- **Digital Twins and Simulation**: Virtual replicas of physical processes or products that allow for real-time monitoring and optimization.

- **Artificial Intelligence (AI) and Machine Learning (ML)**: These technologies analyze complex datasets to optimize production lines and predict maintenance needs.

- **Cloud Computing**: Facilitates data storage, processing, and sharing across the manufacturing ecosystem.

- **Predictive and Prescriptive Maintenance**: Using data to predict equipment failures and prescribe maintenance actions before issues arise.

- **Flexibility and Adaptability**: Ability to quickly adapt to design changes and varying production levels.

The goal is to improve productivity, sustainability, and economic performance by creating a highly connected, knowledge-enabled industrial enterprise.

Several leading aerospace companies are actively incorporating smart manufacturing technologies to enhance their production processes. Here are a few notable examples:

Boeing: Boeing uses advanced robotics, digital twins, and IoT to streamline its manufacturing processes and improve efficiency.

Airbus: Airbus employs smart manufacturing techniques, including digitalization and automation, to optimize production and reduce waste.

Lockheed Martin: This company integrates smart manufacturing with digital engineering and advanced analytics to enhance its aerospace and defense manufacturing capabilities.

Northrop Grumman: Northrop Grumman uses smart manufacturing to improve the precision and efficiency of its production processes.

GKN Aerospace: GKN Aerospace focuses on smart manufacturing to support sustainable aviation and zero-emission goals.

Visit our new website 'Technologies' section at: Technologies of the Fourth Industrial Revolution – The Schools' Aerospace Careers Programme

Now we continue with chronological news items.

- **25 April 2024**

Andrew Orlowski explains that in a vast Farnborough hangar the wings of the largest aircraft made in Britain recede into the far distance. Despite its size – at 85 feet, the wingspan is considerably greater than an executive Learjet – I could probably pick it up if I was allowed to. The Zephyr, made by Aalto, weighs just 65kg.

Its light weight helps the craft reach dizzying heights. Unlike conventional aircraft, which typically fly between 30,000 and 40,000 feet, Aalto is one of several British ventures blazing a trail in the

stratosphere, the region of our airspace that starts at 60,000 feet. “It flies at twice the height of an airliner, but at the speed of a bicycle,” staff politely explain on the production line. It’s here, in the cold, thin air that was previously the sole domain of spy planes like Lockheed’s U-2, where Britain has taken an unlikely pioneering lead. Aircraft that inhabit this domain are called “High Altitude Platforms”, or HAPS.

“It’s a pseudo satellite,” explains Tim Robinson of the Royal Aeronautical Society. Not quite in space but above the weather systems, these HAPS can offer the same services as a satellite: chiefly, imaging and communications. Read on at: Meet Britain's cutting-edge stealth aircraft – that flies at the speed of a bicycle (telegraph.co.uk)

Aalto Zephyr. Credit: Aalto

➢ 9 May 2024

Raoul Simons writes in The Telegraph that a whistleblower has claimed one of Boeing’s largest suppliers regularly allowed aircraft fuselages to leave its factory with up to 200 defects. Santiago Paredes, who worked for Spirit AeroSystems in Kansas between 2010 and 2022, told the BBC he often found defects on parts being prepared for shipping to Boeing.

Mr Paredes even earned the nickname “showstopper” from colleagues for slowing down production when he raised concerns, he claimed. Before he departed from the company, he led a team of inspectors based at the end of the production line for Boeing’s 737 Max planes. Mr Paredes told the BBC he was accustomed to finding “anywhere from 50 to 100, 200” defects on fuselages - the main body of the plane - bound for Boeing. “I was finding a lot of missing fasteners, a lot of bent parts, sometimes even missing parts,” he said.

Spirit said it “strongly disagree[d]” with the allegations. A spokesman said: “We are vigorously defending against his claims.” Boeing declined to comment to the BBC on Mr Paredes’s claims. See the full article at: Boeing supplier Spirit AeroSystems 'regularly shipped defective aircraft fuselages' - whistleblower (telegraph.co.uk)

➢ 12 May 2024

Mat Oliver reports that just weeks into his new job running Rolls-Royce, Tufan Erginbilgiç gathered nervous staff for a meeting at the engineering giant's headquarters in Derby. The meticulous Turkish executive had spent the past month studying the FTSE 100 company from all angles and talking to investors who were long past fed up. Now, he had a characteristically blunt verdict for its 42,000 employees: Rolls was a "burning platform" – and they were all standing on it. "Given everything I know, this is our last chance," he warned.

It was a shock and awe tactic that divided opinions, with some critics branding it a "Gerald Ratner approach", the British jewellery magnate who called his own company's products "total c---". At the company's annual general meeting a few months later, one angry shareholder berated Erginbilgiç for "destabilising" the business. Erginbilgiç was unrepentant – and remains so.

"What I was doing with that description was telling people that, actually, they were living in a fake world," he tells the Telegraph (although he concedes his "burning platform" comment was only ever meant to be heard internally). "The company effectively was at a point where we couldn't do anything we wanted to do. And what we could do, frankly, wasn't a lot. "I thank everybody who contributed to the history of Rolls-Royce. But we need to talk about some facts here."

Just over a year on, things look starkly different. Erginbilgiç, known as "Turbo Tufan" by analysts, is now hailed in the City as a conquering hero – the man who finally got the unwieldy Rolls-Royce machine firing on all cylinders. The company's blockbuster annual results in February seemed to confirm as much, with Rolls reporting a doubling of profit margins and record free cash flows. Rolls's share price has risen 350pc under Erginbilgiç and the company's prized "investment grade" status has been restored by credit rating agencies. (A stepping stone, perhaps, towards the return of the dividend following a four-year absence.) Read on at: Inside Rolls-Royce's extraordinary British revival (telegraph.co.uk)

➢ 22 May 2024

Christopher Jasper advises that Airbus is to hire 400 engineers at its wing manufacturing plant in Wales as the company races to extend its lead over crisis-hit Boeing in the market for single-aisle jets. Additional staff will be required at the plant in Broughton, near Chester, as Airbus transforms a building that made wings for the A380 superjumbo into a production line for the best-selling A320neo model. Covering an area larger than 10 football pitches, the West Factory site is key to plans to lift monthly A320 output from an average of 48 last year to 75 by the end of 2026.

Jerome Blandin, Airbus's head of global wing production, said the new line will not be as fully automated as the plant's most recent new A320 wing line, which opened seven years ago, making it potentially more labour intensive. The ramp up will help Airbus reduce its six-year manufacturing backlog for the model and make space for new orders. It is expected to heap more pressure on Boeing as the US business slows build rates to address the safety crisis surrounding its 737 Max, the chief global rival to the A320.

Broughton currently employs about 5,000 people and is Airbus's main UK manufacturing site. A second wing facility at Filton in Bristol is a focus for design, engineering and support and has about 3,000 staff. The recruitment drive for the new plant comes after Airbus added 1,100 staff in Britain

last year across divisions also including defence and space. The expansion is a far cry from the years before Brexit, when then boss Tom Enders warned that a no-deal departure from the European Union would force Airbus to make some "potentially very harmful decisions for the UK", including moving wing production elsewhere.

Mr Blandin said one of the challenges for Broughton is to keep pace with the demands of the company's A320 assembly lines in Toulouse, Hamburg, Alabama and China, while constantly honing the production process for what remains a traditional, metal wing. He said: "We will see a level of improvement and a better efficiency on the new production line in terms of how we put the product together."

Airbus has already taken steps to increase A320 wing capacity at Broughton's original East Factory site, located across the runway from the former A380 building and dating to 1939 when it was built for the construction of Lancaster and Wellington bombers. Production is running round the clock in a three-shift pattern and Airbus has taken steps to compress each part of the manufacturing process in an effort to shave days off the six to seven weeks required to make a wing.

The last wholesale expansion of A320 manufacturing capabilities at Broughton came in 2016 with the opening of a new, fully automated production line alongside the existing one, which extended capacity by 26 aircraft wing sets a month to the current 63. Read further at: Airbus to hire 400 British engineers in race against crisis-hit Boeing (telegraph.co.uk)

- **23 May 2024**

Matt Oliver reports that Rolls-Royce has been chosen to supply technology for a new version of the American military aircraft nicknamed the "Doomsday plane" for its ability to survive a nuclear blast. The engineering giant is joining a group of aerospace companies working on the Survivable Airborne Operations Center (SAOC) project, which aims to develop a successor to the US Air Force's E-4B planes – militarised versions of the Boeing 747-200 jumbo jet that have been in service since the 1970s.

Normally used to transport the Secretary of Defence, the E-4Bs are also designed to function as a mobile command centre during national emergencies – should ground facilities be knocked out – with the aircraft capable of being refuelled in the air and withstanding nuclear blasts and electromagnetic pulses. Four of the planes are currently in service and at least one is always kept on alert at a US military base somewhere in the world.

Each one can seat up to 111 people, including the flight crew. In an emergency they are designed to carry the US president, the secretary of defence and the joint military chiefs, with the ability to give orders to American forces across the globe while in flight. Within the E-4B's main deck is a command work area, conference room, briefing room, operations team area, communications area and rest area, according to the US Air Force. Read further at: Rolls-Royce wins contract for US military's 'doomsday plane' (telegraph.co.uk)

➢ 25 May 2024

Christopher Jasper writes that away from the busy commotion of the factory floor, there's a corner of the Broughton complex where even Airbus staff are not allowed to tread without permission. The Advanced Manufacturing Research Centre (AMRC), an outpost of the University of Sheffield, sits at the heart of Airbus's efforts to develop a next-generation plane capable of consolidating the company's lead over Boeing in the market for single-aisle jets. Key to this is Airbus's Wing of Tomorrow programme, which is building three prototype wings to establish just how far the engineering envelope can be pushed. To describe the efforts as futuristic would be a rank understatement.

Current plans envisage composite wings far longer and thinner than those on Airbus's existing planes and feature a hinge at each end so that the tips can be folded vertically, allowing the aircraft to fit into existing airport gates without clashing. The new wings are being developed for Airbus's narrow-body planes – the single-aisle, workhorse aircraft that make up the majority of the aviation market.

Airbus is not the first to dream up folding wings: Boeing will introduce them on its new 777X jet, due for delivery in 2026. The plane will feature a long wing that, without the hinge, would otherwise limit it to using gates reserved for jumbo jets. However, the number of planes involved in Boeing's widebody 777X project is tiny compared with the vast market for a new single-aisle plane. Airbus's existing narrow-body A320 family alone has accrued more than 18,000 orders since its launch.

The Boeing 777X with folding wings. Source: Shutterstock

Folding wings may sound eccentric but a parallel programme at the AMRC will test even more radical ideas. The eXtra Performance Wing, known as X-wing within the company, has a 52-metre span – 16 metres more than an A320 – and is equipped with so-called adaptive control technologies that will allow the wing to reshape itself to suit changing flight conditions, much as a bird's wing does.

Airbus is examining such exotic solutions in a pursuit of the holy grail of wing dynamics: increasing lift while diminishing weight, and hence reducing fuel burn. It's a challenge that goes to the heart of efforts to curb aviation's carbon footprint. "These are longer, leaner wings that will improve aerodynamic efficiency and make a very significant contribution to fuel-burn reduction," says Sue Partridge, who leads Wing of Tomorrow and is also Airbus's UK country manager for commercial aircraft. Read the full report at: Airbus plots folding wings in latest challenge to rival Boeing (telegraph.co.uk)

➢ May 2024

With Europe, the US and other nations around the world hoping to seize their share of military sales, in the May edition of AERO SPACE an article by Professor Keith Hayward titled 'Fighting for the Market' looks at those trying to break into the global fighter market.

Additionally, under the title 'Use them/lose them? Attritable drones', Ed Hunt investigates the future of collaborative combat aircraft, loyal wingmen and commercial off-the-shelf alternatives.

Continuing in the same AERO SPACE edition, Jonathan Glanville and Steve Bleymaier share their thoughts on 'Digital engineering for next-generation air superiority'.

Furthermore, with machine learning and AI technologies in mind, Dr Dave Sloggett asks the question will 'Intelligent EW Systems be a viable counter to stealth-based technologies?'

And Andrew Eady in an article titled 'Sustainable, responsible and holistic' explains how the FCAS (Future Combat Air System) sustainability strategy reflects a broader shift within the defence sector towards responsible innovation.

Finally, in the same edition, Tim Robinson reports on 'Designing Tempest from the inside out'; and Bella Richards looks at how Airbus plans to connect air and space combat clouds in the FCAS programme.

4 June 2024

Source: Airbus and The Telegraph

Staying with Airbus, Matt Oliver reports that [the company] has unveiled a new unmanned combat jet (above) that will be capable of acting as a "loyal wingman" for RAF pilots flying Eurofighter Typhoon aircraft. The European aerospace giant unveiled the sleek-looking concept drone at the Berlin International Airshow, where defence companies are this week showing off their latest wares.

On the tarmac at the event, the company is exhibiting a 1:1 scale "show car" version of the machine. According to Airbus, the Wingman drones will be used as affordable "force multipliers" that will be under the control of a pilot in a nearby manned aircraft. Their tasks could include carrying out reconnaissance, jamming targets and attacking ground or airborne targets with precision guided weapons, allowing them to take on high-risk missions that would pose a danger to humans. However, the company stressed that the pilots commanding the machines would always act as "the final decision-making authority".

Airbus said it is working to have the Wingman operational by the early 2030s, with the company currently exploring the concept with the German air force. Airbus said talks were ongoing with Germany and Spain about possible purchases, adding: "We cannot comment on whether the UK might, or might not be interested."

A spokesman said: "The Wingman project is an Airbus's concept of a next-generation, high-performance, autonomous, collaborative platform. It is currently a self-funded Airbus effort to pioneer the technologies that could enable the entry-into-service of such a capability in the early 2030 timeframe, in order to initially operate alongside current-generation fighter aircraft (e.g. Eurofighter)."

The machine is one of several unmanned aircraft being developed by defence companies around the world as militaries look for ways to bulk up their forces with nimbler, more affordable vehicles that can complement more expensive and advanced platforms such as F-35 stealth jets. For example, Boeing is currently working to develop the unmanned "Ghost Bat" for the Royal Australian Air Force, while the US Air Force has been trialling the Kratos XQ-58 Valkyrie stealth jet drone. Read on at: Airbus unveils unmanned stealth combat aircraft to support fighter jets (telegraph.co.uk)

- **June 2024**

In 2024 a joint survey by the RAeS and digital manufacturing experts, Protolabs, revisited a 2023 questionnaire on the top concerns and issues for those in aerospace manufacturing. One year on in this month's edition of AERO SPACE Tim Robinson reports on the findings of this updated industry snapshot.

- **1 July 2024**

Christopher Jasper writes that the future of a major British aerospace plant is in doubt with up to 2,400 jobs at risk following a "carve-up" of Spirit AeroSystems between Boeing and Airbus. A chunk of Spirit's operations at the facility in Belfast has been left without an owner, putting the long-term future of the entire factory in danger.

Boeing is to buy Kansas-based Spirit for $4.7bn (£3.7bn) in order to gain control of a key supplier to its troubled 737 Max jet, while offloading operations that provide components for Airbus to its European rival. This means Airbus will be taking control of a part of the Belfast factory that oversees wing and fuselage production for the Airbus A220 regional jet.

Boeing said an alternative buyer is being sought for the other parts of Spirit's Belfast business that neither manufacturer is prepared to take on. But if this deal falls through it is feared the entire facility – the biggest manufacturer in Northern Ireland – will no longer be commercially viable. See: Future of UK factory in doubt after Boeing deal puts 2,400 jobs at risk (telegraph.co.uk)

- **8 July 2024**

John Arlidge writes that Christian Scherer, the head of Airbus's civil aircraft division, sparked excitement last month when he suggested that the European plane-maker might resume production of its four-engine A380 double-decker superjumbo. Airbus scrapped production of the $450 million "king of the skies" in 2021 after airlines opted for smaller, more fuel-efficient twin-engine jets. But Scherer told the German newspaper Hamburger Abendblatt that while the door to the A380 production line "is closed, it is not locked. In industry, nothing is ever ruled out."

The reason for his teasing announcement? The A380 is enjoying a remarkable comeback. When Covid struck, many airlines decided to scrap "the big bird" because, with fuel costs rising and predictions that demand for business- and first-class travel would crater post-pandemic, most figured the behemoth would be unprofitable. But Lufthansa, Qatar Airways, Korean Air, Japan's ANA and Etihad, the Abu Dhabi flag carrier, have all done a U-turn at 39,000ft and re-introduced the A380. (Only Air France and Malaysian Airlines have stuck to their original decision).

What's more, those airlines which remained committed to the A380 all along have improved it. Singapore Airlines has refurbished its superjumbos, even introducing double beds in Suites Class at the front of the upper deck. Qantas's A380s now boast top designer David Caon's business-class suite and a bar in the nose cone. British Airways' chief executive, Sean Doyle, recently announced that his airline's 12 A380s will be refitted with the new Club Suite on the upper deck and a new First Class, also likely on the upper deck, rather than downstairs as it is now.

A new kid on the airport block, Global Airlines, recently secured its first A380, which it flew from the US to Prestwick in Scotland for a refit. Global's founder, James Asquith, wants to use a fleet of A380s to "transport passengers back to the golden age of air travel", starting with flights from London to Los Angeles and New York. The former investment banker is refurbishing the first of the four superjumbos he and his investors have bought to create a large bar on board. First-class ticket holders will be chauffeur-driven to the airport for Global flights. Food and drink will be "the best at 39,000ft" and include Laurent-Perrier champagne, even for economy-class passengers, he promises.

Overall, 145 Airbus A380s are back in the air, spread across 10 airlines, according to aviation analysts ch-aviation.

- **10 July 2024**

Christopher Jasper advises that Airbus plans to use a series of small electric motors to power its first hybrid airliner as it bids to slash carbon emissions by relying on technology developed for the car industry. Trials of the motors are already underway on an experimental helicopter that first flew last year, boosting hopes of rolling them out across other types of aircraft. Karim Mokaddem, the firm's head of electrification, told The Telegraph that Airbus's approach to building a hybrid successor to the best-selling A320 jet will form a blueprint for all other models. The strategy will simplify the task

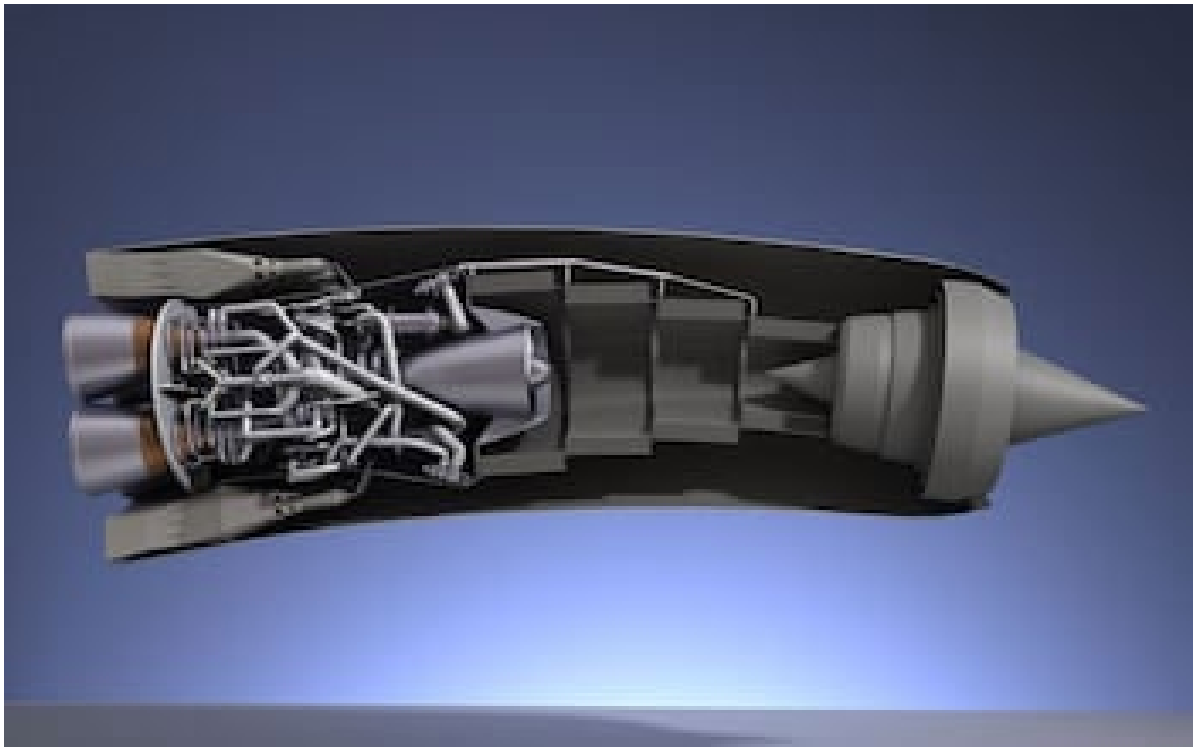
of scaling up electrification, he said, as it will mean the planemaker will only need to add or remove motors depending on the size of a plane.

Crucially, the deployment of smaller motors and batteries will also help Airbus build on advances pioneered by the automotive sector in its own shift away from fossil fuels. That will help Airbus access higher volumes of the required hardware without relying on suppliers to develop bespoke technology solely for the aviation industry. Mr Mokaddem said: “When it comes to batteries and electrical parts we will have to compete with a market that’s much bigger than the one we’re in today. “The beauty of a modular approach is that we can work with the automotive sector and enjoy the benefits of volume production.”

While all-electric propulsion may be practical for very small aircraft, batteries lack the energy required to power full-sized airliners such as the 180-seat A320, Airbus’s rival to the Boeing 737 and a workhorse on short-haul flights around the world. Airbus is working on concepts for planes that would use a liquid hydrogen propellant instead of jet fuel, but views hybrid power as a more immediate pathway toward reducing emissions.

A hybrid airliner would use auxiliary batteries to supplement its traditional jet engines, which would continue to provide the bulk of the required thrust. Electric motors would kick in at certain times, such as when the engines were idling during descent. They would also power non-propulsion-related activities, such as taxiing at the airport. Read further at: Airbus trials electric engines to power the future of flight (telegraph.co.uk)

- **12 July 2024**



Reaction Engines’ Sabre is able to operate as a conventional jet engine and a rocket. Credit: PA

Matt Oliver reports that Rolls-Royce is holding talks with fellow shareholders over a struggling British space plane engine developer as the start-up races to raise cash. The FTSE 100 engineering giant is involved in discussions about how to support Oxfordshire-based Reaction Engines, which it backed alongside Boeing because of the business's potential breakthrough in heat management technology. Reaction claims its hybrid jet-rocket engine could one day enable a new era of hypersonic flight – where any destination around the world is never more than a few hours away – leading some to anoint it the heir to Concorde. But as with the famous Anglo-French project, developing the technology has proved costly and bosses at Reaction are reportedly scrambling to raise more money after missing their financial forecasts.

On Thursday, Simon Burr, Rolls-Royce's engineering chief, confirmed the company was among those engaged in talks. Mr Burr said: "We are interested in the challenges they have, and we still need better heat exchange technology for the future, so we are obviously not disinterested. "There are discussions happening about it [within Rolls-Royce] and between the various stakeholders. I can't say anything more than that." Read further at: Rolls-Royce in talks over struggling Concorde successor (telegraph.co.uk) And also at: Why the British attempt to invent Concorde's successor flew into trouble (msn.com)

- **15 July 2024**

Christopher Jasper advises that Airbus is to freeze hiring and cut its costs as it fights a wave of cheaper airliners from China. The European champion is scrambling to boost productivity and reduce costs per plane ahead of an expected onslaught of exports from the Commercial Aircraft Corporation of China (Comac), which is seeking to establish itself as a major player in Western air travel.

Some Airbus roles may be axed, although the plan – codenamed 'Lead' – does not amount to a formal redundancy programme, bosses said in a memo to workers. The memo, which was confirmed by the company, highlighted Comac's strong state-backing and large domestic market, while also warning that Boeing is likely to emerge stronger from the current safety crisis around its 737 Max model.

- **20 July 2024**

Christopher Jasper also reports that the worldwide number of passenger jets will double to 50,000 planes over the next 20 years as more people embrace flying in defiance of climate campaigners, according to a Boeing forecast. Soaring passenger numbers will require 1,600 more jets than the US manufacturer estimated a year ago, it said in its latest update, as demand for travel outpaces economic growth.

The retirement of older planes, which emit more CO2, has also slowed to half the usual rate as supply-chain issues limit new deliveries, while average fuel consumption has increased. Meanwhile, planes are expected to continue flying only 80pc full for the foreseeable future, while the process of squeezing more seats on to each jet is expected to slow.

Boeing's forecast is a challenge to the so-called flight-shaming movement, which has been encouraging holidaymakers to shun air travel for the sake of the planet. While the airline industry has committed to reaching net zero emissions by 2050, fuel produced from waste cooking oil, seen as key to slashing CO2 output until the advent of new technologies, is costly and available only in very low volumes.

In a further blow to the climate lobby, Boeing also cited an analysis of multiple passenger surveys as indicating that the majority of people plan to take more trips and spend more on them. Two-thirds of respondents suggested that they aim to fly more than before Covid, while 85pc said they would make travel a spending priority. Average trips will also last a day longer.

Technological advances will tend to act as a global enabler for accessing travel rather than holding back demand as Zoom calls proliferate, Boeing said. The average global airfare has barely budged in 20 years even as overall consumer prices have doubled, making flights comparatively more affordable.

Even the advent of more comfortable cabins has served to increase emissions. Premium economy seats that weigh more and take up space that could have been occupied by extra passengers now account for a third of all bookings on transatlantic routes, Boeing said.

Demand for flights will grow fastest in emerging markets such as India, according to the company's annual commercial market outlook, as an expanding middle class embraces a travel revolution that began in the West in the 1960s and 1970s. See: Airline fleets to double in new blow to flight-shamers (msn.com)

- **22 July 2024**

AFP reports that Boeing announced today a raft of orders on the first day of Britain's Farnborough Airshow, shrugging off safety and production woes as the industry struggles to keep up with demand. The embattled US aviation giant swooped for a bumper deal with Korean Air, inking a firm order for 20 777-9 wide-body jets — which has yet to be certified — and 20 787-10 Dreamliners. The purchase, including an option for 10 extra 787 aircraft, is worth more than $15 billion at catalogue prices — although big discounts are usually applied to vast orders.

"I have full confidence in Boeing," Korean Air chief executive Walter Cho told reporters at a signing ceremony unveiling the deal, in reference to the US group's recent woes. "We are working on the new designs right now. We are always pursuing the best customer experience and comfort," he said, adding the Seoul-based carrier expects the first delivery "on time" in 2028.

The Boeing 777-9 has just begun certification flights and could be authorised to fly passengers by 2025 at the earliest, which is five years behind schedule. The Seattle-based planemaker also took the opportunity to formalise a purchase from Japan Air Lines for 10 Dreamliner 787-9s, with options for another 10 jets, in a deal flagged in March worth almost $3 billion. "Boeing and Japan Air Lines have a very long and enduring relationship, even through difficult and challenging times," said Yukio Nakagawa, JAL's executive officer for procurement, at Farnborough. "Together with Boeing, we remain dedicated to our commitment to safety and quality." US group National Airlines placed a firm order for four 777-200 wide-body cargo planes as it looks to tap into global e-commerce.

"We have an incredibly strong backlog. We're sold out until the end of this decade," Stephanie Pope, chief executive of Boeing Commercial Airplanes, said on the eve of the show.

➢ **23 July 2024**

The chief executive of BAE Systems has told Sky News that, while the programme to build the UK's planned sixth-generation fighter jet is expensive, it will be vital for the country's future defence requirements and for creating tens of thousands of skilled jobs.

The new concept Tempest combat aircraft has been unveiled at the Farnborough International Airshow. Pic: BAE Systems© Other

Charles Woodburn was speaking on day one of the Farnborough Air Show amid speculation that the Global Combat Air Programme (GCAP), nicknamed Tempest in the UK, could be at risk in the forthcoming Strategic Defence Review. He said: "GCAP is an incredibly important programme for the UK, in military air capability. There's in excess of 50,000 jobs, very high-quality jobs around the UK, in the military air sector. GCAP is the future.

"We know programmes such as GCAP are expensive programmes, which is why working in partnership with like-minded allies like Japan and Italy is so important because there you're able to share the cost and share the capabilities across multiple like-minded allies. "And we've got a very strong partnership, which is really driving this programme forward."

Tempest was first unveiled in 2018 as a successor to the Typhoon and to previous generations of jet fighters such as the Tornado. GCAP has subsequently become an important element of UK diplomatic policy, as well as UK manufacturing, as a number of international defence contractors including Leonardo, the Italian parent company of helicopter maker Agusta Westland and Saab, Sweden's leading defence contractor, joined Team Tempest.

Two years ago, Japan agreed to merge its own sixth-generation jet fighter programme, Mitsubishi F-X, with Tempest, bringing on board Mitsubishi Heavy Industries as a prime contractor. And the diplomatic importance of GCAP was underlined when, in December last year, Rishi Sunak's

government formally signed an international treaty with Italy and Japan confirming that the project would be headquartered in the UK.

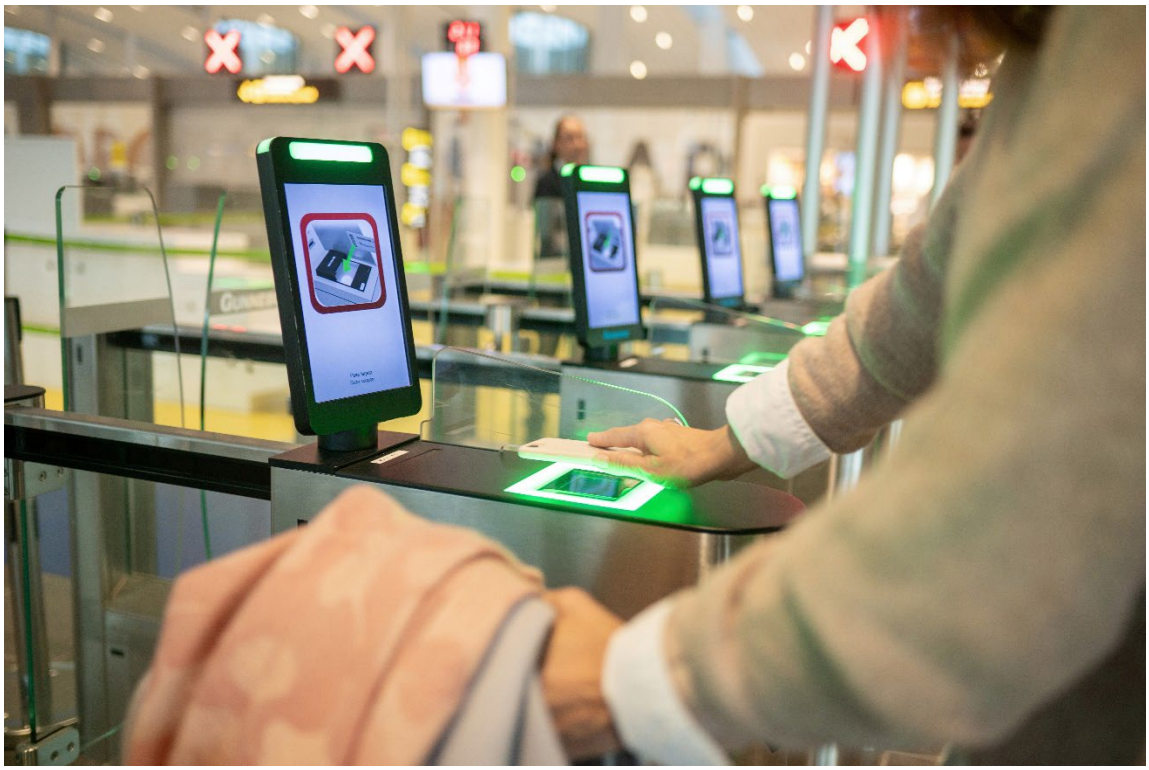
Sir Keir Starmer, the Prime Minister, later made reference to that meeting when, during his visit to Farnborough, he was asked about GCAP. He told reporters: "It's important for me to put on record just how important a programme this is…I know that people in the room will want to hear me say that. The defence secretary is holding a ministerial-level meeting…in relation to this because of the significant benefits here in this country."

Mr Woodburn was speaking as the three main GCAP partners unveiled the latest concept model of the aircraft which features a much more evolved design with a wingspan larger than previous concepts - aimed at improving the aircraft's aerodynamics. He added: "There are quite a number of differences in the wing design and the profile of the aircraft. Obviously, we've been working now with our partners on this programme for the last 18 months together, and it's evolved. And you see some of those evolutions on the design.

➢ July 2024

In the July edition of AERO SPACE, Professor Keith Hayward in an article titled ‘A new thirty year war?’ considers the question, could state investment in a new generation of greener airliners spark renewed legal battles between Europe and the US?’

COMMERCIAL AVIATION OPERATION



Source: Shutterstock

With the smart technology of 4IR being increasingly adopted across so many facets of everyday life we commence this section with an explanation of Smart Airports. Curtesy of Copilot here are some key features and benefits.

Key Features:

- ***Internet of Things (IoT)***: IoT devices and sensors are used throughout the airport to monitor and manage various operations, such as baggage handling, security, and passenger flow.
- ***Artificial Intelligence (AI)***: AI helps in predictive maintenance of equipment, optimizing flight schedules, and providing personalized services to passengers.
- ***Automation****:* Automated systems, including self-service kiosks, biometric check-ins, and automated baggage handling, streamline processes and reduce waiting times.
- ***Data Analytics****:* Real-time data analytics improve decision-making by providing insights into passenger behaviour, operational efficiency, and resource management.
- ***Sustainability***: Smart airports often incorporate green technologies to reduce their environmental impact, such as energy-efficient lighting, waste management systems, and renewable energy sources.

Benefits:

- ***Enhanced Passenger Experience***: With faster check-ins, real-time updates, and personalized services, passengers enjoy a smoother and more pleasant travel experience.

- ***Operational Efficiency***: Automation and data analytics help in optimizing airport operations, reducing delays, and improving resource allocation.

- ***Safety and Security***: Advanced surveillance systems, biometric identification, and predictive maintenance enhance the safety and security of both passengers and staff.

- ***Economic Benefits***: By improving efficiency and passenger satisfaction, smart airports can increase revenue through higher passenger throughput and additional services.

Heathrow Airport

Smart airports represent the future of air travel, combining technology and innovation to create a seamless and efficient experience for everyone involved. Heathrow Airport is a leading example having embraced various smart technologies to enhance its operations and passenger experience. Here are some key aspects that make Heathrow a smart airport.

- ***Biometric Technology***: Heathrow uses biometric systems, including facial recognition, to streamline the check-in and boarding processes. This technology helps reduce wait times and enhances security.

- ***IoT and Data Analytics***: The airport employs IoT devices and advanced data analytics to monitor and manage airport operations in real-time. This includes tracking passenger flow, optimizing resource allocation, and improving overall efficiency.

- ***Artificial Intelligence***: AI is used for predictive maintenance of equipment, improving punctuality, and reducing delays. For example, AI-powered cameras and machine learning algorithms help monitor and manage passenger movements.

Which result in:

- ***Positive Boarding****:* This project uses smart data tracking to improve departure punctuality and enhance the passenger experience. It involves tracking passengers' movements through the airport to ensure they reach their gates on time.

- ***Sustainability Initiatives****:* Heathrow is committed to reducing its environmental impact through various green technologies. This includes energy-efficient lighting, waste management systems, and the use of renewable energy sources.

- ***Enhanced Passenger Experience****:* With faster check-ins, real-time updates, and personalized services, passengers enjoy a smoother and more pleasant travel experience.

- ***Operational Efficiency****:* Automation and data analytics help optimize airport operations, reducing delays and improving resource allocation.

- ***Safety and Security**:* Advanced surveillance systems, biometric identification, and predictive maintenance enhance the safety and security of both passengers and staff.

- ***Environmental Sustainability**:* By incorporating green technologies, Heathrow reduces its carbon footprint and promotes sustainable practices.

And with the UK in mind we turn to British Airways to commence our chronological news reporting.

➢ 10 May 2024

Chris Leadbeater writes that it was the ancient Chinese philosopher Lao Tzu, reputedly, who offered the sage remark that "a journey of a thousand miles begins with a single step". But in the case of British Airways, this week saw a journey of seven billion pounds begin with… a single aircraft. From the outside, G-TNED is not much to look at – in that it seems no different to any other short-haul plane in the BA fleet; that classic white livery, those semi-symmetrical splotches of red and blue on the tailfin. But inside, quietly, this A321neo is at the vanguard of a huge (and, some might say, overdue) overhaul of our national flag carrier.

This process was announced at the start of March; the airline's CEO Sean Doyle talking of "a journey to a better BA for our people and for our customers, underpinned by a transformation programme that will see us invest £7 billion over the next two years, to revolutionise our business". To put this in less boardroom-inflected language, this gentle revolution will equate to a new website, a new app, a whole new lounge at Dubai International Airport, and fully refurbished ones in Seattle, Lagos, Edinburgh and Heathrow. It will also make for 350 new jobs at said London hub, a phasing in of artificial-intelligence technology that will (supposedly) "help flights depart on time", stylish new "suites" in the first-class cabins of long-haul planes (which should start to appear in the airline's A380 behemoths by the end of next year) – and redesigned interiors and seats on their short-haul siblings.

These latter bells and whistles are where G-TNED takes the stage. While another seven brand-new A320neos and A321neos – fitted out in the same manner – will be slotted into the hangar by the end of the year, for now, G-TNED is the sole British Airways plane in service boasting this fresh blueprint. Only delivered to the airline by Airbus at the start of this month, it has been going about its duties – without much in the way of fanfare – since last Friday (May 3), via flights to the likes of Brussels, Edinburgh, Barcelona, Stockholm, Athens and Marrakech. Come Tuesday morning, it was Rome – and my turn. Read on at: BA's £7bn transformation has begun... with a single plane (telegraph.co.uk)

➢ 5 June 2024

Christopher Jasper reports that the Lancastrian boss of a new Saudi Arabian airline is planning to serve 100 cities with a fleet of 200 jets as part of the Kingdom's bid to become a global tourist hub. However, rather than muscling in on the Middle East's dominant airlines, Tony Douglas is vying to build a "world-class national carrier" by regaining Saudi travellers who have been neglected for too long.

Mr Douglas says limited international flights from Saudi airports have left locals reliant on hubs in the United Arab Emirates and Qatar for links with the rest of the world. That is despite the IMF forecasting that the Saudi economy will be the second-fastest growing in the world this year.

Mr Douglas is the person largely responsible for overhauling the country's connectivity, as he oversees plans for the launch of Riyadh Air. His start-up carrier is scheduled to commence services next summer, spearheading a push by Crown Prince Mohammed bin Salman to diversify the Saudi economy.

Establishing a new carrier from scratch is a tall order at the best of times, with the vast majority of airline start-ups failing within a few years. Yet the challenge facing Mr Douglas is even tougher, with Riyadh Air poised to compete against the might of Emirates, Qatar Airways and Etihad. Dubai-based Emirates ranks as the world's biggest carrier on international routes and all three are industry heavyweights with globe-spanning networks across five continents.

However, Mr Douglas, who was born 13 miles from Liverpool in Ormskirk, and jumped ship from Etihad to take the Saudi job, told the Telegraph his mission is not to take on the Gulf giants at their own game by competing for global passenger flows. Instead, Riyadh Air will seek to recapture traffic that Saudi Arabia regards as rightfully its own, and at the same time provide the enhanced global links demanded by Vision 2030, which aims to lift Saudi's tourist numbers to 100 million a year.

He said: "It's no secret that for a long time, Saudi Arabia has lagged way behind in terms of global connectivity, and there's no good example anywhere in the world of a sustainable, fast-growing economy that hasn't got good connectivity. "The Kingdom needs a new world-class national carrier that will be its own version of Emirates and Qatar Airways, and the answer to that is Riyadh Air." Read further at: The British boss building a 'world-class national airline' for Saudi Arabia (telegraph.co.uk)

- **10 June 2024**

Christopher Jasper writes that at some point, every frequent flier will have seen the seatbelt signs ping on mid-trip, and experienced a sudden lurch as their aircraft is buffeted by gusts of air. It is fortunately very rare for turbulence to end in disaster. But during a Singapore Airlines flight from London last month, passengers were thrown around the cabin and a man died from a heart attack.

The death was the first connected to the phenomenon in 23 years – and follows the safest year recorded for air travel in 2023, with no fatal accidents involving passenger jets anywhere in the world. However, it came against a backdrop of steadily increasing turbulence incidents. Just days later, a Dublin-bound service operated by Qatar Airways was buffeted over Turkey, leaving 12 people injured.

Airlines say it's not clear whether the rise in turbulence stems from increasingly erratic weather patterns or is simply a result of the number of flights increasing by more than two-thirds in the past two decades. Whatever the underlying cause, it was up there with the challenge of cutting carbon emissions as the hottest topic among airline bosses gathered in Dubai last week for the annual meeting of the International Air Transport Association (Iata).

While there was agreement on the need to gather more data, quite how far the industry might be prepared to go with efforts to mitigate the risk of injuries is less clear. Sir Tim Clark, president of Emirates, the biggest long-haul airline, appeared to hint at an approach that could keep people in their seats for the whole flight. He said: "Let's be quite honest. If you haven't got people strapped in, in some of the clear air turbulence interjections, it's a real risk. So the whole industry is now upping the

game with regard to making sure the passengers are strapped in. We are looking at all the protocols." See the full report at: Why planes are being rattled by rising turbulence (telegraph.co.uk)

- **11 June 2024**

Staying with Christopher Jasper, he also reports that Sir Richard Branson's Virgin Atlantic is examining a return to Gatwick and flights from regional airports such as Bristol after giving up hope of a third runway at Heathrow before the end of the decade. Chief executive Shai Weiss said the airline was evaluating more flights from the carrier's secondary hub in Manchester and an expansion of the Virgin Holidays arm as part of its plans for growth between 2025 and 2030. The blueprint, not yet made public but known internally as VX30, will aim to grow revenues by 20pc beyond the £3.5bn expected this year, Mr Weiss said.

He said: "I think we've got to rule out a third runway, which leaves either the acquisition of slots at Heathrow or flights from Gatwick and secondary cities in the UK." Growth at Virgin's main Heathrow base remains the preferred option because of the high margins and better connectivity between flights there, but the new growth plan will assume scope for that will be limited.

Heathrow, which operates almost at full capacity, put plans for a third runway on hold during Covid when the project was already facing renewed political and legal hurdles, and has yet to formally revive them. Willie Walsh, the former British Airways boss who now leads airline industry trade group Iata, said last week that a new runway may never be built at Europe's busiest hub. Read on at: Virgin Atlantic eyes Gatwick return as it gives up on Heathrow third runway (msn.com)

And staying with the subject of Heathrow Airport, Ben Marlow also writes on 11 June that "The paralysis over a third runway is a national embarrassment. See: Heathrow embodies Britain's dwindling status as a viable investment (telegraph.co.uk)

Finally on 11 June Greg Dickinson, Senior Travel Writer for The Telegraph, takes "a deep dive into the airline British passengers love to hate." See: Wizz Air: 20 things you didn't know about the ultra low-cost carrier (telegraph.co.uk)

- **June 2024**

Tim Robinson reports in this month's edition of AERO SPACE how an innovative RAeS discussion paper attempts to forecast eVTOL 'accident investigations of the future' to help the evolving Advanced Air Mobility sector avoid the mistakes of the past.

And Marc Atherton from the RAeS Human Factors Specialist Group in an article entitled 'Pilot mental health – can AI-powered psychological assessment help?' - investigates to what extent can risk be monitored and quantified by means of the psychological assessment of safety-critical staff

- **4 July 2024**

Smiling service, snacks, and a great movie selection: these small things make hours spent on a plane just a little more bearable. But the experience can vary wildly depending on which carrier you pick. So which airline should you choose for the best in-flight experience? This week, 'the Oscars of the aviation industry' revealed the best airlines of 2024.

Created by UK-based airline rating organisation Skytrax, the World Airline Awards drew on surveys from more than 21 million passengers in 100 countries flying with more than 350 different airlines. Three European airlines made it into the top 10 - though the winning spots were dominated by Middle Eastern and Asian carriers.

Narrowly knocking Singapore Airlines off the top spot, **Qatar Airways** is the Airline of the Year 2024. It's the eighth time Qatar's flag carrier has been granted first place in the 25-year history of the awards. Passengers love the Middle Eastern airline for its comfort, tasty food, up-to-date entertainment, warm service and modern fleet of aircraft.

The airline's wide reach, covering 341 airports across Australia, Asia, Europe, the Middle East, Africa, North America and South America, means flights are readily available to many global destinations. As well as receiving the overall crown, Qatar Airways won accolades for the World's Best Business Class, the World's Best Business Class Lounge and the Best Airline in the Middle East.

No European airlines made the top five, which consisted of Singapore Airlines in close second place followed by the UAE's Emirates, Japan's ANA All Nippon Airways and Hong Kong-based Cathay Pacific - which also won World's Cleanest Airline. East Asian and Middle Eastern airlines also made an appearance in the top 10, with Japan Airlines in sixth place and Taiwan's EVA Air in eighth place.

Turkish Airlines ranked in seventh place, making it the Best Airline in Europe. Flying to over 300 destinations - among the most of any airline in the world - it was also recognised for its food with the Best Business Class Catering award.

The Air France-KLM Group took ninth place, making it one of the leading European airport groups. Air France also won awards for the World's Best First Class Catering, the Best First Class Lounge Dining (at Paris Charles de Gaulle Airport) and the Best Airline in Western Europe. Swiss International Air Lines rounded out the top 10, also earning second place for the World's Best First Class Lounge at the busy Zurich airport. Although no North American airlines made it into the top 10, Delta Air Lines was declared the best airline in the region thanks to its attentive staff.

Skytrax also ranked the best budget airlines for 2024, with European carriers making up an impressive six of the top 10. Malaysian low-cost carrier AirAsia came out on top for the 14th year in a row, followed by Singapore's Scoot, Spain's Volotea, Saudi's Flynas and France's Transavia. Also in the top 10 were India's IndiGo, Spain's Vueling, Latvia's airBaltic, Spain's Iberia Express and Ireland's Ryanair, with eastJet narrowly missing out in 11th place.

- **23 July 2024**

And with Qarar Airways in mind John Arlidge writes in Telegraph Travel that airlines make 75 per cent of their profits from the lucky few passengers who sit in business class. That's why carriers invest hundreds of millions of pounds trying to come up with the most comfortable seats and beds. It is why they install onboard bars. The battle to pamper one per centers never ends – and it has just become even more competitive.

"Our new business class is better than most other airlines' first class," said Qatar Airways designer and new product chief, Xia Cai, as she showed off the carrier's new Q Suite business class seat at the Farnborough Airshow on Monday. Cai has taken the Q Suite, introduced seven years ago and the

winner of every business class award going, and made it better. The Q Suite Next Gen, as it is grandly named, is bigger than the outgoing suite, with more storage and better tech.

The major leap forward, though, is the way it enables couples – two adults and two children, or a set of four friends or business partners – to travel together. Cai has designed a wall, containing a television screen, that can divide each suite but which can also be folded back to open them up, allowing for more social travel.

The new Q Suite is larger than the outgoing version, with more storage and better tech© Provided by The Telegraph

The new offering, which will be installed on Qatar's Airbus A350 and Boeing 777-9 jets, offers more space than the previous version. "The side walls and sliding doors are the highest in business class at almost 57in tall – 2¼in taller than the outgoing version," says Cai, an Australian who is responsible for the look and feel of all Qatar Airways' aircraft and lounges. These high walls not only offer more privacy, they also enable passengers to work or read without disturbing those who want to sleep or relax. Legroom comes in at a spacious 8ft, while the 2ft-wide seats provide ample room.

Each suite comes equipped with a 4K OLED Panasonic Astrova IFE screen – a first for any airline. Wi-Fi is provided by Elon Musk's Starlink low-orbit satellites and will be fast enough to stream live television. Phone charging is wireless on several different surfaces dotted around the suite and there is a USB-C power socket strong enough to charge a laptop, or AC power if you prefer. All the armrests are controlled electronically.

Storage, too, is bigger and more innovative. A slot on one side of the suite holds a laptop or iPad. There is floor-level stowage for shoes, and, in the quad, space for a holdall. Best of all is the lockable drawer for valuables, a first at 39,000ft, which allows you to key in your own unique pin number.

The only duff note is the fake marble effect on some of the horizontal surfaces. It looks tacky in such an otherwise luxurious suite. Perhaps Qatar Airways will replace it before the suite is installed.

Each of the new innovations in the Q Suite puts the airline on a par with or slightly ahead of what many of its rivals offer. Virgin Atlantic has installed the new Retreat Suite on its Airbus A330s, which features two large seats with sliding doors for privacy and enough room on either side of the huge dining table for two people to sit comfortably and eat facing one another. JetBlue boasts the Mint Studio on its transatlantic Airbus A321 aircraft. The suite has an additional ottoman seat on one side, giving you a choice of where to sit. American Airlines is in the process of introducing a new Flagship Suite. The new Q Suite manages to amalgamate the innovations of other carriers, plus its own, into a single package. But is Cai right to say that the Q Suite is better than first class on other airlines?

I agree with her that the suite itself is better than the current first-class offerings from British Airways and Air France, and it certainly offers the chance for far more social travelling than any first or business-class ticket out there. But it is not as effortlessly elegant as Qantas's new first class aboard its A350s, which has a residential feel thanks to light-coloured fabrics and wood-effect veneer. What's more, Qatar does not offer showers, which passengers on Dubai's Emirates and the Abu Dhabi flag carrier Etihad can enjoy. Nor does Qatar offer a separate bed and seat as Singapore Airlines does in its Suites Class cabin aboard its Airbus A380s.

Qatar's business-class cabin will be large, with around 40-50 seats on a wide-bodied jet. First-class cabins on other carriers offer no more than 14 seats, with some as small as six. Some do away with all overhead bins to create a more spacious and visually relaxing cabin. Plenty of travellers would prefer a slightly less snazzy suite for the exclusivity of a smaller cabin.

Cai can settle the argument once and for all when she shows off Qatar Airways' new first class next year. Her boss, Badr Mohammed Al-Meer, the chief executive of the airline, promises it will elevate the carrier to the best in first and in business class. No pressure then.

➢ 24 July 2024

Finally, and staying with Qatar Airways, Christopher Jasper advises that the world's most luxurious fleet of A380 superjumbo jets has been saved from the scrap heap after operator Qatar Airways opted to upgrade them amid a boom in long-haul travel. Eight of the Airbus behemoths, which can carry more than 500 passengers, will be kept operating to maximise capacity at airports such as Heathrow instead of retiring as they approach 10 years of age.

The superjumbos, already among the most luxurious in the skies, will now undergo a series of modifications to prepare them for more years of use, Badr Al Meer, the Qatar Airways chief executive, said at the Farnborough International Airshow. The work will begin with an upgrade of the fleet's onboard wi-fi, which is too slow and patchy, he said, before progressing to an overhaul of passenger cabins. That could open the way for installation of a new version of the airline's super-luxurious Q Suite business class seats unveiled this week.

Mr Meer said of the A380: "The decision between the commercial department and finance planning team was to extend operations. "It's the best option to operate to certain airports, for example, when we are restricted on the number of flights to Australia." Qatar Airways' change of heart on the

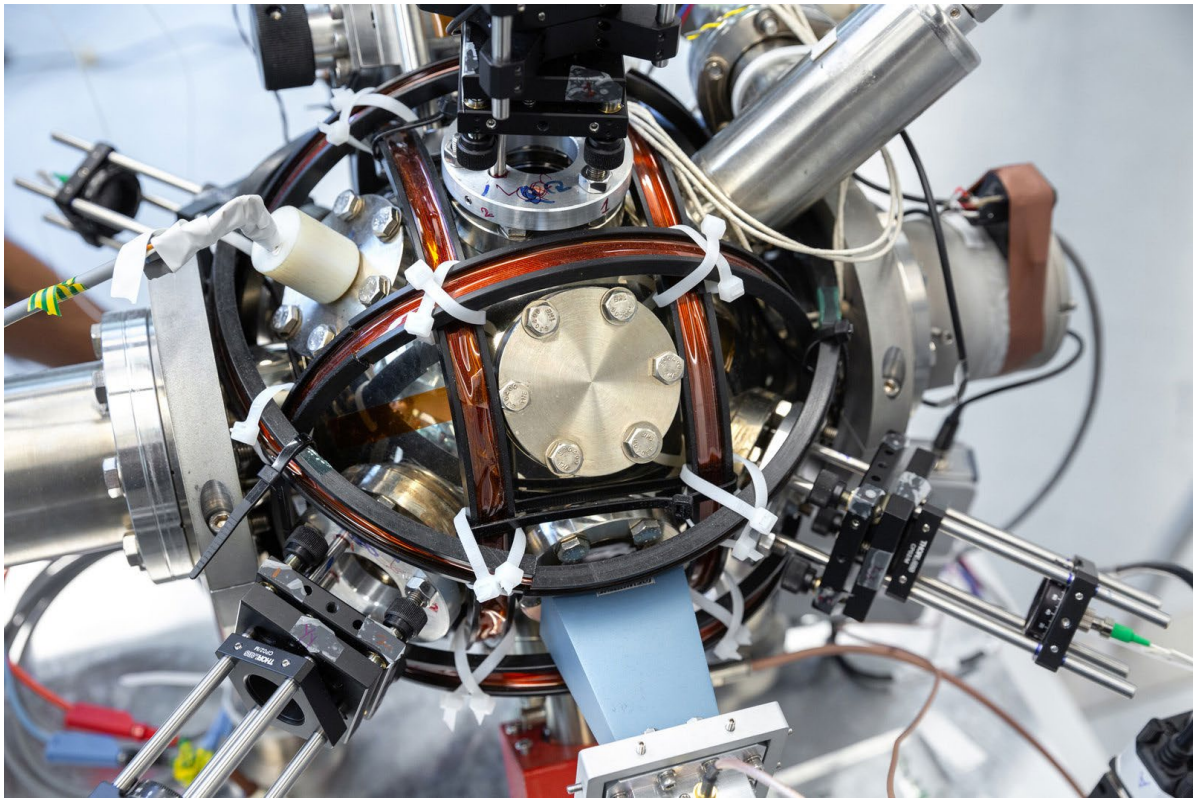
superjumbo is part of a wider renaissance for a model that failed to sell in the numbers envisaged by Airbus, as most airlines opted for smaller planes suitable for a wider variety of routes.

Covid appeared to have hastened the demise of a model already branded a white elephant as plunging passenger numbers led to mass groundings, only for a sharp rebound in demand to bring it back into favour. Akbar Al Baker, Mr Meer's predecessor, said during the pandemic buying the A380 had been his "biggest mistake", and reiterated as recently as last year that it would not remain in the Qatar fleet for long. Mr Meer said those comments were "based on the situation of the industry at that time", and that "today it is different".

While focusing on upmarket travel, he said that Qatar Airways is also pursuing investments in emerging markets, including an approach for an unidentified carrier in southern Africa. The Middle Eastern carrier is competing with Emirates and Turkish Airlines for dominance in the continent.

➢ July 2024

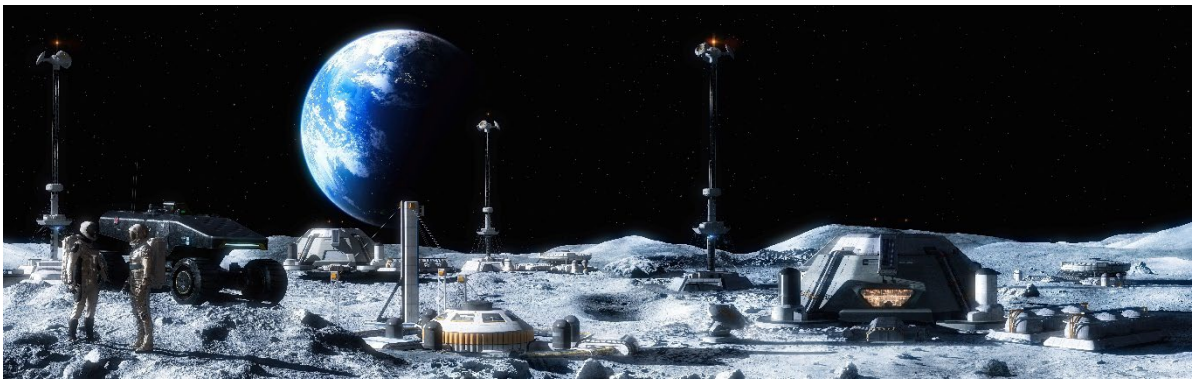
The alleged Russian jamming of satellite navigation signals in recent months has demonstrated how easily one of the key technologies underpinning modern society can be disrupted. One solution is a more accurate version of the inertial navigation system (INS) technology that dates back to the 1940s. With that in mind 'Pushing the Envelope' in this month's edition of AERO SPACE features Robert Coppinger discussing quantum navigation.



A quantum compass. Source: Tesla News

And Dr Robert Joslin from Embry-Riddle Aeronautical University explains why he thinks existing traffic avoidance and terrain awareness systems will be inadequate to resolve 'The eVTOL collision conundrum'.

SPACE



Source: Shutterstock

Overview

The Artemis program is a Moon exploration program that is led by the United States' National Aeronautics and Space Administration (NASA) and was formally established in 2017 via Space Policy Directive 1. The Artemis program is intended to re-establish a human presence on the Moon for the first time since the Apollo 17 Moon mission in 1972. The program's stated long-term goal is to establish a permanent base on the Moon to facilitate human missions to Mars.

Two principal elements of the Artemis program are derived from the now-cancelled Constellation program: the Orion spacecraft and the Space Launch System (SLS) (as a reincarnation of Ares V). Other elements of the program, such as the Lunar Gateway space station and the Human Landing System, are in development by government space agencies and private spaceflight companies. This collaboration is bound together by the Artemis Accords and governmental contracts.

The Space Launch System, Orion spacecraft and the Human Landing System form the main spaceflight infrastructure for Artemis, and the Lunar Gateway plays a supporting role in human habitation. Supporting infrastructures for Artemis include the Commercial Lunar Payload Services, development of ground infrastructures, Artemis Base Camp on the Moon, Moon rovers and spacesuits. Some aspects of the program have been criticized, such as the use of a near-rectilinear halo orbit and the sustainability of the space program.

Orion's first launch on the Space Launch System was originally set for 2016, but faced numerous delays; it launched on 16 November 2022 as the Artemis 1 mission, with robots and mannequins aboard. According to plan, the crewed Artemis 2 launch is expected to take place in late 2025, the Artemis 3 crewed lunar landing is scheduled for late 2026, the Artemis 4 docking with the Lunar Gateway in late 2028, the Artemis 5 docking with the European Space Agency's ESPRIT, Canada's Canadarm3, and NASA's Lunar Terrain Vehicle in early 2030, and the Artemis 6 docking which is expected to integrate the Crew and Science Airlock with the Lunar Gateway station in early 2031. After Artemis 6, NASA expects yearly landings on the Moon to occur from then on.

Space Launch Systems Missions in Detail

The Artemis program is organized around a series of SLS missions. These space missions will increase in complexity and are scheduled to occur at intervals of a year or more. NASA and its partners have

planned Artemis 1 through Artemis 5 missions; later Artemis missions have also been proposed as indicated above. Each SLS mission centres on the launch of an SLS launch vehicle carrying an Orion spacecraft. Missions after Artemis 2 will depend on support missions launched by other organizations and spacecraft for support functions.

Artemis 1 (2022) was the successful uncrewed test of the SLS and Orion, and was the first test flight for both craft. The Artemis 1 mission placed Orion into a lunar orbit and then returned to Earth. The SLS Block 1 design uses the Interim Cryogenic Propulsion Stage (ICPS) second stage, which performs the trans-lunar injection burn to send Orion to lunar space. For Artemis 1, Orion braked into a polar distant retrograde lunar orbit and remained for about six days before boosting back toward Earth. The Orion capsule separated from its service module, re-entered the atmosphere for aerobraking, and splashed down under parachutes.

Artemis 2 (2025) is planned to be the first crewed test flight of SLS and the Orion spacecraft. The four crew members will perform extensive testing in Earth orbit, and Orion will then be boosted into a free-return trajectory around the Moon, which will return Orion back to Earth for re-entry and splashdown. Launch is scheduled for no earlier than September 2025.

Artemis 3 (2026) is planned to be the first American crewed lunar landing since Apollo 17 in December 1972. The mission depends on a support mission to place a Starship Human Landing System (HLS) in a near-rectilinear halo orbit (NRHO) of the Moon prior to the launch of SLS/Orion. After Starship HLS reaches NRHO, SLS/Orion will send the Orion spacecraft with a crew of four to rendezvous and dock with HLS. Two astronauts will transfer to HLS, which will descend to the lunar surface and spend about 6.5 days on the surface. The astronauts will perform at least two Extravehicular Activities (EVAs) on the surface before the HLS ascends to return them to a rendezvous with Orion. Orion will return the four astronauts to Earth. Launch is scheduled for no earlier than September 2026.

Artemis 4 (2028) is planned to be the second crewed lunar landing mission. Orion and an upgraded Starship HLS will dock with the Lunar Gateway station in NRHO prior to the landing. A prior support mission will deliver the first two Lunar Gateway modules to NRHO. The extra power of this mission's SLS Block 1B will allow it to deliver the I-HAB Gateway module for connection to the Lunar Gateway. Launch is scheduled for no earlier than September 2028.

Artemis 5 (2030) is planned to be the third crewed lunar landing, which will deliver four astronauts to the Lunar Gateway station. The mission will deliver the European Space Agency's ESPRIT refuelling and communications module and Canadarm3, a Canadian-built robotic arm system for the Gateway. Also delivered will be NASA's Lunar Terrain Vehicle. Launch is scheduled for no earlier than March 2030. The mission will also be the first to use Blue Origin's Blue Moon lander to take astronauts to the Moon's surface.

Artemis 6 (2031) is planned to be the fourth crewed lunar landing, which will integrate the Crew and Science Airlock with the Gateway Space Station. Launch is scheduled for no earlier than March 2031. As of 2024, the Airlock module is under construction.

Support missions

Support missions include robotic landers, delivery of Gateway modules, Gateway logistics, delivery of the HLS, and delivery of elements of the Moon base. Most of these missions are executed under NASA contracts with commercial providers. Under the Commercial Lunar Payload Services (CLPS) program, several robotic landers will deliver scientific instruments and robotic rovers to the lunar surface after Artemis 1. Additional CLPS missions are planned throughout the Artemis program to deliver payloads to the Moon base. These include habitat modules and rovers in support of crewed missions.

A Human Landing System (HLS) is a spacecraft that can convey crew members from NRHO to the lunar surface, support them on the surface, and return them to NRHO. Each crewed landing needs one HLS, although some or all of the spacecraft may be reusable. Each HLS must be launched from Earth and delivered to NRHO in one or more launches. The initial commercial contract was awarded to SpaceX for two Starship HLS missions, one uncrewed and one crewed, as part of Artemis 3. These two missions each require one HLS launch and multiple fuelling launches, all on SpaceX Starship launchers. NASA later exercised an option under the initial contract to commission an upgraded Starship HLS for Artemis 4 and a separate contract to Blue Origin to develop a third crewed lunar lander, which will make its first crewed flight as part of the Artemis 5 mission.

The first two Gateway modules (PPE and HALO) will be delivered to NRHO in a single launch using a Falcon Heavy launcher. Originally planned to be available prior to Artemis 3, as of 2021 it is planned for availability before Artemis 4. The Gateway will be resupplied and supported by launches of Dragon XL spacecraft launched by Falcon Heavy. Each Dragon XL will remain attached to Gateway for up to six months. The Dragon XLs will not return to Earth, but will be disposed of, probably by deliberate crashes on the lunar surface.

We now continue with our chronological news items.

➢ 22 May 2024

Neil Pooran reports that the successful test-firing of a rocket on the Shetland Islands is a “big moment” ahead of the first space launch due later this year, the head of the UK Space Agency has said. Dr Paul Bate praised the “hot test” of a German rocket’s first stage at SaxaVord Spaceport last week, saying the UK could become the leading country in Europe for small satellite launches. Dr Bate also said there should be no “race to the bottom” in regulation of the industry, after concerns were voiced that there is too much red tape involved in launching from the UK.

Rocket Factory Augsburg (RFA) test-fired four Helix engines from the first stage of their rocket, One, sitting atop a 12-metre high launch stool. The rocket stage was transported by sea and road from Germany to SaxaVord at the northernmost tip of the UK. Watch: Watch: First 'flawless' rocket engine test at Shetland spaceport | STV News

Another space launch is expected to take place next year from the Sutherland Spaceport on the Scottish mainland, Dr Bate said, with this one being a rocket from UK company Orbex. The head of the UK Space Agency spoke to the PA news agency at the Space Propulsion Conference, which is taking place in Glasgow, bringing together organisations involved in rocketry and spacecraft from around the word.

Scotland's "wonderful geography" means it is an ideal location for launches to polar and sun-synchronous orbits, he said, with several sites hoping to host vertical or horizontal launches in future. Amid strong global demand for small satellite launches, many countries and private companies are exploring new ways of reaching space. Dr Bate said: "RFA are hitting their milestones – they're at a stage where they're testing four of their engines now on their first stage and it's all worked according to plan. "A hot fire is a big moment, a lot can go wrong – early indications are that it's been a very successful test." He said he hoped the UK could become "the leading launch nation for small satellites in Europe". Read further at: UK chief hails test-firing of rockets at Scottish spaceport as 'big moment' | The Independent

An artist's impression of the RFA One rocket taking off (Rocket Factory Augsburg) (PA Media)

➢ 23 May 2024

Mike Wall writes in SPACE.com that Boeing is now targeting June 1 for the first crewed launch of its Starliner capsule, though that date is far from set in stone. The flight date for the mission, called Crew Flight Test (CFT), has been in considerable flux recently. It had been scheduled to lift off on May 6 atop a United Launch Alliance (ULA) Atlas V rocket from Cape Canaveral Space Force Station in Florida, but that try was called off about two hours before launch due to a misbehaving valve in the rocket's upper stage.

ULA decided to replace the valve, which required rolling the Starliner-Atlas V stack off the pad — a move that pushed the planned liftoff back to May 17. That target was soon shifted to May 21, however, after a small helium leak was detected in Starliner's service module. But the launch team soon adjusted the target again, to May 25, explaining that more time was needed to assess the leak. Then, on Tuesday (May 21), NASA announced that May 25 was no longer an option for CFT but did not give a new target launch date. In an update on Wednesday evening (May 22), the agency provided one: June 1, at

12:25 p.m. EDT (1625 GMT). There are backup opportunities on June 2, June 5 and June 6, NASA officials added. These dates are very preliminary, however; team members continue to analyze data and map out potential paths forward.

➢ 6 June 2024

The Daily Mail reports that Elon Musk's SpaceX has successfully completed the first splash-down of its Starship rocket, bringing the billionaire one step closer to colonizing Mars. The 400-foot-tall rocket, consisting of the Starship cruise vessel mounted atop its towering Super Heavy rocket booster, took off from Boca Chica, Texas at 8:50am ET.

Musk proclaimed the missions as an 'epic achievement' after Starship soared 130 miles above the surface and making a soft landing in the Indian Ocean as planned. The previous three attempts saw the prototypes explode midair or break apart during re-entry - only tiles and a damaged flap occurred during Thursday's mission. Along with a successful Starship splashdown, the booster also landed in the Gulf of Mexico eight minutes after take-off.

It was a critical milestone in the company's plan to eventually return the Super Heavy booster to its launch site for reuse. The Starship is classified as a super heavy-lift launch rocket that is celebrated as the most powerful ever built. As the rocket re-entered the atmosphere an hour after lift-off, pieces of its flap started shredding off and a hole appeared as debris covered the camera, cracking the lens.

The Starship was 'hanging on by bolts and threads,' leaving SpaceX staff and millions of people worldwide on the edge of their seats as they waited for confirmation of a splashdown after the rocket initiated its first-ever landing-burn. The live view went in and out as the rocket started cooling, receiving applause each time it turned back on, indicating Starship was still receiving data as it decreased to 620 miles per hour - below the speed of sound.

'The payload for these flight tests is data. Building upon what we achieved during Starship's third flight test, our primary goal today is to get through the extreme heat of re-entry,' SpaceX posted on X. The flight path will be similar to the third test, which took place in March and saw Starship fly for 49 minutes before it was eventually lost as it re-entered the atmosphere over the Indian Ocean. Since then SpaceX has made several software and hardware upgrades.

Starship is designed to be fully reusable, which is why SpaceX wanted to control the booster's entry into the Gulf and the spacecraft's descent into the Indian Ocean — it is intended as practice for planned future landings. However, neither stage will be recovered following Thursday's launch.

Congratulations SpaceX on Starship's successful test flight this morning!' NASA chief Bill Nelson wrote on X. 'We are another step closer to returning humanity to the Moon through #Artemis - then looking onward to Mars.'

Designed to eventually be fully reusable, Starship with both stages combined is 90 feet taller than the Statue of Liberty. Its Super Heavy booster produces 16.7 million pounds (74.3 Meganewtons) of thrust, about twice as powerful as the Saturn V rockets used during the Apollo missions - though later versions should be more powerful still. While Thursday's mission did not end as planned, the test flight was the farthest performed with a Starship rocket.

➢ 17 June 2024

David Axe writes in The Telegraph that China's secretive space plane has recently performed a dramatic manoeuvre in low Earth orbit, dropping from an altitude of 375 miles to 365 miles in the span of roughly a day earlier this month.

The robotic spacecraft – in essence a quarter-length Space Shuttle – has been in space since Dec. 14, zipping around Earth at different altitudes and even releasing at least one object: potentially a tiny satellite, a now-useless piece of its launch hardware or, alternatively, a target for practice manoeuvres. It would make sense that it's a target. The space plane, China's answer to the US Air Force's own Boeing X-37B space plane, is widely assumed to have inspection capabilities. That is, it can manoeuvre close to other spacecraft in order to inspect them – or, in wartime, tamper with them, possibly even destroying them.

With its apparent wartime role, the Chinese space plane is just one of several "dual-use" spacecraft – with civilian and military application – in orbit right now. On May 16, Russia launched an apparent inspection satellite designated Cosmos 2576. Four days later, Ambassador Robert Wood, the US alternate representative for special political affairs in the United Nations, claimed Cosmos 2576 is "likely a counter-space weapon, presumably capable of attacking other satellites in low Earth orbit."

And on December 28, the US Air Force launched one of its two X-37Bs on the type's seventh mission. The 29-foot X-37Bs, which launch atop heavy-lift rocket stacks and land like airplanes, have flown longer and increasingly ambitious sorties – demonstrating impressive manoeuvrability and reusability. The current mission could last longer than two years: it probably involves higher altitude orbits than previous missions as the spaceplane went up on America's most powerful rocket booster, the SpaceX Falcon Heavy. (In theory the upcoming Space Launch System is even more powerful, but this has flown only once and is not available for normal launch purposes.)

The Americans are the world leaders in reusable spacecraft, including robotic mini-shuttles. But the Chinese are catching up. China "continues to develop a variety of counter-space capabilities designed to limit or prevent an adversary's use of space during a crisis or conflict," the US Defense Department warned in the latest edition of its annual report on the Chinese military. Full details at: China has made a move. Watch the skies (telegraph.co.uk)

➢ 21 June 2024

Matthew Field and Matt Oliver advise that "Faults on the Starliner craft are just the latest calamity to hit the US aerospace giant." They go on to write that Boeing's Starliner was sitting on Cape Canaveral's launchpad in Florida when a small but crucial issue with the spacecraft's 191ft booster rocket brought the countdown to a halt.

The US aerospace giant had been hired by Nasa to ferry two astronauts – Sunita Williams and Barry "Butch" Wilmore – to the International Space Station (ISS) under a contract worth $4.2bn (£3.3bn). But on May 6, engineers found that a valve used to regulate the rocket's flow of oxidizer – which is mixed with fuel in a combustion chamber to create thrust – was creating an audible buzzing sound, forcing them abort the mission. This first "sticky valve" has been followed by a cascade of further issues. Yet on June 5, Nasa and Boeing pushed ahead with the launch anyway.

Now, with the malfunctioning Starliner and its passengers stranded in orbit for two weeks longer than planned, it is a decision they may regret. “The company is in a deep crisis. The optics of it are terrible,” says Rob Adlard, the chief executive of British space launch company Gravitilab. “Space is super hard, but it does contrast with SpaceX’s successes.”

The seemingly small valve issue found on May 6, which affected the Starliner’s Atlas V booster rocket (built in a joint venture between Boeing and Lockheed Martin), is typical of the minuscule problems that can play havoc with complex rocket launches. On spacecraft, these valves control the flow of important gases such as helium as well as oxygen and other propellants. Boeing was previously forced to fix corroded valves in the Starliner which were found in 2021 after 13 failed on the launch pad.

Starliner, which was originally commissioned for a crewed mission in 2017, has been plagued with issues that have cost Boeing more than $1bn, from software glitches to parachute problems. The setbacks mean Boeing has fallen behind Elon Musk’s rocket company, SpaceX, which has also partnered with Nasa to ferry astronauts into space. SpaceX’s Dragon spacecraft has been carrying out regular trips to the ISS since 2020.

After May’s discovery of Atlas V’s faulty rocket valve, more problems followed. As engineers tackled the problem, they realised Starliner was suffering from a helium leak. The gas is used as a pressurant to push propellant into the thrusters, meaning a leak can cause them to fail. Worryingly, during the resulting testing, the leak – which was traced to a bad seal – appeared to get worse, Steve Stitch, Nasa’s crew programme manager, said at the time.

Fixing the leak would have required separating Starliner from the Atlas rocket, causing longer delays, and Nasa and Boeing decided it was possible to proceed safely anyway. Boeing’s Starliner manager, Mark Nappi, even said the delay had a “silver lining” because the company had discovered the helium issue ahead of the mission.

Starliner eventually launched at 10.52am on June 5. But mid-flight, with its crew sleeping, more helium leaks were detected and five of the spacecraft’s 28 thrusters failed as it approached the ISS. Wilmore and Sunita were forced to undertake manual manoeuvres in space in a docking sequence that took an hour longer than planned. A further valve issue was also uncovered, with one valve in the “reaction control system”, which helps steer the spacecraft, failing to shut properly. Starliner is now relying on a backup “B valve” instead.

Now, Nasa and Boeing have the complicated task of double-checking Starliner’s systems and troubleshooting as many of the in-orbit issues as possible to ensure a safe return home. In a news conference on June 18, Stitch said one thruster, B1A3, only fired at 11pc of its expected power during a “hot fire” test, and will remain switched off for the remainder of the mission. He said the helium leaks and the thruster problems “seem to be related”. Starliner had been scheduled to return on June 14, but now will not undock until June 26.

On the ground at the Marshall Space Flight Centre, experts are also testing copies of Starliner’s helium seals by “purposely damaging a seal, cutting a seal, looking at leak rates” to assess the impact, Stitch said. Boeing and Nasa are confident the craft can return, but they are being kept in orbit to conduct more tests on why the problems keep occurring. Stitch said the team wanted to “make sure we’re really ready to come home”. Nappi, of Boeing, told journalists on Tuesday: “We have a good, safe spacecraft.”

Adlard, of Gravitilab, said the issues sounded "fixable", adding that some problems may have emerged as components "perform differently in the absence of gravity". Chris Welch, a consultant and former professor of space engineering at the International Space University in Strasbourg, said: "All these components are like links in a chain that have to work in synchrony. Valves in particular are very little, fiddly things that have to operate very precisely, under a wide temperature range and under challenging conditions. You can simulate them as much as you'd like, but you can never really be sure how they are going to work until you actually put them out in the field."

Should Starliner experience further delays, the ISS has months' worth of food supplies, while the craft can remain docked for up to 45 days. While helium has been gradually leaking out of the craft, it still has enough for 70 hours of flight – and it only needs seven to make it home.

- **June 2024**

In the June edition of RAeS's AERO SPACE Dr Joseph Aschbacher, Director General of the European Space Agency, discusses with Bella Richards Europe's ambitions in space, Ariane 6 delays, the launch crisis and the challenge of space debris.

Additionally, under the heading of 'Here comes the Sun' Kate Arkless-Grey reports from the International Conference on Energy which addresses the question: Could 24/7 solar power from orbit be the answer to the world's future energy challenges?

- **7 July 2024**

Matthew Field writes that Beijing's lax approach toward safety has done little to slow its progress in rocketry.

Chinese rockets are often propelled by hazardous fuels that pose lethal risks to those unfortunate enough to come into contact with them CREDIT: STR/AFP via Getty Images

He goes on to say that it was supposed to be a moment of triumph for China's space industry. The 180ft Long March 3B rocket stood on the launch pad, ready to carry an American-made satellite into orbit on its debut mission. But just seconds after blast-off it was clear something had gone horribly wrong. In grainy video footage, the rocket is seen veering hard to the left, barely clearing the tower and torpedoing off into the night at a right angle.

It landed in the nearby village of Mayelin, near China's Xichang Launch Centre, creating a huge fireball that flattened buildings and drenched the landscape in rocket fuel. Footage smuggled out by an Israeli engineer shows an apocalyptic landscape. In China's official account of the incident, six people died – although US defence officials estimated the true number was in the hundreds. The 1996 disaster precipitated a hasty retreat by US space companies from working with China – effectively bringing in a regime of strict export controls that exists to this day.

Despite the fallout, China has emerged over the last decade as a space superpower – launching a rival to the International Space Station, landing a probe on the dark side of the Moon and a satellite constellation to rival GPS. Amid this explosive growth, China's space industry has been dogged by a history of near-misses and environmentally damaging missions. Just last week, a private rocket company, Space Pioneer, billed as a domestic rival to Elon Musk's SpaceX, was conducting a "static fire" engine test of its new Tianlong-3 launcher – which translates to "heavenly dragon".

As the name of the test would suggest, the rocket is supposed to remain locked to the launch pad while scientists analyse its thrusters. However, the vehicle broke its moorings, blasting into the sky before its engines shut down and it plummeted back to Earth, crashing into a mountain near the city of Gongyi. Read further at: China's dirty and dangerous race to become a space superpower (telegraph.co.uk)

- **15 July 2024**

Joe Pinkstone reports that astronauts could set up lunar bases inside underground Moon caves, scientists believe. A tunnel has been spotted underneath the Sea of Tranquillity by Nasa satellites orbiting the Moon and analysis suggests it could be more than 250ft long. Radar images indicate the site, which is at the bottom of the Mare Tranquillitatis Pit, the deepest known crater on the Moon, show an opening about 150ft wide.

Researchers said this is the first lunar tunnel to be discovered that could be accessible to humans and previous Moon caves did not feature any entry points. The "milestone discovery" comes as Nasa prepares to send its first crewed mission to the Moon in more than 50 years and experts are working on how to make it hospitable for long-term human habitation.

Scientists have long suspected the Sea of Tranquillity chasm – along with 200 other pits on the Moon – may have tunnels lurking beneath. Dr Leonardo Carrer, an assistant professor at the University of Trento in Italy, said: "For the first time, we have located and accurately mapped a cave that is actually accessible from a pit on the lunar surface. "We were able to obtain the first 3D model of a part of the cave's actual shape." Lorenzo Bruzzone, a professor at the university, added: "These caves have been theorised for over 50 years, but it is the first time ever that we have demonstrated their existence."

It is thought that there could be a system of tunnels under the lunar surface which were created by the collapse of ancient lava flows. Experts say underground caves could play a crucial role in establishing human settlements on the Moon as constructing lunar shelters from scratch requires a lot more resources and effort than colonising lava tubes. Prof. Carrer said: "Building a base on the surface of the Moon requires highly complex engineering solutions, which may be less effective than what is already provided by nature."

For the study, published in the journal Nature Astronomy, the researchers re-analysed radar data gathered by Nasa's Lunar Reconnaissance Orbiter in 2009. The Sea of Tranquillity is the ancient lava plain where the Apollo 11 astronauts Neil Armstrong and Buzz Aldrin first set foot on the moon in 1969. The researchers said the cave may be either flat or inclined by around 45 degrees. Prof. Carrer said: "The data that we have used for our discovery allows us to see only the initial part of the conduit. We expect that it is longer than the portion that has been identified and modelled."

The Moon is hostile to human life and its surface is exposed to cosmic radiation that is up to 150 times more powerful than on Earth. The lunar surface is also vulnerable to frequent meteorite impacts and extreme temperatures, ranging from 127C (260F) to -173C (-280F). Previous research has suggested underground caves have an average temperature of about 17C (62F) creating cosy conditions for astronauts. The researchers said these caves may also give astronauts easier access to critical resources such as water ice and other minerals.

An artist's impression of the lunar pit in the Sea of Tranquillity on the Moon - University of Trento/PA© Provided by The Telegraph

➢ July 2024

In AERO SPACE under the title of 'Bringing them home' Bella Richards looks at the past and present state of rescue missions and asks what would happen if an Apollo 13 event happened today?

UK DEFENCE




We commence this section with an article by Dr Patricia Lewis (Research Director; Director, International Security Programme, Chatham House) and Olivia O'Sullivan (Director, UK in the World Programme, Chatham House.)

Chatham House, also known as the Royal Institute of International Affairs, is a prominent British think tank based in London. Established in 1920, its mission is to help governments and societies build a secure, prosperous, and just world. Chatham House is renowned for its independent research, analysis, and dialogue on international affairs. It covers a wide range of topics, including global economy, international security, and environmental sustainability.

On 18 July the new UK government announced it would conduct a Strategic Defence Review (SDR), shaped by three external reviewers: Lord Robertson of Port Ellen, Dr Fiona Hill and General Sr Richard Barrons. Parameters have been set out which are consistent with the previous government. And much of the threat analysis in the 2023 Integrated Review Refresh will likely still stand – although it is inevitable that any definitive statement of security threats risks being overtaken by events. The SDR will stress the importance of NATO, retain the UK's nuclear weapons system, and ensure continued support for Ukraine.

Prior to the 2024 election, the Labour Party also said they were committed to continuing the AUKUS partnership on nuclear submarines and on new technologies (AUKUS Pillar 2). The UK government will also presumably look to set out a timetable for hitting their 2.5 per cent GDP target on defence spending.

However, some shifts in emphasis are evident. The appointment of the external reviewers suggests that the focus will be even more on the practicalities of European security in the face of a more

unpredictable United States: Dr Hill has extensive Russia expertise and knowledge of US politics; General Sir Richard Barrons has deep military experience; and George Robertson, the first secretary of defence in the Blair government, was a highly regarded secretary general of NATO.

Statements from when Labour were in opposition also suggest there will be a firm focus on recruitment and personnel, and on ensuring defence spending has a return in terms of jobs at home. What is essential is that the SDR builds adaptability into its strategic aims to future proof investments, and ensures that UK industry and society are resilient.

Defence reviews can be lengthy processes with bureaucratic and practical pitfalls, and this one is being conducted at a time of fiscal pressure and growing international risks. To be effective, the review should focus on clearly articulating goals for the defence of the UK and ensuring that the resources available match these goals. To do this, the review should aim to build on existing work, rather than reinventing the wheel, address persistent failures in procurement and recruitment – and make tough choices between competing service priorities. What is essential is that the SDR builds adaptability into its strategic aims to future proof investments, and ensures that UK industry and society are resilient.

Some in the opposition Conservative Party have said the review is unnecessary and the new government should focus on increasing spending now. The range of risks facing the UK and its poor state of defence readiness mean increased spending is desirable – as Chatham House research has indeed previously called for. But there are few other areas of public spending where the government would commit to more funds without asking: On what? For what purpose? And in what way?

The UK's defence spending is among the highest in Europe but it does not spend enough on personnel, military housing and basic equipment – whereas many long-term big-ticket investments run over time and over budget.

The new government has already said the government will act before the review to address the challenges facing armed forces personnel, including numbers. That means improving recruitment, housing for serving individuals and families, and career pathways. It also means providing training which delivers the skills modern armed forces need.

Recent parliamentary committee reports have itemized…the delays, technical problems and spiralling costs related to the Ajax armoured vehicle and the Type 26 frigate. The Haythornthwaite Review of UK Armed Forces personnel has 67 recommendations on just these issues and was only published in June 2023 so retains its relevance.

It's also well-known that defence procurement faces serious problems. Recent parliamentary committee reports have itemized some signal examples across the MOD's portfolio, including the delays, technical problems and spiralling costs related to the Ajax armoured vehicle and the Type 26 frigate. These highlight some specific recent problems: there has been high turnover in political leadership (eleven Ministers of State for Defence Procurement since 2016), and scrutiny and transparency could be better.

But they also illustrate wider tensions in any procurement process. Industry partners have been held to specifications that are all too often obsolete by the time of delivery. UK jobs can become dependent on complex long-running projects, and optimism bias can stymie effective planning. But there are

ongoing attempts to learn lessons from these experiences. The (February 2024) Integrated Procurement Model set out under the last government details some clear approaches. These include focusing on 'spiral' procurement – where teams aim to reach a minimum viable product with industry partners quickly, and then test and learn over time, rather than relying on expensive, detailed specifications that can take years to deliver and cannot easily be adapted to changing needs.

The challenge for the review team will be to avoid simply re-diagnosing the problems in UK defence or restating the same recommendations. Finding creative, effective and cost-effective solutions that will be resilient in the long-run should be the focus of the SDR.

In reviews of this nature, the heads of the different services tend to advocate for their own force. This can turn the process into a 'spread-the-love' exercise which avoids real joined-up choices. These internal arguments can be driven by narratives about the type of military power the UK 'should' be, with attendant pressures about sunk costs and commitments already made, rather than a genuine assessment of the threats and risks the UK faces. Taking tough decisions not to further sink costs in equipment that might well be obsolete by the date of deployment will take courageous decision-making.

The decision to appoint three external reviewers indicates the hope that they can better assess these demands. George Robertson, who leads the team, was the originator of the modern strategic defence reviews in 1997-98 and will be wise to all these pressures. But perhaps the most important thing that this SDR could achieve is to find a way to future-proof defence spending by building adaptability and resilience into strategic decisions. For example, harnessing the new spiral procurement approach by investing in interoperable, multi-purpose adaptable platforms and increasing the investment in cheaper drones to operate in all domains.

Taking tough decisions not to further sink costs in equipment that might well be obsolete by the date of deployment will take courageous decision-making. And debates about where to continue spending on existing programmes remain difficult, as recent media and political arguments about whether the review will jeopardize the Global Combat Air Programme, or force choices between it and AUKUS show.

New technological capabilities are not an alternative to spending on weapons, ammunition and personnel. But they are crucial in terms of reducing vulnerabilities in the near and long terms: the UK's decades-long investment in cyber defence has had enormous positive impact for both Ukraine and the UK against ongoing cyber offensives from Russia and other hostile states.

Learning from Russia's war against Ukraine means that in order to deter, the UK must have the clear capability to fight. This means enough manufacturing capability, personnel and resources to produce conventional force in the near future. This will mean protecting and investing in critical industries beyond the traditional defence sector – including electronics, steel, energy, and space communications.

A new SDR could be a worthwhile exercise to ensure that an increase in defence spending has a real impact, rather than feeding the problems of the past. Clearly assessing the type of conflict the UK expects to fight and the capabilities it realistically needs to do so should guide the process, rather than an inter-service contest for resources. An SDR conducted on that principle could make a real contribution to enhancing the UK's role in NATO and its long term foreign policy.

➢ 26 April 2024

Charles Moore writes that it is notoriously hard to predict a war. This week, in Warsaw (the right location), Rishi Sunak said we must put our defences "on a war footing". When he spoke, I happened to be reading the essays of Dean Inge, one of the most brilliant columnists and thinkers between the wars. In his preface, composed in January 1937, Inge wrote, "The opinion on the Continent is that we are approaching a new and terrible European war … I do not believe it … Germany is in such a plight financially that I have grave doubts whether the Hitler regime can last the year." The Second World War began in September 1939. Warsaw fell that same month.

Poor Inge was making a mistake common among rational, intelligent people. He thought that, because a course of action cannot ultimately work, it will not happen. He added that Germany could never win a war against Russia. He was right about that, but drew the rational, wrong conclusion that Hitler would never attack.

I have Mr Sunak down as a hyper-rational, hyper-intelligent man and, for that very reason, liable to underrate the risk of human evil and madness. He prefers the careful deliberations of the counting house to the clash of human passions. So his Warsaw speech is particularly welcome. He has, belatedly, noticed just how serious the danger is. He may have cast aside hesitation partly because Labour's defence spokesman, John Healey, was chasing similar thoughts.

The Prime Minister is not the first to announce an increase in British defence spending to 2.5 per cent of GDP by 2030. The person who gave me Inge's book is Mr Sunak's old boss, Boris Johnson, who now lives in "The Gloomy Dean's" former country house in Oxfordshire. At the Nato summit in Madrid, not long after Vladimir Putin's invasion of Ukraine in 2022, Boris made a similar commitment to 2.5 per cent, for a similar reason.

Some say that the target is pretty much inevitable anyway because of existing defence commitments. Others point out that percentages are useless in themselves: what matters is how the money is spent. They are right, but they should not forget that, for Mr Sunak, like Boris, the context is the current 2 per cent spending commitment made by all Nato members but fulfilled by so few. The point of announcing 2.5 per cent is to lead a European response to the famous Trump challenge to pay our defence dues.

Mr Sunak wants to show Putin that Europe and Britain won't let him win. Germany, Britain, and France each has a higher GDP than Russia, four times higher when combined. Although Nato, 75 years old this month, desperately needs continuing US support, the idea that it cannot resist Russian military threats is untrue. It is a question of will. Read on at: Sunak is right to put Britain on a war footing. Its meaning goes beyond defence (telegraph.co.uk)

➢ 27 April 2024

Tony Diver explains that Britain plans to equip the Armed Forces with a homegrown hypersonic cruise missile by the end of the decade, The Telegraph has learnt. Military chiefs want a weapon capable of reaching speeds exceeding Mach 5 as the Government races to catch up with China, Russia and the US. The Ministry of Defence (MoD) has insisted that the new weapon be designed and built entirely in Britain and is understood to have set a deadline of 2030 for it to enter service.

The project has been identified by Prime Minister Rishi Sunak as one destination for a planned £75 billion uplift in the defence budget over the next six years. A government defence source said: "Cutting-edge projects like this are only possible because of the massive new investment the Government has made this week in defence innovation. "With Labour refusing to match our investment, continuing this project would be impossible under Keir Starmer – the military would be forced to cut the hypersonic programme, in a move that would make Putin's dreams come true."

The missile plans are understood still to be at an early stage, with no decision taken so far on whether it would be launched from land, sea or air. One option is a weapon that could be fitted to a fighter jet like the Typhoon or F-35, which would have a shorter range and smaller payload than a larger weapon launched from the ground. The missile could also be launched from one of the UK's warships.

The project is being managed directly by MoD headquarters in Whitehall, rather than by one of the three armed services. Since late last year, the MoD has been running a consortium of around 80 companies to come up with possible designs. The Hypersonic Technologies & Capability Development Framework Agreement was launched in December in what has been described as a "national mission".

Sources involved in the project said the construction of the missiles would be especially difficult because some of the materials required do not yet exist, and must be developed from scratch to withstand the high temperatures that come with hypersonic speeds. Engineers are also working on a British version of a "scramjet" engine, which uses compressed air moving at supersonic speeds to aid the combustion of liquid or solid fuel.

The MoD declined to comment in detail on the plans, citing national security concerns, but a spokesman said: "We are pursuing hypersonic technologies to further develop UK sovereign advanced capabilities. We continue to invest in our equipment to meet current and future threats." Read the full report at: Britain to deploy homegrown hypersonic missile by 2030 (telegraph.co.uk)

- **28 April 2024**

Roger Bootle suggests that "No. 10 faces no more important task than equipping our Armed Forces to protect the UK. Read: Britain's defence spending has been seized by Treasury bean counters (telegraph.co.uk)

- **4 May 2024**

Matt Oliver and Christopher Jasper write that: Described as an Apache gunship that fits in the back of your car, the British-made Hydra drone has the potential to be a game-changer on the battlefield. The unmanned device, which will use rotors and rocket boosters to lift up to 400kg, can be fitted out to carry everything from laser-guided Brimstone missiles to a heavy machine gun. The Hydra was showcased by the Army at last September's Defence and Security Equipment International (DSEI) exhibition in London. It is exactly the sort of innovation the military wants to see more of.

But after four years of fruitless talks with officials, Hydra says it still doesn't know whether the Ministry of Defence will ever fund its idea to completion. Bosses have already sunk more than £800,000 into the company, with demo versions of the drone tested in Army exercises at Salisbury Plain in 2022 and 2023. To produce a final prototype the company needs to raise £500,000 – money

it had hoped to secure from the MoD until January, when it was suddenly told that budget freezes would make this impossible. Since then, they have heard nothing.

The situation has forced Hydra to canvass further afield for potential partners. Indonesia is now among the countries that may buy the drone instead. "We've got a British product that we want to sell into the British market, and everyone seems to like it – the Army put it on their exhibition stand," says Stephen Prior, Hydra's chief executive. "But at the moment, no one's willing to put in that relatively small amount of money to get the thing off the ground. So there's a huge question mark."

Hydra's case underlines a problem facing Rishi Sunak as the Prime Minister pushes to revitalise Britain's defence industry. Last week he set out plans to fire up the country's military industrial base by increasing defence spending to 2.5pc of GDP by the end of the decade. Sunak said it represented an "incredible opportunity" for Britain's smartest defence start-ups.

The MoD has also talked up an ambition to work more closely with innovative small and medium-sized enterprises (SMEs) to develop cutting-edge technologies such as drones and autonomous weapons. However, there are big questions about whether Whitehall can get its act together. "The challenge is to encourage new ideas, new thinking," says Keith Hartley, a defence expert and emeritus professor of economics at York University. "It will involve costs, and it will involve risks." These are two things the Government has been averse to in recent years. Read on at: 'We call it the valley of death': inside Britain's battle to rearm itself (telegraph.co.uk)

➢ 10 May 2024

Henry Bodkin reports that the pair of Britain's newest Apache attack helicopters hover 40ft above the ground, their guns trained on the dense woods. Beneath them, assault troops from the Parachute Regiment and the US Airborne Division steal into the trees. They are quickly met by deafening explosions, machine gun fire and thick grey smoke. The woods are being "contested", meaning the Paras and their American comrades have a fight on their hands.

This is what the start of the Third World War looks like – at least according to Nato planners, who are overseeing the Alliance's biggest exercise since the end of the Cold War. We are just over an hour's drive from Estonia's eastern border, and the "enemy" in the mock attack, as part of operation Swift Response, is, of course, Russia.

In preparing for what until relatively recently was unthinkable – a land invasion of a Nato member – senior officers are having to work out how they could stop a potentially overwhelming Russian advance. The answer, if Friday's exercise is anything to go by, is a highly aggressive but sophisticated counter-attack that buys the Western allies breathing space to rally more troops. Continue at: On the 'front line' as British paratroopers take on imaginary Russian forces (yahoo.com)

➢ 13 May 2024

Danielle Sheridan explains that the Royal Marines are to get up to six new ships which will enable drones to be launched and laser weapons to be fired from them, The Telegraph can reveal. Grant Shapps has announced that development has begun on the new Multi Role Support Ships (MRSS), which will be specialist warships designed to rapidly transport the Royal Marines Commando Force from sea to shore around the world.

In an interview with The Telegraph, the Defence Secretary said he was investing money into the support ships because Britain will need to fight and win future battles with China at sea. "We're making these critical investments in shipbuilding to build the future Royal Navy needed to deter our adversaries, and then win if they are not deterred," Mr Shapps said. "As nations like China and Russia invest heavily in their militaries we must make sure the UK leads our allies so that the West is not left behind."

An image of what the Multi Role Support Ship will look like Credit: BMT

Mr Shapps will make the announcement for the new MRSS at the First Sea Lord's Sea Power Conference at Lancaster House on Tuesday. His comments come after the Prime Minister committed £75 billion in new funding to the Ministry of Defence, taking the defence budget to 2.5 per cent of national wealth by the start of 2030. The MRSS are the first pieces of new equipment Mr Shapps has pledged to buy with his increased budget.

The new vessels will feature docks for landing craft, a hangar that can take a Chinook, as well as a launch pad for helicopters and will crucially have the ability to host and launch attack drones from a dock that can be lowered into the water. It is also hoped that DragonFire, a high-powered laser beam that can shoot down enemy drones and missiles, will be fitted on ships. Read on at: Royal Marines to get six new ships which can launch drones and fire laser weapons (telegraph.co.uk)

➢ 4 June 2024

David Axe asks the question: Should the Royal Navy join the US in a very exclusive club? He goes on to write that there are calls for the Royal Navy to acquire a class of submarine it's never had before – a nuclear powered guided missile sub (SSGN). This is a large nuclear powered submarine, not unlike a nuclear deterrent boat but with a large number of vertically-launched cruise missiles rather than a smaller number of nuclear-tipped intercontinental ballistic missiles. It's a very good, but very expensive, idea.

Expect the cost to overwhelm the benefit. The Royal Navy is continuing to shrink as it struggles to afford new frigates, destroyers, amphibious vessels, support ships and submarines in adequate numbers to sustain the roughly 80-ship front-line fleet.

Many conventional and nuclear-powered attack submarines – SSs and SSNs, respectively – carry some cruise missiles, including the Royal Navy's current Trafalgar and Astute class SSNs. But they carry only a few cruise missiles, and fire them horizontally from their torpedo tubes, limiting the pace and volume of the shooting.

The idea behind an SSGN is to optimize the boat's strike potential, by arming with a lot of cruise missiles – and firing them from vertical launch tubes that can salvo scores of missiles in a span of minutes. An SSGN is bigger than an SSN, the same size as a ballistic missile deterrent sub (an SSBN), and it can fit several vertical tubes for cruise weapons into the same space as a single intercontinental nuclear missile. This means a lot of cruise missiles.

It's this fast, concentrated firepower, packed into an all-but-undetectable stealthy platform, that makes SSGNs such an attractive asset for the most sophisticated navies. It's their cost – billions of dollars per boat – that limits their use to only the richest navies. At present, only the US and Russian fleets operate SSGNs.

At least one think-tank wants the Royal Navy to join that exclusive club. "The submarine service should be de-risked by … procuring an additional Dreadnought as a missile submarine (SSGN) to provide extra deep strike," William Freer and Dr. Emma Salisbury wrote in a new report for the London-based Council on Geostrategy. Read on at: US Navy style cruise missile and special forces SSGNs for the Royal Navy? Good idea (telegraph.co.uk)

➢ 21 June 2024

Maciej Hypś advises that the United Kingdom plans to finalise a deal to purchase 27 fifth-generation F-35B Lightning II fighters this summer. This announcement was made by James Cartlidge, Secretary of State in the British Ministry of Defence. This is good news for the British Air Force and Navy, which share a fleet of these aircraft. Until now, they have had to be content with the promise of only 48 fighters ordered a few years ago, of which 33 so far have been delivered.

The United Kingdom planned to purchase a total of 138 F-35Bs to replace the now-retired Tornado strike aircraft. However, numerous changes in British governments in recent years have led to continuous modifications to these plans, and it is not really known today what the final number of the British F-35B fleet will be. The needs are significant. Besides the necessity of equipping two aircraft carriers with these planes, the Royal Air Force also has its requirements. The current number of aircraft does not allow for the completion of all the missions set for the Air Force. This will be the case even after all the planes from the first contract have been delivered.

British Queen Elizabeth-class aircraft carriers are adapted to carry about 30 F-35Bs each, and they have already gone to sea simultaneously. This means that to equip just the aircraft carriers, about 60 aircraft are needed, and preferably more, because some are always used for training on land, and there needs to be a reserve in case of overhauls or failures. And the F-35 is known for its unreliability. Then there are the Air Force's needs. Therefore, the announcement of the purchase of an additional 27 units, which will allow the formation of a third squadron armed with F-35Bs, is meeting with enthusiasm

from aviators. If the contract is signed in the next few weeks, aircraft deliveries should be completed by the end of this decade.

Indeed the current government has returned to the idea of purchasing a total of 138 F-35s. This is supposed to happen by the middle or end of the next decade. It is not yet known which versions of the aircraft will be ordered in the future. Years ago, when the shape of the British F-35 fleet was decided, two concepts clashed. The first called for the purchase of conventional F-35As for the Air Force and F-35Bs with short take off and vertical landing for the Navy. According to the second concept, only F-35Bs were to be bought to achieve full interchangeability of aircraft between the Air Force and the Navy. Ultimately, the second concept prevailed, but there may be some changes in the future. The F-35B can operate from aircraft carriers but carries less armament and has a shorter range than the F-35A. Additionally, the land-based version of the fighter is significantly cheaper.

Nevertheless, ordering an additional 27, and ultimately acquiring a total of 138 F-35s by the United Kingdom, may negatively impact the British-Italian-Japanese program to build the next-generation GCAP fighter. Each of these countries intends to acquire a significant fleet of F-35s in various variants. However, the costs associated with such purchases may turn out to be so high that they will not be able to afford a sufficiently large number of GCAP fighters. Based on the available numbers and plans for F-35 purchases in the three countries, it can be estimated that GCAP production will not exceed 400 units, with a more probable number being about 350 units.

For such a small production scale, the unit costs of each next-generation fighter will be enormous. Therefore, it may turn out that the result of the GCAP program will be a much simpler aircraft with fewer capabilities than the French-German-Spanish competitor NGF. Such an approach would significantly lower the price and allow the new aircraft to enter service much faster. Time also suggests that the GCAP may be simpler than the NGF. Current schedules indicate that GCAP production is expected to start around 2035, while for NGF, the time is five years longer.

Apart from considerations about fighters, work is underway in the United Kingdom to develop several types of unmanned aircraft to operate from aircraft carriers. In addition to developing the drones themselves, this will require the rebuilding of both aircraft carriers, particularly installing catapults and arrestor cables (brake lines).

➢ 20 July 2024

Dominic Penna advises that British soldiers are using a new smartwatch that can control drones as part of a rollout of the latest battlefield technology. The watch forms part of a range of wearable equipment tested out in a pilot to mark the start of the Future Soldier Programme. The Ministry of Defence (MoD) scheme aims to give the next generations of troops an edge over their adversaries while using a range of technology to improve wider military capability. Watches that give the wearer the ability to both control and pre-programme drones were used by troops from the 2nd Battalion The Royal Anglian Regiment in Leicestershire.

Other technology that is set to be deployed more widely after the trial includes helmet-mounted detection equipment that warns troops when they are being targeted, while a laser range finder can be used to calculate the range of an object or target. Ground sensors that were used in the pilot can detect the movement of enemies and proceed to send an alert to body-worn systems.

Digital day and night systems for weapons will be introduced through their Picatinny rail, a platform which is used to attach accessories to firearms. The development of new technology under the Future Soldier plan is set to continue for the next five years and the next phase of the trial will focus on vehicle-mounted operations. See the full report at: British soldiers test smartwatch that controls drones in rollout of latest battlefield tech (telegraph.co.uk)

➢ 21 July 2024

Martin Evans explains that the RAF is considering using augmented reality technology to train the next generation of front-line fighter pilots amid warnings the UK's military requires urgent modernisation. Cutting edge software developed by a US company allows pilots to experience hostile combat situations while in the air rather than in simulators. Images of virtual enemy aircraft are beamed into the airman's visor and then various scenarios can be programmed to test their response. It allows pilots to prepare for combat situations while in the cockpit and vastly improves the efficiency of training exercises.

BAE Systems is due to demonstrate the Advanced Tactical Augmented Reality Systems (ATARS) on a Hawk TMk2 aircraft later in 2024. If successful, AR technology could be rolled out more widely throughout the RAF and could help pilots develop the skills needed to stay one step ahead of adversaries.

There have been warnings that the Armed Forces need to modernise to deal with the developing threat posed by Russia, China, Iran and North Korea. Sir Keir Starmer has announced a Strategic Defence Review that will fully assess the risks and capabilities of Britain's military. Lord Robertson of Port Ellen, the former defence secretary and secretary general of Nato who will lead the review, said: "We're confronted by a deadly quartet of nations increasingly working together and we in this country, and the Nato alliance that met so successfully last week, have got to be able to confront that particular quartet as well as the other problems that are pervading the world at present."

➢ 22 July 2024

Matt Oliver reports that a high-powered laser weapon capable of shooting down aerial drones has been fired from a British military vehicle for the first time. Raytheon's high-energy laser weapon system (HELWS) was mounted on a British Army Wolfhound armoured truck for the test-fire, which took place at the Government's Porton Down science and defence technology campus in Wiltshire. It is the first time the weapon has been trialled in the UK as part of an ongoing Ministry of Defence (MoD) programme to develop directed energy weapons.

HELWS, which is already cleared for use by the US military, is designed to shoot down small drones and be compatible with existing air defence systems. Developing anti-drone systems is increasingly important as low-cost weapons become more common on the battlefield. For example, Russia and Ukraine have relied heavily on drones to launch attacks on one another.

British and American ships were recently forced to fire multimillion-pound missiles to shoot down inexpensive unmanned drones launched by Houthi rebels on the Red Sea. Shooting down drones with lasers, which cost far less per shot than the drones themselves, offers a much cheaper solution.

James Gray, chief executive and managing director of Raytheon UK, said: “We have proven that the Raytheon high-energy laser weapon system can track and engage targets whilst mounted on a vehicle. “The speed at which this capability was delivered is only possible due to the hard work of our British partners, coupled with the operationally proven technology developed by Raytheon.” UK-based companies including Frazer Nash, NP Aerospace, LumOptica, Blighter Surveillance Systems and Cambridge Pixel contributed technology to the project.

The test comes after the MoD demonstrated DragonFire, another laser weapon, that the Navy hopes to mount on warships by 2027. DragonFire was developed by a consortium including MBDA, Leonardo and QinetiQ. Raytheon’s HELWS is being developed in partnership with the Defence Science and Technology Laboratory (DSTL) and Defence Equipment and Support (DE&S), which are both part of the MoD.

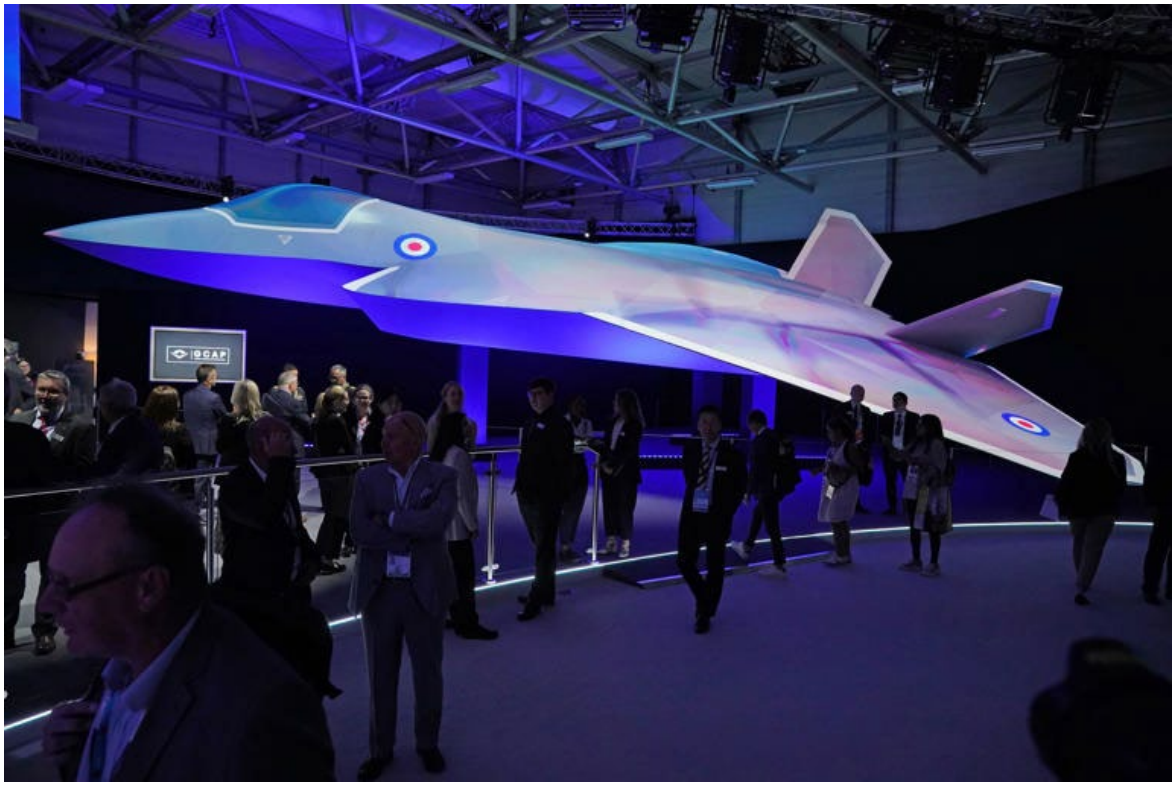
➢ 24 July 2024

Jabed Ahmed writes in The Independent that Sir Keir Starmer has voiced his commitment to a new multibillion-pound fighter jet under development for the RAF following his visit to Farnborough International Airshow. The UK’s future flagship jet, known as Tempest, is set to be a sixth-generation stealth aircraft, equipped with advanced weapons and radars, with the ability to fly at supersonic speeds, in a step up from the F-35 warplane. The jet, roughly the size of a tennis court, is being built in partnership with BAE Systems, Italy’s Leonardo and Japan’s Mitsubishi Heavy Industries, and has been described as the “Future Combat Aircraft”.

Speaking at PMQs, Conservative Party leader Rishi Sunak sought assurances that the government would continue talks with Saudi Arabia about its possible involvement in the project. The Labour leader did not address the question directly, but said: “This is a really important programme, significant progress has already been made and we want to build on that progress, and I’ve had some initial discussions, not least in Farnborough, where I was just a few days ago.”

Mr Sunak highlighted the importance of a prime minister being able to use their prerogative power to ensure the UK military responds quickly to protect national security, adding: “Sometimes without giving this House prior notice. Now these are perhaps the most difficult decisions that a prime minister can take and I welcomed his support when I made them. And I want to take this opportunity to assure him of the Opposition’s support if he deems it necessary to take similar action in the future.”

Mr Sunak asked if Sir Keir agreed such power was “essential to ensure the safety and security of the British people”, with the Prime Minister replying: “I agree it’s essential and our security is the first duty of government.” He said the new government would “endeavour” to brief the opposition where possible on any such action. Following PMQs, MPs approved legislation that would provide the legal framework for the Global Combat Air Programme (GCAP), amid concerns its immediate funding is in doubt.



A life-size scale model of the GCAP stealth fighter on display at the BAE Systems area at the Farnborough International Airshow (Jonathan Brady/PA Wire)© Provided by The Independent

➢ 25 July 2024

Ben Riley-Smith writes that Britain's new "drone killer" radio wave weapon has been thrown into doubt after Labour cancelled Tory plans to increase defence spending to 2.5 per cent of GDP by 2030. The Ministry of Defence (MoD) had been on the brink of signing a contract for about 15 of the radio frequency directed energy weapons from Thales, the defence company. The technology, which is still being developed, allows soldiers to fire radio waves to disable enemy electronics and can take down a swarm of drones.

The MoD announced the project in May 2024. Delivery of the weapons was expected in 2026 and Tory ministers wanted to give some to Ukraine to help counter the Russian invasion. But The Telegraph can reveal the project's future is now uncertain after the Labour Government scrapped the Tory timeline for increasing defence spending this decade. Sources familiar with discussions told The Telegraph there was no clarity on when the contract might be signed, with delays looming as Labour conducts a strategic defence review.

Each radio wave weapon is only expected to cost around £10 million, which is relatively small given other military spending figures. Industry figures have been urging the MoD to approve decisions on smaller pressing projects even if larger ones need wider consideration in the review. One prototype is being tested

The strategic defence review may not be concluded until summer 2025, but many procurement decisions need to be signed off before the end of the financial year in March 2025. Read on at: 'Drone killer' radio wave weapon in doubt in Labour defence review (msn.com)

CYBER

Source: Shutterstock

We open this section with an extract from, and the Introduction to, SoSafe's Cybercrime Trends 2024:

In 2023, everything changed. It's time to prepare for what's to come. The year 2023 was a turning point in our global narrative. Since OpenAI announced the launch of ChatGPT-3 in November 2022, there has been a surge of AI-driven innovation and a profound shift in how we interact with technology. This evolution is particularly evident in information security, where AI has emerged as a pivotal force, not only strengthening cyber security defenses but also elevating the sophistication of cyberattacks.

As we head into 2024, fuelled by this unprecedented speed of technological innovation, we face a confluence of challenges: AI's ever-growing involvement in cyberattacks, the double-edged sword of emerging technologies like 5G and quantum computing, and the maturing of cybercrime into a highly professionalized industry. This context is further complicated by the rise of hacktivism and cyberattacks amid global political crises and the rise of disinformation campaigns, making threats more complex and far-reaching. All this while cyber security professionals are battling burnout in the face of these escalating threats.

With the likelihood of an attack resulting from human error expected to increase in this threat landscape, a strong security culture is the only hope we have. That's why this report focuses on the eight cybercrime trends for 2024 and provides security best practices to better prepare against this diverse array of cyber threats. These trends are:

- *AI's growing role in cyberattacks.*
- *Cybercriminals exploit all new technologies.*
- *Cybercrime will become more professionalized.*
- *The hacktivist movement is gaining momentum.*
- *Disinformation-as-a-service.*
- *Challenges for the public sector and critical infrastructure.*
- *Pretexting and multichannel tactics.*

❖ *Rising burnout rates in security teams.*

Now read on at: Cybercrime Trends 2024 | Report (sosafe-awareness.com)

Turning now to our chronological related news items we start with an article by Lauren Shirreff on:

➢ **23 April 2023**

It sounds like every pilot's worst nightmare – the hijacking of a plane's GPS while it's suspended some 40,000 ft above ground, with hundreds of passengers on board. Yet this sort of scenario, it has emerged, is remarkably commonplace, with new data showing that 46,000 planes flying over the Baltic have logged GPS problems since last August.

Two types of interference are taking place: intentional signal "jamming", where GPS signals are blocked, and "spoofing", where planes are sent fake GPS position signals in an attempt to throw them off course. Both spoofing and jamming are not new, but instances of both became common "around the airspace of Ukraine when the conflict began in 2022", says David Mumford of Opsgroup, which monitors changes in global airspace.

"But then in 2023 we started getting reports of spoofing across the Middle East, including instances near Iraq, Iran, Egypt, Israel, Jordan, Turkey, Cyprus and Lebanon. We've since had reports from all kinds of other places, including Pakistan, Niger and China." Opsgroup knows of one spoofing incident where a plane almost drifted into Iran's airspace, where missiles were ready to meet unauthorised aircraft.

At the end of March there was a "63-hour sustained period of GPS jamming in the Baltic area", says Mumford. One person presumed to be a victim of this incident was Grant Shapps: last month an RAF plane carrying the Defence Secretary home from Poland had its GPS signal tampered with for half an hour while the plane flew close to Kaliningrad, a Russian enclave sandwiched between Poland and Lithuania.

NATO too says that spoofing and jamming are on the rise. "We have seen an increase in GPS jamming since the start of Russia's war against Ukraine, and allies have publicly warned that Russia has been behind GPS jamming affecting aviation and shipping," a NATO official says. "Russia has a track record of jamming GPS signals and has a range of capabilities for electronic warfare. In the Middle East, Russia has used GPS jamming against Allied air forces fighting Isis for years."

It certainly sounds concerning. Furthermore, it appears there is little airlines or aviation authorities can do to tackle the trend. GPS jamming equipment can be operated in the air by planes and drones, or by vehicles on the ground below. But exactly how it's done is unknown. "Even if you were to ask a tech expert how jamming or spoofing is done they wouldn't be sure," says Nick Eades, who was the world's most experienced Boeing 747 pilot when he retired in 2022. "The Americans who look after the GPS system look at ways to prevent it from happening, but in a few weeks the people behind it will have found another way to corrupt the signals."

As for the motivation behind the attackers, Richard Dearlove, former head of MI6, thinks that all this is an ominous show of power on Russia's part. Dearlove says that GPS jamming is typical of Russia.

"We're in a state of grey war with Russia," he says. "None of this is particularly surprising, but it does reflect the fact that we are in a confrontation with Russia, and we are only just beginning to realise the seriousness of that here in the West."

Dearlove also points out that Russia is likely to have tampered with three under-sea internet cables that went out of action last year. "Either those were simultaneous accidents, or someone did something to demonstrate their capability," he says, and signal jamming works to much the same effect. Russia will "do all sorts of things to undermine the quality of our daily life and disrupt things", Dearlove says, "and messing with our air travel or our internet cables is a very good way to do that." Read the full article at: Russia is constantly targeting our planes, pilots say – here's how it happens (telegraph.co.uk)

➢ 14 May 2024

Matthew Field reports that Vladimir Putin's Russia is preparing "physical attacks" against the West, the head of GCHQ has warned, as British and American intelligence officials laid bare the dual threat posed by Moscow and Beijing. Anne Keast-Butler, who was appointed to lead Britain's signals intelligence operations last May, used her first major speech to highlight the immediate threat posed by the Kremlin and the "epoch-defining" risk posed by China to the UK and its allies. The GCHQ director told a gathering of cyber security experts in Birmingham that her agency believed Moscow was looking to go further than attacks simply in cyberspace.

The signals agency is "increasingly concerned about growing links between the Russian intelligence services and proxy groups to conduct cyber-attacks – as well as suspected physical surveillance and sabotage operations". Ms Keast-Butler, who is the first woman to hold the post in the agency's 105 year history, said Moscow was "nurturing and inspiring" groups of cyber attackers, and "in some cases seemingly co-ordinating physical attacks against the West". Last week, a British man was charged with an arson attack in London and accused by prosecutors of working for Wagner Group, the Russian paramilitary organisation.

Speaking at the CyberUK conference, Ms Keast-Butler said, "Putin has not given up on his maximalist goal of subjugating the population of Ukraine". She added that UK support for Kyiv remained "steadfast", with British spies continuing to bolster the country's cyber defences.

Russia has long been accused of protecting cyber gangs that target Western organisations, allowing them to operate with relative impunity as they carry out sophisticated hacks. Last week the National Crime Agency named Dmitry Khoroshev, a Russian national, as the person behind LockBit – a ransomware group that had stolen hundreds of millions of pounds from businesses. Royal Mail fell victim to a LockBit attack last year, after the Russia-based gang paralysed the postal service's ability to send letters and parcels abroad.

Directing physical attacks in the West would represent an escalation of Moscow's hostility towards the West. Despite the growing threat from Russia, Ms Keast-Butler said China was taking up "more resource… than any other single mission" at GCHQ. Ms Keast-Butler said China posed the greatest threat to Britain, representing a "genuine and increasing cyber risk to the UK". While she said the UK was open to engaging with China on areas that are "mutually beneficial", such as climate change or artificial intelligence safety, Ms Keast-Butler added that the "PRC [People's Republic of China] poses a significant risk to international norms and values".

She said China was seeking to shape global technology standards "in its own favour" and wanted to "assert its dominance within the next 10 to 15 years". The warning over China comes days after it emerged a Ministry of Defence contractor was hacked in an attack blamed on Beijing. Payroll data on 270,000 current and former military personnel was compromised in the breach. The US government has also accused China of extensive efforts to infiltrate its critical infrastructure via a hacking group dubbed Volt Typhoon. American officials believe the group has sought to penetrate water facilities, the power grid and transportation systems, lying dormant with tools that can be unleashed in the event of a conflict. Read further at: Putin is plotting 'physical attacks' on the West, says GCHQ chief (telegraph.co.uk)

- **20 June 2023**

Russian hackers who targeted NHS hospitals have demanded a £40 million ransom. The group, called Qilin, claimed responsibility for the cyber-attack on computer systems run by Synnovis, which provides pathology services to hospitals and GP surgeries in London. More than 1,100 operations have been postponed as a result of the attack on June 3, which have left three major London hospital trusts struggling to process blood, urine and tissue tests. New figures, released on Thursday, revealed that 1,134 operations and 2,194 outpatient appointments at King's College, Guy's and St Thomas' hospital trusts have been cancelled in the two weeks since.

It is understood the Qilin group, thought to have links to Vladimir Putin, the Russian president, has threatened to publish data stolen in the breach. Ciaran Martin, the first head of GCHQ's national cyber security centre, had previously said Qilin appeared to be behind the attack. A Qilin website, on which the group listed its alleged victims, disappeared from the internet in the days after the hack. Another page remained online, but Synnovis was not listed.

A Synnovis spokesman said: "The investigation into the attack continues, including any possible impact to data. Once further information is known, we will report in line with the Information Commissioner's Office requirements, and prioritise the notification of any impacted individuals or partners as required. "We also continue to engage with law enforcement and the information commissioner and are working closely with the National Cyber Security Centre and NHS England's cyber operations team." Qilin first emerged in 2022 and has been responsible for 29 ransomware attacks globally this year, according to research by Comparitech.

- **29 June 2024**

Gareth Corfield and Ben Butcher advise that Russia has jammed the GPS on hundreds of RAF flights over Eastern Europe this year, The Telegraph can reveal. More than one in four transport and surveillance flights in the first four months of 2024 were subject to GPS interference, analysis of data from thousands of flights has shown. Detailed analysis shows how the indiscriminate jamming can threaten the safety of military and civil flights alike, experts said, and it demonstrates the extent of Russia's interference with aviation.

Grant Shapps, the Defence Secretary, said: "This is another example of Russia's recklessness and more evidence that they are an out-of-control hostile state. "Thankfully our planes and pilots can see off this threat but it illustrates Putin's contempt for the West and for the international rules-based order." Ian Petchenik, a spokesman for Flight Radar 24, which shared the flight data with The Telegraph, said: "GPS jamming can create substantial headaches for operators, disrupting navigation

systems and increasing pilot workload in congested airspace near conflict zones. Mitigating these risks is essential to air safety."

The Telegraph's analysis of data from Flight Radar 24 looked at flights carried out by 63 RAF aircraft between Jan 1 and April 30, totalling 1,467 journeys across Eastern Europe and the Middle East. It found that 142 RAF transport and surveillance flights out of 504 across Eastern Europe were subject to GPS jamming between January and April. Of those, 60 saw repeated jamming attempts – equating to one in eight flights.

Each of the aircraft in the analysis has a transponder that broadcasts a number saying how accurate the onboard GPS is. When that number drops below a certain threshold, experts say that is a reliable indication that jamming is taking place. The analysis included all of the RAF's Voyager and leased Airbus A330 passenger and tanker aircraft, along with two Dassault Falcon business jets and the Government's specially-fitted Voyager used for VIP trips. Also included were the A400M and C-17 cargo carrying fleets, as well as the RC-135 surveillance aircraft, which is based on the Boeing 707 airliner design. While these are not front-line fighters and bombers, they all form a critical part of the UK's defence capabilities. Read the full report at: Hundreds of RAF flights had GPS jammed by Russia (telegraph.co.uk)

➢ 2 July 2024

The Independent reports that the US National Security Agency (NSA) has issued advice to smartphone owners to prevent their devices from being hacked and their personal details and money stolen. The government agency's Mobile Device Best Practices report is aimed at the billions of people around the world who use either an Android or an iOS smartphone, who are all exposed to a variety of cyber risks like spear-phishing attacks and zero-click exploits.

Smartphone users can protect themselves against many of these hacks by simply turning their phones off and on again, according to the NSA's guidance. "Threats to mobile devices are more prevalent and increasing in scope and complexity," the US surveillance agency wrote in its guide. "Users of mobile devices desire to take full advantage of the features available on those devices, but many of the features provide convenience and capability at the sacrifice of security."

Among the standard advice of using strong passwords and using any biometric security features like face and fingerprint recognition, the NSA also offers other instructions that may be less familiar to average phone users. Phone owners are urged to only use their original charging cords and not use public USB charging stations to avoid their devices from being infected with spyware. The NSA also recommends updating a device's software as often as possible and never to connect a personal device to government computers via WiFi or Bluetooth, or to public WiFi networks.

"Disable location services when not needed [and] do not bring the device with you to sensitive locations," the advice states. "Do not have sensitive conversations in the vicinity of mobile devices not configured to handle secure voice. Do not have sensitive conversations on personal devices, even if you think the content is generic."

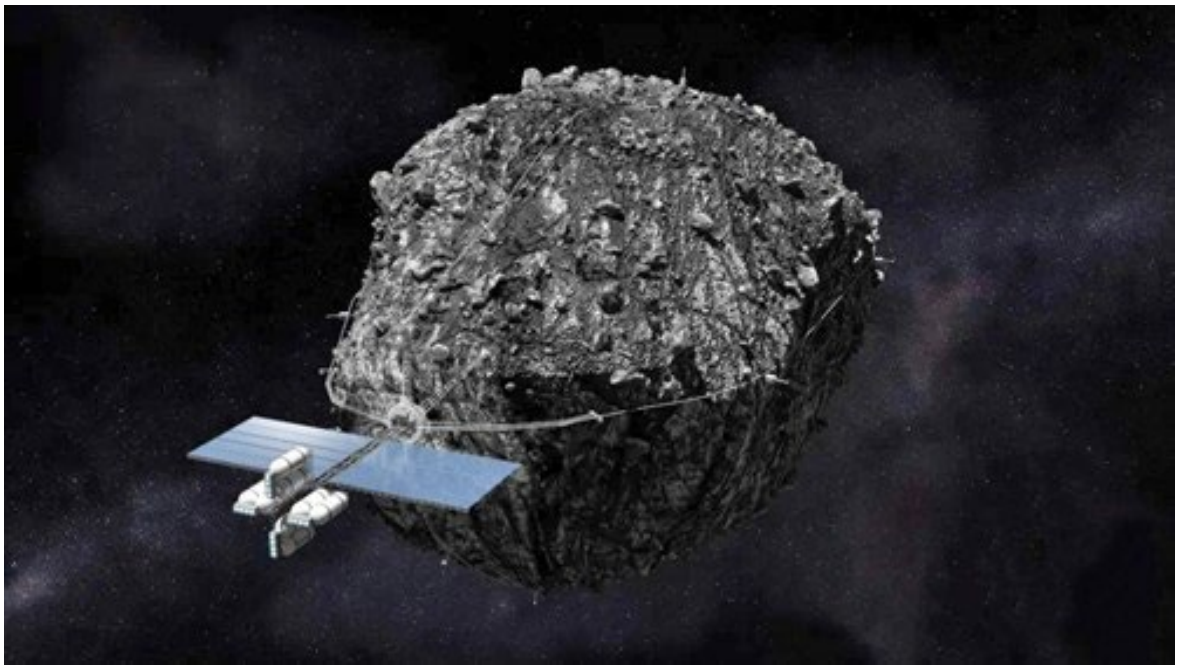
Read the report in full at: Spy agency issues urgent warning to billions of smartphone users to avoid being hacked | The Independent

CAREERS

In this edition we feature an article by Brodie Stanhope from the RAeS Next-Generation Board who examines ten exciting careers possibilities.

Working in aerospace is, in large part, about looking ahead. Decades in advance, engineers, scientists and managers, among others, are working on incredible new technologies for future generations of aircraft and spacecraft. The aviation, aerospace and space sectors look set to evolve rapidly and will be propelled by a new generation of professionals. So what could their careers look like? Here are ten possibilities:

Asteroid Miner

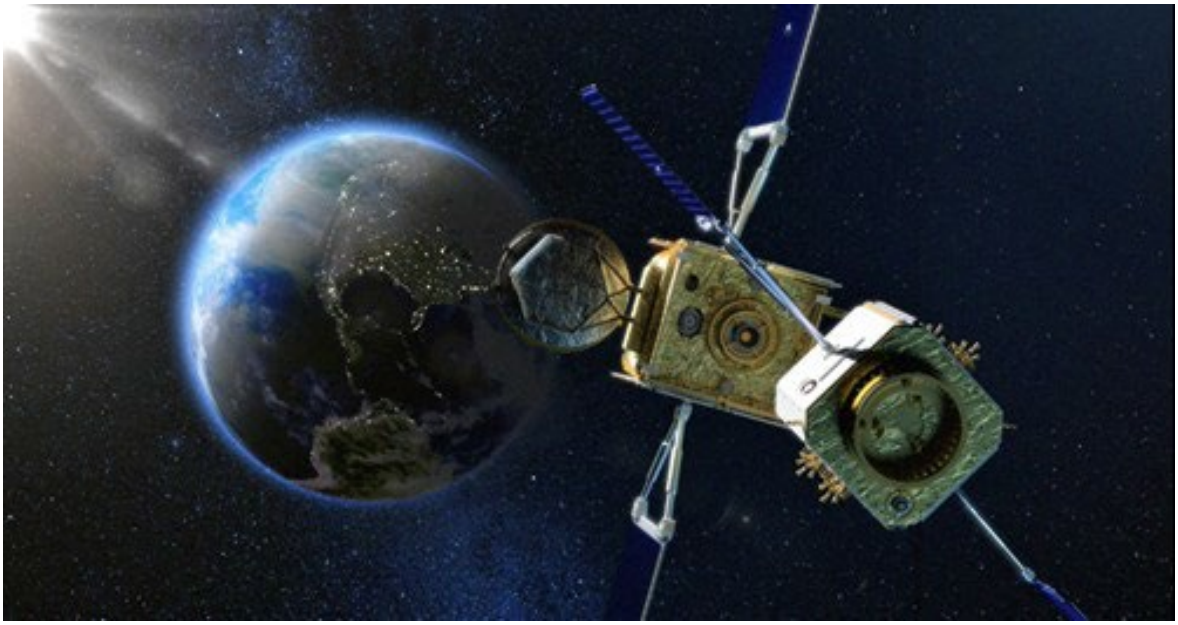


Deep Space Industries' Harvestor class spacecraft for asteroid mining. Asteroids are a source of both precious metals and construction materials that could be essential for future space exploration. (Deep Space Industries)

The Solar System's asteroids are rich in precious metals and construction materials. Any future exploration and activity in deep space will likely rely, to some degree, on materials harvested from asteroids. Asteroid mining will enable the construction of larger structures, such as space stations in orbit, and reduce material shortages on Earth. People with knowledge of the structure of asteroids and the complex equipment needed to mine them will, therefore, be in high demand.

They might have experience in engineering, physics or geology and would be able to work well under pressure. Asteroid miners would be sent out for weeks or months at a time before returning home. A typical day might include maintenance of mining equipment, analysing data to locate valuable resources, completing spacewalks to the asteroid surface and preparing material for transport around the Solar System.

In-Orbit Refueller



In-orbit maintenance could be facilitated by Telespazio's proposed START-€ servicing spacecraft (gold, left). Seen here attached to a satellite (white, right) orbiting Earth. (ESA)

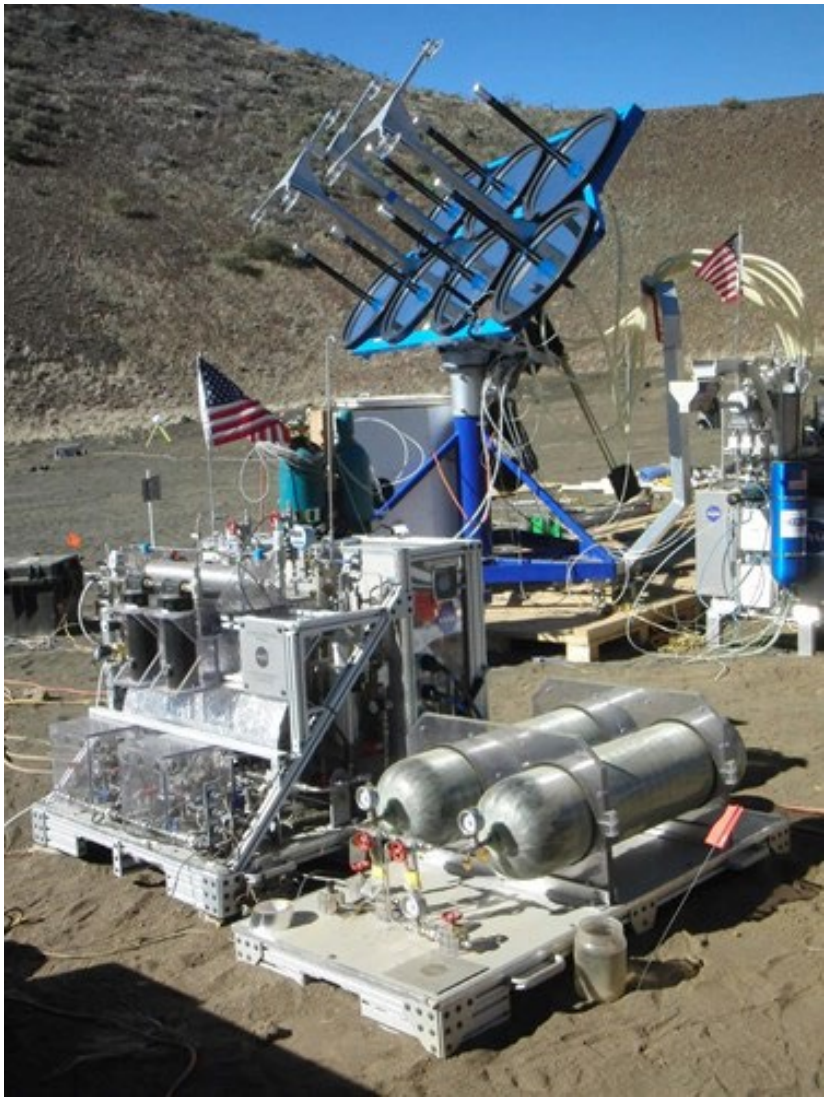
Undoubtedly essential to increasing the range of spacecraft travelling throughout the Solar System, in-orbit refuelling will shape the future of space exploration. Refuelling infrastructure will initially comprise depots in Earth orbit and be regularly replenished by tankers from Earth. As in-space mining becomes more common, depots might be located in the Moon's and other planets' orbits. The positioning of these depots and refuelling stations will be of strategic importance.

An in-orbit refueller would need a background in engineering or physics, and in particular an understanding of fluid behaviour in microgravity. Additionally, a proficiency in rapid decision-making and knowledge of safety regulations would be essential. Refuellers might work shifts lasting a few days in Earth's orbit, before heading back, or be stationed at a particular depot for a few months at a time. Each day might see the refuelling of several spacecraft, maintenance and construction tasks being completed, and conducting inspections on refuelling infrastructure.

3D Printing Specialist

The use of 3D printing is revolutionising production processes on Earth, but is still very much an emerging technology in the aerospace sector. In passenger aviation, the use of 3D printing will enable the manufacturing of much lighter, and therefore more fuel-efficient, aircraft. Additionally, the versatility of the manufacturing process means that structures could be built on the surface of the Moon or Mars, potentially using materials sourced from ISRU and asteroid mining. Such additive manufacturing requires an advanced understanding of materials science and engineering. For aerospace, in particular, high safety standards must still be upheld, and any 3D printed components will be held to these same standards. A 3D printing specialist would have a background in aerospace materials engineering or materials science. They may also be experienced in the testing, evaluation and approval of parts. A 3D printing specialist would be involved in a combination of research and development, design, testing and operational roles. A large portion of their work could consist of evaluating computer-aided designs to ensure airworthiness.

In-Situ Resource Utilization (ISRU) Specialist



In-Situ Resource Utilization (ISRU) specialists would use lunar or space resources for manufacturing on the Moon's surface or in orbit. (NASA)

After any resources are mined, either on the surface of the Moon, a planet or an asteroid, they will require refining and processing. In-Situ Resource Utilization (ISRU) refers to any processing and use of resources at the location where they are mined and is essential to any permanent base or space station. An ISRU plant could process metals for construction or refine fuel to supply depots. Many proposals for missions to Mars rely on ISRU to refuel vehicles for the return journey.

An ISRU specialist has much in common with the chemical engineers of today, with a deep understanding of both chemical processes and engineering. Additionally, the harsh environment of space presents further thermal engineering challenges and anyone working with ISRU will need to understand these. ISRU specialists might work on Earth, designing refineries, or could be sent out to repair, maintain and operate ISRU systems. Additionally, research and development efforts would be ever continuing to improve the efficiency of refineries or to access more resources.

Cryogenics Engineer

Increasing demand for chilling in the food industry and growing aerospace industry use is driving a rise in the demand for cryogenic fuels. (Pixabay)

Cryogenics refers to the science and engineering of keeping something at a very low temperature, often for long periods of time. In the aerospace sector, many of the most efficient rocket propellants are cryogenic. Historically, liquid hydrogen and liquid oxygen have been used in space launch vehicles, while liquid methane is being rapidly adopted. In the future, projects, like NASA's Artemis programme, are looking to store cryogenic propellants in Earth's orbit for months on end. Simultaneously, the aviation sector is looking to adopt liquid hydrogen as a zero-emission replacement for kerosene fuels.

A cryogenics engineer would need an understanding of thermal engineering, systems engineering, fuel systems or propulsion. Furthermore, experience in all stages of the product life cycle, especially in developing an initial concept into operational hardware, would be beneficial, as would specialised experience in testing and evaluating cryogenic systems. Cryogenics engineers will, undoubtedly, play a role in a huge variety of systems, from propulsion to fuel systems. Their work will take place in research and development, and maintenance, helping to create and support essential systems for spaceflight and zero-emission aircraft.

Sustainable Aviation Engineer

Aviation can be changed to become more sustainable and meet government and industry targets. A sustainable aviation engineer would specialise in making these changes by implementing new and existing technologies to aircraft. These could include the use of SAF or fuels, such as liquid hydrogen, as well as exploring innovations in aerodynamics that could improve fuel efficiency. A sustainable aviation engineer would benefit from experience in several areas. Systems engineering would be essential to understand the effects of sustainability-driven changes to aircraft.

Additionally, propulsion engineering, especially surrounding the introduction of new fuels, while chemical and environmental engineers might determine the effect of different fuels on the environment. Those following this career path could work anywhere from design teams to government and international authorities. Just as important as designing aviation systems will be evaluating how sustainable an aircraft is, and ensuring critical carbon emission targets are met by the aviation industry.

Spaceport Traffic Controller

The increase in space traffic, satellites and space 'junk' means the role of Space Traffic Control will be vital in the years to come. (Decent Cybersecurity/ESA)

As spaceports become busier, dedicated traffic controllers will be required. They will have to manage regular rocket launches and spaceplane landings and ensure the safety of all departing and arriving traffic. Unlike aircraft, space traffic requires much further planning, especially for returning spacecraft. Once a spacecraft has committed to landing, it only has a single attempt to do so. As a result, a spaceport traffic controller must operate perfectly. A high degree of training would be necessary for a space traffic controller, as would a background in and knowledge of spaceflight. Previous experience in air traffic might be required or, alternatively, in spaceflight operations.

Additionally, weather will certainly continue to be a determining factor in space operations and an extensive knowledge in weather, especially at higher altitudes, will therefore be invaluable. Like an air traffic controller, spaceport traffic staff will be limited to working short shifts of one to two hours

at a time. However, due to the longer timescales and planning involved in spaceflight, they will likely be supported by a separate team of analysts and engineers to ensure a safe timeline of launches and landing is maintained.

Space-Based Maintenance Engineer

On Earth, maintenance of vehicles is a critical part of life. As space vehicles become more common, people specialising in their maintenance and operational support will also become necessary. These activities will increasingly begin to take place in space and will certainly be complicated and challenging – yet essential to future space exploration. Experience maintaining equipment with high safety standards would be necessary to look after spacecraft, much in common with the aviation maintenance industry of today.

Additionally, a maintenance engineer supporting spacecraft would need to be resourceful, able to work under pressure and a good team worker. Like asteroid miners and other space-based careers of the future, a space-based maintenance engineer would likely be sent on multi-week detachments. They would likely require specialised licences and certifications to ensure the highest safety standards of spacecraft are met.

Autonomous Aviation Specialist

Reliable Robotics is already working toward certification of its autonomous navigation system on the Cessna 208 Caravan. Recruits with knowledge of software and aerospace engineering will be needed to ensure this sector is both safe and efficient. (Reliable Robotics)

With artificial intelligence (AI) currently revolutionising the research, design and development of aircraft, it may soon also be used to operate some of them. People with knowledge of both software and aerospace engineering will ensure that any AI systems used to control aircraft are functional, safe and efficient. Aside from a qualification in aerospace or software engineering, a good understanding of systems engineering would be essential for an autonomous aviation specialist; any AI used on an aircraft would need to control multiple components, which all need to operate correctly both individually and as a system. Furthermore, industry experience in airworthiness certification or safety would also be desirable to ensure AI can control an aircraft reliably.

Autonomous aviation specialists could work both within industry and government. As AI is a new technology, those with high levels of experience in AI and aerospace engineering would be needed to form regulatory bodies within aviation authorities to certify autonomous aircraft as airworthy. In industry, autonomous aviation specialists will likely work on flight research and testing to 'train' AI/machine learning models on the flight characteristics of a particular aircraft design.

eVTOL Pilot

Will the pilots of the future have their pick of eVTOLs to fly? (Klissarov Acro)

Aircraft designs for travelling around densely populated urban environments are being developed by companies around the world. These aircraft must be quiet and environmentally friendly, with most designs being some variation on the eVTOL concept. These aircraft will need pilots with a focused skill set to fly passengers safely within towns and cities. The pathway towards becoming an eVTOL pilot will likely be similar to that of an airline pilot. However, as eVTOL aircraft will have significantly different flight characteristics to traditional fixed-wing aircraft, global and national aviation authorities may require specialised licensing for pilots.

An eVTOL licence is likely to require training encompassing urban air navigation, emergency procedures and maintenance. Due to the unique challenges of eVTOL aviation, in the near future pilots would work for organisations, such as a government transport authority or an air taxi company. However, if advanced air mobility becomes more widely available, privately owned, private hire air taxis could even become the norm.

Conclusion

With the aerospace industry increasingly in the public eye, there is an undeniably high level of enthusiasm among young people aiming to work in the sector. Whatever aviation, aerospace and space careers are created in the future, it is certain that the people working in these areas will have a profound influence on the future of aviation and spaceflight. Today, the options for those looking to work in aerospace are more varied than ever, especially with the increasing popularity of apprenticeships among employers, while universities continue to drive research into new technologies in partnership with industry.

Regardless of where prospective employees are educated, or whether they have experience in a particular subject matter, transferable skills will become more essential in the aerospace industry of the future. As new technologies are researched, designed, implemented and maintained, knowledge and experience from multiple areas will be required, and the skills to work effectively in multi-disciplinary teams will be even more important than they are today.

CAREER
IN AEROSPACE

Now log into Careers in Aerospace – Careers in Aerospace is the only website dedicated to providing independent and impartial information, advice and guidance on career pathways in the aerospace and aviation community and is brought to you by the Royal Aeronautical Society, the UK Department for Transport and ADS Group, working in partnership to provide a non-commercial, free-to-use platform for users of all ages.

RECOMMENDED CONTACTS

And finally we recommend readers look at, first:

Career and Learning (theiet.org)

Space skills and careers resources - GOV.UK (www.gov.uk)

'Supporting Companies' www.aerospacecareersprogramme.co.uk

'Useful Contacts' – www.aerospacecareersprogramme.co.uk

Then:

10 Entry-Level Jobs in the Aerospace Industry (With Salaries) | Indeed.com

15 aerospace engineering careers (Duties and salaries) | Indeed.com UK

18 Jobs in the Aviation Industry | Indeed.com

A range of careers in the aerospace industry - Search Videos (bing.com)

Aerospace engineer | Explore careers | National Careers Service

Aerospace engineer job profile | Prospects.ac.uk

Careers & Education (aerosociety.com)

Careers | The Aerospace Corporation

Education and skills (raeng.org.uk)

Empowering women in the aviation and aerospace industry – UKRI

How to get into the Aerospace Industry | Careermap

Home - EngineeringUK | Inspiring tomorrow's engineers.

Top Careers in Aerospace Engineering | Indeed.com

top engineering universities uk - Search (bing.com)

Women in Aviation, Aerospace & Space Committee (aerosociety.com)