Credit: Space X *Polaris Dawn Spacewalk*

The Schools' Aerospace Careers Programme Newsletter

Autumn 2024

Edited by: Dr Michael Smith FRAeS

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

COVER PICTURE

Polaris Dawn was a private crewed spaceflight operated by SpaceX on behalf of Shift4 CEO Jared Isaacman, the first of three planned missions in the Polaris program. Launched on 10 September 2024 as the 14th crewed orbital flight of a Crew Dragon spacecraft, Isaacman and his crew of three — Scott Poteet, Sarah Gillis and Anna Menon — flew in an elliptic orbit that took them 1,400 kilometers (870 mi) away from Earth, the farthest anyone has been since NASA's Apollo programme. They passed through parts of the Van Allen radiation belt to study the health effects of space radiation and spaceflight on the human body.

Flight day three of the five-day mission was dedicated to the first-ever extravehicular activity (EVA) on a commercial spaceflight mission. After extensive preparations, all four crew members donned their EVA suits, which are pressurized with 100% oxygen at 5.1 pounds per square inch (35 kPa). Since the Crew Dragon lacks an airlock, the entire capsule was depressurized during the EVA, exposing all crew members to the vacuum of space, though only two partially exited the spacecraft.

Depressurization of the capsule took about 30 minutes. Isaacman went first, spending seven minutes and 56 seconds outside. Gillis went next, spending seven minutes and 15 seconds outside. From hatch open to hatch close the EVA took about 26 minutes and 40 seconds. During the EVA, Isaacman and Gillis performed several tests of their suit mobility including trials of hand/body control, vertical movement, and using a foot restraint, only their lower legs were still inside the spacecraft. Gillis, at 30 years old, became the youngest person to date to participate in a spacewalk.

Read further at pages 43 to 45.

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INTRODUCTION

This Newsletter covers a very busy time for the ACP with words such as review, revision, development, fund-raising and preparation being most pertinent. This is explained in depth in pages 5 to 6. Under 'Technologies of the Fourth Industrial Revolution' we continue with our description of two more technologies, this time Blockchain and Cryptocurrency, their link, benefits, applications and challenges. And under 'UK Economy' we describe the UK Budget process, refer to the improving UK situation pre-budget, and then the substantial reservations following the new Government's run up to, and then delivery of, its first Autumn Statement.

We start 'Aerospace Manufacturing' with an Industry Growth and Market Projection by the Redline Group which is very positive. Included in this section are comments on Boeing's new 777-9 airliner, problems at Reaction Engines, orders from the Farnborough 2024 Air Show, and the new US Sixth Generation Fighter – the F/A-XX. Moving on to 'Commercial Aviation Operations' we provide an overview of London Heathrow Airport, its history, operations and further development, and then highlight the new found popularity of the A330neo, the reintroduction of the A380, problems with NATS, and the results of a study to determine 'The World's Best Airline'. Readers' attention is also drawn to articles from this quarter's AERO SPACE journals, on both these two sections and the next.

In our 'Space' section we open with the Polaris Dawn Program and, in particular, the first commercial 'spacewalk'. See also the note on the Cover Picture. Comments are also included on current NASA and SpaceX activity, plus the launch of UK Space Command's 'Tyke' satellite. Additionally, on the stranding of Barry Wilmore and Sunita Williams on the International Space Station (ISS), plus SpaceX's first successful vertical capture by 'Mechazilla'.

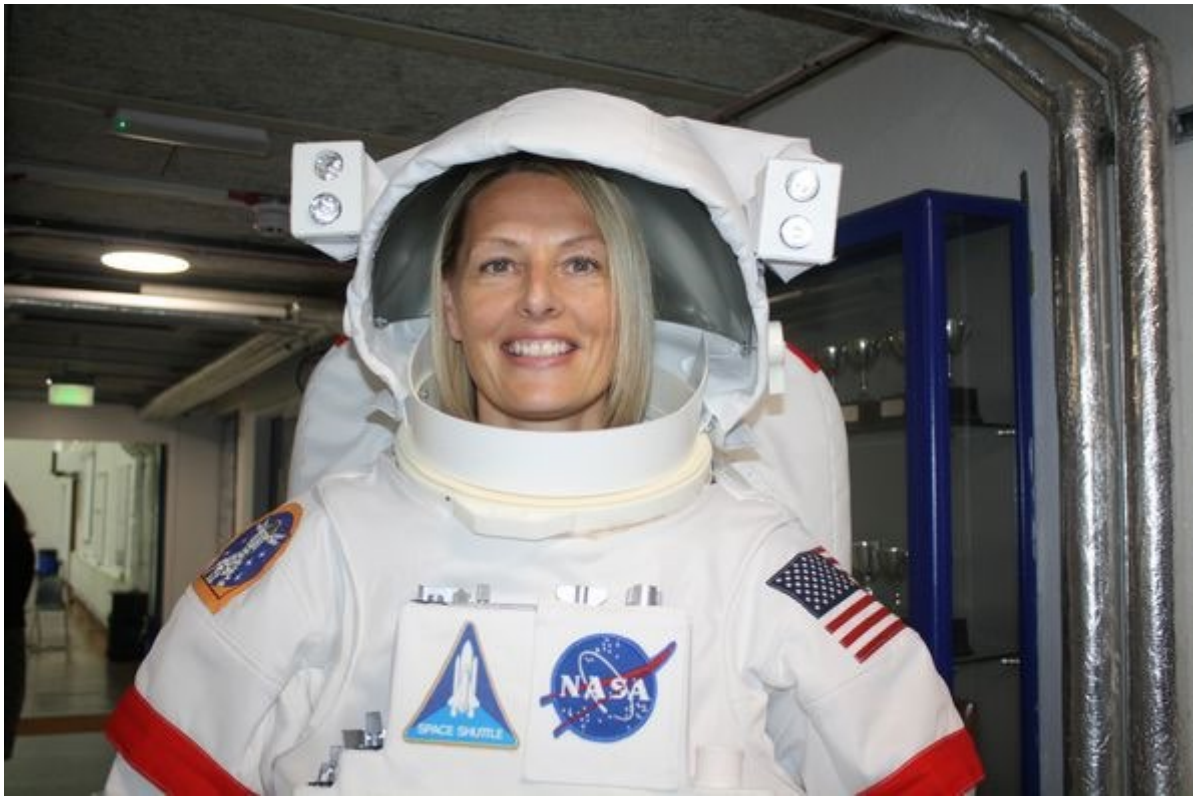
'UK Defence' commences with a set of five proposed tests for the new Government's Strategic Defence Review (SDR) as proposed by the Royal United Services Institute, refers to the UK's new Deep Space Advanced Radar Capability, and the "new concept" for the tri-national Global Combat Air Power Programme fighter – Tempest – as outlined at the 2024 Farnborough Air Show. Comment is included on the Government's decision to give the Chagos Islands to Mauritius, the use of ChatGPT-type software in the SDR, a study into nuclear powered RN surface ships, progress on the penultimate Astute class submarine, and the third of class Type 31 frigate.

Concerning 'Cyber' we report on the results of an extensive Cyber Security Breaches Survey undertaken for the Home Office and Department for Science, Innovation and Technology which makes disturbing reading. It is followed by an article on how AI can make "mischief", and comments from the Head of MI5. Under 'Careers' we focus on commercial pilot training, recruitment and employment, and finish the section with a reference to the increasing attraction of apprenticeships rather than full-time university education, many of the former leading to a degree. As always we include throughout the Newsletter relevant news items, and conclude by referring to Further Contacts.

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 31 October 2024

THE SCHOOLS' AEROSPACE CAREERS PROGRAMME



Courtesy of the ACP – Colchester County High School for Girls' very own 'Astronaut'

Covering late Summer and Autumn, this period of our Newsletter, of necessity, included some holiday time, and then a great deal of reviewing, revising, report writing, continuing development, new introductions, fund raising and preparation for the next academic year. In particular, the ACP reviewed and revised its previous academic year's roadshow events, including the content and delivery of the morning presentations, and how the hands-on equipment was utilised in the associated afternoon breakout sessions.

The former kept the material up-to-date (which is an important spin-off from the research involved in preparing these quarterly newsletters) and the latter the demonstration and use of our example '4IR technologies' such as robotics via Spot now augmented with AI and voice (of many languages and both sexes), drones (including videography), flight simulators with their 85" screens, AR/VR design linked to 3D printing (an example of which is presented to each host school) and VR headset experiences. It also enabled us to reorganise and improve the manner in which we conduct our roadshows to groups of schools.

Results carried forward to academic year 2024/25 include longer set-up and testing time prior to commencing a presentation, new videos, updated content, amended software for Spot, different programmes for the VR experience, and an increasing database of feedback for consideration for the following year's roadshow as well as for publicity purposes. Additionally, the presentation at Colchester County High School for Girls (see the photo above) provided one of the centre pieces for

our upcoming new YouTube video – *Behind the Scenes at the ACP* – which will be released very shortly and forms an important part of a promotional programme which will commence, UK-wide, in respect of industry, appropriate other organisations, schools and universities in early December 2024 or late January 2025.

Regarding report writing, one task that was particularly important was the ACP's annual report for the year up to 31 December 2023 that was required by 31 October 2024; it was completed and submitted well in time and, should you wish, the public section can be viewed on-line at: The Schools' Aerospace Careers Programme - 1190721

Continuing development is epitomised not only by the description above of our work relating to the Roadshows but also on that concerning our website where, as you will find, we are continuing to increase and keep up-to-date the new Technologies Section (see: Technologies of the Fourth Industrial Revolution – The Schools' Aerospace Careers Programme and Technology Directory – The Schools' Aerospace Careers Programme). Additionally, under what can be described as 'new introductions', work continues on the next new section of the site – current Careers with our supporting companies and example Future Careers over the next 25 years in aerospace, space and aviation.

With introductions in mind, conversations continue with companies and organisations who are interested in working with us in more depth such as, to name a cross-section of examples, Anglia Ruskin University, Boston Dynamics, MBDA Systems, QinetiQ, the IET, the North West Aerospace Alliance, The Careers and Enterprise Company, the RAeS and, via the 'Reach for the Sky Challenge', the CAA/DfT. Further conversations will undoubtedly follow once the promotional programme referred to earlier starts to unfold.

Turning to events generally, the 2024/25 Roadshow of Presentations to groups of Schools is now well underway and readers will find the dates and locations listed at: School Presentations Roadshow – The Schools' Aerospace Careers Programme. Furthermore, the Roadshow programme for 2025/26 is now under construction and will be included in the Spring 2025 edition of our quarterly newsletter. Also as you will see from The ACP Network – The Schools' Aerospace Careers Programme, network events continue to gather pace with our attendance at the European Airlines Training Symposium on 5/6 November 2025 following closely on the heels of our hands-on activities session at the Peterborough STEM Festival on 19 October 2024.

To date, the ACP has now reached, in-person face-to-face, over 8,700 people and we expect that total to exceed 10,000 by March 2025. And then there is our digital reach-out which just continues to grow via our website, social media and YouTube platforms which always takes a marked step forwards every time we conduct a Presentation and Network event. Furthermore, work continues on our planned on-line Foundation Aviation & Associated New Technologies Course which is scheduled to go live in time for Christmas 2024.

Finally, with Christmas in mind, from all of us to all of you, as the next Newsletter will not be published until the end of January, we wish everyone a very merry Christmas and a most successful 2025.

See: Bing Videos where Spot *'Puts a bow on it!*

TECHNOLGIES OF THE FOURTH INDUSTRIAL REVOLUTION

Source: Shutterstock

Blockchain and Cryptocurrency

Continuing our quarterly explanation of two 4IR technologies in each Newsletter we now introduce Blockchain and Cryptocurrency. First, **Blockchain** which, according to built.com is an immutable digital ledger that enables secure transactions across a peer-to-peer network. It records, stores and verifies data using decentralized techniques to eliminate the need for third parties like banks or governments. Every transaction is recorded, then stored in a block on the blockchain.

Each block is encrypted for protection and chained to the preceding block — hence, "blockchain" — establishing a code-based chronological order. This means that, without consensus of a network, data stored on a blockchain cannot be deleted or modified. These new-age databases act as a single source of truth and, among an interconnected network of computers, facilitate trust less and transparent data exchange. Apart from moving cryptocurrencies from one wallet to the next, blockchain technology is an emerging technology with wide-ranging application potential, from preventing fraudulent banking and supply-chain bottlenecks to safeguarding medical records.

Why Is Blockchain Important?

Blockchain is a revolutionary technology because it helps reduce security risks, stamp out fraud and bring transparency in a scalable way. Popularized by its association with cryptocurrency and NFTs (Non-Fungible Tokens), blockchain technology has since evolved to become a management solution for all types of global industries. Today you can find blockchain technology providing transparency

for the food supply chain, securing healthcare data, innovating gaming and changing how we handle data and ownership on a large scale.

How Does Blockchain Work?

Blockchains are distributed data-management systems that record every exchange between their users. These immutable digital documents use several techniques to create a trust less, intermediary-free system. Each block contains stored data, as well as its own unique alphanumeric code, called a hash. These cryptographically generated codes can be thought of as a digital fingerprint. They play a role in linking blocks together because new blocks are generated from the previous block's hash code, thus creating a chronological sequence, as well as tamper-proofing. Any manipulation to these codes outputs an entirely different string of gibberish, making it easy for participants to spot and reject misfit blocks.

Another key feature to the inner workings of blockchain is decentralization. In lieu of a centralized entity, blockchains distribute control across a peer-to-peer network made up of interconnected computers, or nodes. These nodes are in constant communication with one another, keeping the digital ledger up-to-date. So when a transaction is taking place among two peers, all nodes take part in validating the transaction using consensus mechanisms. These built-in protocols keep all in-network nodes in agreement on a single data set. No block can be added to the blockchain until it is verified and has reached consensus. Luckily, this step has been sped up with the advent of smart contracts, which are self-executing programs coded into a blockchain that automate the verification process. Once a transaction is recorded, it's considered permanent. Blockchains are one-way operations in that there are no reversible actions. This immutability is part of creating transparency across the network and a trustworthy record of all activities on the blockchain.

Blockchain Decentralization

One of the most important concepts in blockchain technology is decentralization. No one computer or organization can own the chain. Instead, it is a distributed ledger via the nodes connected to the chain. Blockchain nodes can be any kind of electronic device that maintains copies of the chain and keeps the network functioning. Every node has its own copy of the blockchain and the network must algorithmically approve any newly mined block for the chain to be updated, trusted and verified. Since blockchains are transparent, every action in the ledger can be easily checked and viewed, creating inherent blockchain security. Each participant is given a unique alphanumeric identification number that shows their transactions. Combining public information with a system of checks and balances helps the blockchain maintain integrity and creates trust among users. Essentially, blockchains can be thought of as the scalability of trust via technology.

Blockchain Benefits, Challenges, Applications

Benefits of Blockchain

Having a cryptographically secure permanent record comes with perks:

- **More Security**
  Cryptography and hashing algorithms ensure that only authorized users are able to unlock information meant for them, and that the data stored on the blockchain cannot be manipulated in any form. Consensus mechanisms, such as proof of work or proof of stake, further enhance

security by requiring network participants to agree on the validity of transactions before they are added to the blockchain. Additionally, blockchains operate on a distributed system, where data is stored across multiple nodes rather than one central location — reducing the risk of a single point of failure.

- **Improved Accuracy**
  By providing a fully transparent, single-source-of-truth ledger, where transactions are recorded in a chronological and immutable manner, the potential for error or discrepancy drops when compared to centralized databases or manual record-keeping processes. Transactions are objectively authorized by a consensus algorithm and, unless a blockchain is made private, all transactions can be independently verified by users.

- **Higher Efficiency**
  Aside from saving paper, blockchain enables reliable cross-team communication, reduces bottlenecks and errors while streamlining overall operations. By eliminating intermediaries and automating verification processes — done via smart contracts — blockchain enjoys reduced transaction costs, timely processing and optimized data integrity.

Challenges of Blockchain

Although this emerging technology may be tamper proof, it isn't faultless. Below are some of the biggest obstacles blockchain faces today.

- **Transaction Limitations**
  As blockchain networks grow in popularity and usage, they face bottlenecks in processing transactions quickly and cost-effectively. This limitation hampers the widespread adoption of blockchain for mainstream applications because networks struggle to handle high-throughput volumes, leading to congestion and increased transaction fees.

- **Energy Consumption**
  The computational power required for certain functions — like Bitcoin's proof-of-work consensus mechanism — consumes vast amounts of electricity, raising concerns around environmental impact and high operating costs. Addressing this challenge requires exploring alternative consensus mechanisms, such as proof of stake, which consumes significantly less energy while maintaining network security and decentralization.

- **Scalability Issues**
  As it is now, every node of a blockchain network stores a copy of the entire data chain and processes every transaction. This requires a certain level of computational power, resulting in slow, congested networks and lagged processing times especially during high-traffic periods. Scalability issues arise due to limitations in block size, block processing times and resource-intensive consensus mechanisms. This is why novel approaches — such as layer 2 scaling solutions, sharding and alternative consensus algorithms — are being developed.

- **Regulation Concerns**
  Governments and regulators are still working to make sense of blockchain — more specifically, how certain laws should be updated to properly address decentralization. While some governments are actively spearheading its adoption and others elect to wait-and-see,

lingering regulatory and legal concerns hinder blockchain's market appeal, stalling its technical development.

Blockchain Applications and Use Cases

Blockchain originally started as a way to safeguard digital records with tamper-proof technology. Since its induction into the mainstream alongside Bitcoin's debut, the data management protocol has expanded beyond DeFi (Decentralized Finance) into various industries across a wide-range of applications.

- **Banking**
  For banks, blockchain makes it easier to trade currencies, secure loans and process payments. This technology acts as a single-layer, source-of-truth that's designed to track every transaction ever made by its users. This immutability protects against fraud in banking, leading to faster settlement times, and provides a built-in monitor for money laundering. Banks also benefit from faster cross-border transactions at reduced costs and high-security data encryption.

- **Smart Contracts**
  Smart contracts are self-executing protocols that automate transaction verification. They're coded into the blockchain and set by predetermined terms. In addition to reducing human error, their function is to facilitate decentralization and create a trust less environment by replacing third-party intermediaries.

- **Cybersecurity**
  Deemed a "new weapon in cybersecurity," blockchain's decentralized, tamper-proof ledger comes with built-in defenses against theft, fraud and unauthorized users via cryptographic coding and consensus mechanisms. Because of this, blockchain has been adopted into cybersecurity arsenals to maintain cryptocurrency, secure bank assets, protect patient health records, fortify IoT devices and even safeguard military and defense data.

- **Healthcare**
  Healthcare services primarily use blockchain to securely encrypt patient data stored in their medical records. Particular functions, like smart contracts, automate processes such as insurance claims processing and medication adherence monitoring, which enhances efficiency and reduces administrative overhead. Blockchain also facilitates secure sharing of medical data between healthcare providers, patients and researchers, and is even being recruited by genome-sequencing start-ups to help crack genetic codes.

- **Logistics**
  In logistics, blockchain acts as a track-and-trace tool that follows the movement of goods through the supply chain. The transparent system offers users real-time visibility of their shipments, from manufacturing to delivery. These insights help compile data, determine faster routes, remove unnecessary middlemen and even defend against cyber-attack interference.

- **NFTs**
  Blockchain makes the creation, ownership and trading of NFTs, or non-fungible tokens, possible. The reason why copying these digital assets is not as simple as a quick screen capture is because each NFT is encrypted with blockchain technology, which keeps a live running record of

ownership over the piece. Smart contracts govern transactions, assigning and reassigning ownership and delivering royalties to artists as pieces move from wallet to wallet.

Types of Blockchain

As blockchain technology evolves, new variations have surfaced. What follows is a brief introduction to four different models that have developed by demand.

- **Public Blockchain**
  Public blockchains are permissionless networks considered to be "fully decentralized." No one organization or individual controls the distributed ledger, and its users can remain anonymous. As long as a user can provide proof of work, they can participate in the network.

- **Private Blockchain**
  Private blockchains are permissioned networks. In the interest of garnering greater control or privacy over a network, private blockchains have a single operator that's in charge of who can access the network and whether participants can view, verify or create data on the blockchain. Adding restricted access to an encrypted record-keeping ledger appeals to certain organizations that work with sensitive information, like large enterprises or government agencies.

- **Consortium Blockchain**
  Consortium blockchains, also known as federated blockchains, are permissioned networks that are operated by a select group. Multiple users have the power to set the rules, edit or cancel transactions. With shared authority, the blockchain may enjoy a higher rate of efficiency and privacy.

- **Hybrid Blockchain**
  Hybrid blockchains combine elements of both public and private networks. They feature selective transparency, which allows blockchain admins to restrict specific parts of the blockchain to certain participant pools while maintaining public visibility over the rest of the thread. This way, organizations are entitled to a certain level of privacy when immutably sharing data independent of a third party.

Source: Shutterstock ***Crypto mining***

C**ryptocurrency** is a digital currency designed to work as a medium of exchange through a computer network that is not reliant on any central authority, such as a government or bank, to uphold or maintain it. It has, from a financial point of view, grown to be its own asset class. However, on the contrary to other asset classes like equities or commodities, sectors have not been officially defined as of yet, though abstract versions of them exist.

Individual coin ownership records are stored in a digital ledger, which is a computerized database using strong cryptography to secure transaction records, control the creation of additional coins, and verify the transfer of coin ownership. Despite the term that has come to describe many of the fungible blockchain tokens that have been created, cryptocurrencies are not considered to be currencies in the traditional sense, and varying legal treatments have been applied to them in various jurisdictions, including classification as commodities, securities, and currencies. In practice, cryptocurrencies are generally viewed as a distinct asset class.

Some crypto schemes use validators to maintain the cryptocurrency. In a proof-of-stake model, owners put up their tokens as collateral. In return, they gain authority over the token in proportion to the amount they stake. Generally, these token stake holders gain additional ownership in the token over time via network fees, newly minted tokens, or other such reward mechanisms. Trace amounts of cryptocurrency that are not worth spending because of the fee needed are called "dust".

Cryptocurrency was not intended to exist in physical form (although there have been some experiments and physical coins have been created as souvenirs). Also, it is typically not issued by a central authority. Cryptocurrencies typically use decentralized control as opposed to a central bank digital currency (CBDC). When a cryptocurrency is minted, created prior to issuance, or issued by a single issuer, it is generally considered centralized. When implemented with decentralized control, each cryptocurrency works through distributed ledger technology, typically a blockchain, that serves as a public financial transaction database.

The first cryptocurrency was bitcoin, which was first released as open-source software in 2009. As of June 2023, there were more than 25,000 other cryptocurrencies in the marketplace, of which more than 40 had a market capitalization exceeding $1 billion.

Continuing with our regular news reports:

- **2 August 2024**

James Titcomb writes that Sir Keir Starmer has cancelled more than £1bn in funding for supercomputer projects announced under the previous Conservative government. The Department for Science, Innovation and Technology (DSIT) said it would not take forward £800m earmarked to build Britain's most powerful supercomputer in Edinburgh. It has also dropped a plan to spend £500m on artificial intelligence computing announced earlier this year.

The Government said it was making "difficult and necessary spending decisions" and that commitments by the previous government had been unfunded. However, the decision was criticised by the Conservatives as "extremely short sighted".

Britain's biggest supercomputer, the Archer 2 facility in Edinburgh, ranks 49th in the global rankings; the most powerful US computer, Frontier, is more than 60 times as powerful. The £800m had been

promised for a successor that would be 50 times more powerful and work had already begun on building it, but the project is now believed to be on hold. It is understood that funding is likely to be reassessed in the future.

- **9 August 2024**

In 'The Telegraph' Britta O'Boyle reports on tests of Apple's head-mounted 'spatial computer' to see if it is worth the quoted price of £3,500. Read the answer at: Apple Vision Pro review: awesome technology – but what will you use it for? (telegraph.co.uk)

- **26 August 2024**

'Live Science' reports that scientists have created an "exceptionally bright" light source that can generate quantum-entangled photons (particles of light) which could be used to securely transmit data in a future high-speed quantum communications network. A future quantum internet could transmit information using pairs of entangled photons — meaning the particles share information over time and space regardless of distance. Based on the weird laws of quantum mechanics, information encoded into these entangled photons can be transferred at high speeds while their "quantum coherence" — a state in which the particles are entangled — ensures the data cannot be intercepted.

But one of the key challenges in building a quantum internet has been that the strength of these photons can fade the further they travel; the light sources have not been bright enough. To build a successful quantum internet that can send data over vast distances, photons must be strong enough to prevent "decoherence" — where entanglement is lost and the information they contain disappears. Read on at: 'Unbreakable' quantum communication closer to reality thanks to new, exceptionally bright photons | Live Science

Also this day Andrew Orlowski asks "Is AI going to make us stupid? Perhaps it's already started to, but we just haven't noticed yet". He goes on to write that in EM Forster's great short story 'The Machine Stops', an entire society now relies on machines. Having forgotten how the machines work, or even basic survival skills, humanity is cocooned underground. When the machine called The Mending Apparatus fails, the end is nigh.

Many of us find ourselves today not in some fully automated luxury, but in the weird twilight zone where humans and machines already work side-by-side. Our environment is already a kind of cyborg system, but we cannot assume that introducing new technology makes things better. In fact, it can throw things out of kilter, with catastrophic results. This is because of what's called deskilling – losing the knowledge and skills we have today. This is a very subtle problem that interests few, Finnish business academics lamented last year in a paper titled "The Vicious Cycles of Skill Erosion".

Deskilling in the face of cognitive automation is a problem that "may remain obscure, acknowledged by neither workers nor managers". We ignore it even when it's right in front of us. Former Premier League referee Mark Clattenberg lamented how VAR technology had made referees reluctant to trust their own judgments. In aviation, deskilling has been a live topic for decades, as technology assumes more and more of the pilot's work.

"There is some reason to believe that flight-deck automation may have already passed its optimum point," the doyen of aviation safety design, NASA scientist Earl Weiner warned as long ago as 1980.

“Digital devices tune out small errors while creating opportunities for large errors,” Weiner noted. Aviation safety history is rich with lessons. The tragic loss of Air France Flight 447, which crashed into the Atlantic Ocean in 2009, was described by Harvard Business Review as an example of the “catastrophic consequences of automation”. Read on at: Technology may be advancing - but it's making us more stupid

- **5 September 2024**

Nick Forbes writes that doctors have welcomed a breakthrough in medicine that will see tiny robots injected into the human body to perform complex tasks. A team of scientists engineered magnetic nanobots made up of blood-clotting drugs encased in a coating designed to melt at precise temperatures. The technology could “open new frontiers in medicine”, scientists announced.

In a study co-led by the University of Edinburgh’s School of Engineering, researchers showed the technology could be used to treat bleeds in the brain caused by aneurysms, which cause about 500,000 deaths globally each year. They injected several hundred billion of the bots, each about a twentieth of the size of a red blood cell, into an artery, and then remotely guided them to the site of the aneurysm using magnets and medical imaging.

Once the swarm of tiny bots was in position, researchers used magnets to cluster them together and heat them to their coatings’ melting point, thereby releasing the drug at the precise point where it could prevent or stem bleeding into the brain. Read further at: Scientists create army of tiny robots that can be injected into the human body (msn.com)

- **7 September 2024**

Craig Hales advises that in an unexpected move toward AI governance globally, China and the US have collaborated to develop the world’s first international standard for Large Language Models (LLM) security in supply chains. The development comes from joint efforts by Chinese giants Ant, Baidu and Tencent, together with US firms Google, Meta and Microsoft.

The ‘Large Language Model Security Requirements for Supply Chain’ initiative was unveiled today at the World Digital Technology Academy (WDTA) in Shanghai. The new standard is aimed to address the entire lifecycle of LLMs in order to prevent security risks like data leaks, model tampering and supplier non-compliance. Top academic and industry institutions, such as the Cloud Security Alliance Greater China Region and Nanyang Technological University in Singapore, joined the American and Chinese companies in drafting and reviewing the guidance. Together, the bodies form the AI Safety, Trust, and Responsibility (AI STR).

Peter Major, Chair of the United Nations Commission on Science and Technology for Development and Honorary Chairman of the WDTA, commented: “International cooperation on AI-related standards has become increasingly crucial as artificial intelligence continues to advance and impact various sectors globally.”

- **10 September 2024**

‘Live Science’ reports that Japan has announced plans to start constructing the first ever "zeta-class" supercomputer next year. Once fully operational, it will be 1,000 times faster than today's most

powerful supercomputers. The supercharged machine, which could cost more than $750 million to build, will help Japan keep up with the pace of artificial intelligence (AI) development and is expected to be fully online by 2030.

Plans for the new machine — first released on Aug. 28 by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) — reveal that the supercomputer could reach speeds on a zetaFLOPS scale, which has never been achieved before. Read on at: Japan to start building 1st 'zeta-class' supercomputer in 2025, 1,000 times more powerful than today's fastest machines | Live Science

Also on this day Charlotte Lytton reports that last week, Noland Arbaugh made the opening move of the Speed Chess Championship in Paris – a competition featuring the game's biggest names. More remarkable, though, is that, in a tournament world-first, he moved the pawn using only his mind.

Arbaugh, 30, is the world's first recipient of a brain chip created by Neuralink, the brain-computer interface (BCI) company founded by Elon Musk. Chess has become a huge part of the 30-year-old's life; it was one of the few things he could still do following an accident that left him paralysed below the shoulders. (He previously used a mouth stick to play games online.)

But since receiving the implant in January – and using his brain to move pieces across the board – it has become his portal to the rest of the world. The company released a video of him playing a month after his surgery; opening the Speed Chess Championship, he says, was "the coolest thing that's happened to me". Continue at: 'Elon Musk put a chip in my brain – it's the coolest thing' (telegraph.co.uk)

- **11 September 2024**

Anthony Cuthbertson writes that scientists have invented an ultra-strong and lightweight battery made from carbon fibre that they claim is energy-dense enough to power electric planes. Billed as the world's strongest battery, a team from Chalmers University of Technology in Sweden said the material is sturdy enough to serve as a load-bearing structure, meaning it can be integrated into the design of a vehicle in order to radically reduce weight and increase range.

"We have succeeded in creating a battery made of carbon fibre composite that is as stiff as aluminium and energy-dense enough to be used commercially," said Richa Chaudhary, a Chalmers scientist who led the research. "Just like a human skeleton, the battery has several functions at the same time." The new battery design could be used in a wide range of applications, capable of halving the weight of a laptop or making a mobile phone as thin as a credit card. The researchers also claim that it could increase the range of an electric car by 70 per cent. Read on at: Battery breakthrough could see electric planes finally take off (msn.com)

THE UK ECONOMY

Source: The National Archives. Tally Sticks, a medieval method of keeping a financial record.

Recognising the very recent change of Government and its first Budget we have started this quarter's section with an explanation of the Budget process.

The Budget of His Majesty's Government is an annual budget set by HM Treasury for the following financial year, with the revenues to be gathered by HM Revenue and Customs and the expenditures of the public sector, in compliance with government policy. The budget statement is one of two statements made by the Chancellor of the Exchequer in the House of Commons, with the Spring Statement being made the following year.

Budgets are usually set once every year and are announced in the House of Commons by the Chancellor of the Exchequer. Since autumn 2017 the United Kingdom budget typically takes place in the Autumn in order to allow major tax changes to occur annually, well before the start of the fiscal year. The most recent budget was presented by Jeremy Hunt on 6 March 2024. Sunak's successor, Kwasi Kwarteng, delivered a fiscal event in September 2022. His successor Jeremy Hunt delivered another fiscal event in November 2022. Although not an official budget statement, they were widely referred to by the media as a "mini-budget".

Budget process

The UK fiscal year ends on 5 April each year. The financial year ends on 31 March of each year. Thus, the UK budget for financial year 2021 runs from 1 April 2021 to 31 March 2022 and is often referred to as 2021–22. Historically, the budget was usually released in March, less than one month before the beginning of the new fiscal year. Parliament was not expected to take action on a budget for the fiscal year until the summer, several months *after* the start of the fiscal year. For that reason, Parliament typically passed a "Vote on Account" in early spring that provided continuity of funding into the new

fiscal year up until the point that the new budget was enacted. The spending authorized in the Vote on Account was normally 45% of the amounts already authorized in the current fiscal year, taking into account the Main Estimates and any revised or Supplementary Estimates already approved by Parliament. Legislative action on the proposed budget generally aligned with the Executive's original budget request; failure to carry the budget would be regarded as tantamount to a vote of no confidence.

Since November 2017 the budget was moved to the Autumn, with a view to passing the Finance Act before the commencement of the Financial Year. Votes on Account should no longer be necessary. Governmental departments submit their funding requests — called "Main Supply Estimates" – to HM Treasury. The government then releases this data in a large, consolidated document titled "Central Government Supply Estimates (Budget Year-Following Year): Main Supply Estimates" The government reserves the right to submit "Supplementary Estimates" in the spring and winter of a given fiscal year to update its agencies' spending totals for the current financial year and report any governmental re-organizations. When an agency submits a Supplementary Estimate, it is customary to also submit an "Estimate Memorandum" to the agency's relevant oversight committee in Parliament describing and justifying the changes. This condenses two functions – reporting supplemental spending requests and agency re-organizations.

Continuing now with our quarterly news articles:

- **3 August 2024**

Kate Andrews asks: “Is there such a thing as too much good news?” She goes on to suggest that the answer is “hard to imagine, especially in these post-pandemic years when the UK economy has only managed to stagger along. Between record-high NHS waiting lists, a surge in people stepping away from work, the struggle to recover living standards to their pre-pandemic levels, and a mild recession at the end of last year, positive economic data is long overdue.

Finally, it’s starting to surface. But timing is everything, because at the same moment as a more promising picture is starting to emerge, Labour needs to convince the country that circumstances have never been worse. It may prove a tougher task than the party originally anticipated”. Read on at: The good economic news keeps rolling in – Labour will be devastated

- **4 August 2024**

The Daily Express reports that the Bank of England Governor, Andrew Bailey, has become the latest senior figure to undermine Rachel Reeves’ claims about the true state of the British economy. Speaking in an interview this weekend, the central banking chief said that their decision this week to cut interest rates for the first time in four years was objectively “good news” and a “reason to be optimistic”. Read further at: Andrew Bailey joins experts pouring cold water on Rachel Reeves' economic claims | Politics | News | Express.co.uk

- **7 August 2024**

Eir Nolsøe writes that economic growth has been revised up sharply after Covid in a boost for Britain, new official figures show. The UK economy grew by 4.8pc rather than 4.3pc in 2022 as initially estimated, the Office for National Statistics has said. The new figures mean the UK economy was actually 2.1pc larger than before Covid by the end of 2022 – much higher than the previous estimate

of 1.3pc. The upgraded figures are further proof that the economy bounced back much faster after the pandemic than economists first believed. Until last year the UK was thought to have been the only G7 economy that was still smaller than before Covid. Read further at: Economic growth revised up sharply in boost for Britain

- **15 August 2024**

Szu Ping Chan reports that the British economy expanded by 0.6pc in the three months to June, in line with economists' expectations and following an expansion of 0.7pc in the first three months of the year, the Office for National Statistics (ONS) said on Thursday. It means UK growth has outpaced every other major advanced economy so far this year, growing by 1.3pc in the first six months of 2024. This is ahead of the US, where growth was 1.1pc and more than double the 0.6pc expansion in France over the same period.

By contrast, Germany has barely grown this year, expanding by just 0.1pc, while the figures for Italy and Canada were 0.5pc and 0.9pc respectively. Despite the good news, the Chancellor hinted tax rises were on the way in her maiden Budget on October 30.

- **11 September 2024**

Eir Nolsøe writes that "Fears grow that the Chancellor will kill the momentum needed for economic growth. Read: Why economists are worried about Rachel Reeves' tax rises

- **3 October 2024**

Michael Bow, Szu Ping Chan and Dominic Penna explain why Rachel Reeves' expected raid on capital gains alongside downbeat messaging [are] blamed for stunting short-lived recovery in pro-UK sentiment. See: Investors dump UK shares amid fears over Reeves Budget

- **11 October 2024**

Brian Monteith writes that "Labour is setting itself up for a series of embarrassing U-turns". Read: Reeves is slowly realising that her policies don't work in the real world

But this day Ambrose Evans-Pritchard suggests in The Telegraph that "Rachel Reeves faces no danger of a global "gilt strike". The likelihood that investors will be spooked by extra borrowing to plug the UK's infrastructure deficit is close to absolute zero. You can measure the mood of the debt vigilantes by how much it costs to insure against British bankruptcy through five-year credit default swaps (CDS). The UK's risk penalty has been falling all year, continued to fall after Labour took power, and has fallen yet further over recent weeks.

As of today, the figures are: Switzerland (6), Germany (10), Australia (12), UK (20), Japan (22), Korea (32), France and Spain (34), US (37), Canada (40), Italy (61), China (63) and Saudi Arabia (67). There is not a flicker of worry about UK solvency, even though markets know that the Chancellor intends to reform – and hopefully eviscerate – the Dark Age fiscal rules that have so harmed this country. Beware false lessons from the Liz Truss episode. It tells us only that markets will punish incoherent and unfunded tax cuts in the middle of an inflation storm.

Global wealth funds can tell the difference between debt to finance investment with a high macroeconomic return, and debt to finance spending that is frittered away on consumption. They can see that the default strategy of cutting net public investment to 1.7pc of GDP by the end of this Parliament is grotesquely anomalous in a world where the US and China are investing trillions in a global arms race for industrial and technology supremacy, and where Europe's Draghi report is calling for a double Marshall Plan to boost investment by an extra 5pc of GDP a year. "The rest of the world is betting on AI and energy technology in the biggest transformation ever seen. We'll just be left behind if we don't invest," said Dimitri Zenghelis, the former head of forecasting at the Treasury and now at the London School of Economics". Read further at: Rachel Reeves should ignore dogmas around debt and go for turbo-growth

- **22 October 2024**

Szu Ping Chan reports from Washington that Britain's growth prospects have been upgraded by more than any other major advanced economy, according to forecasts that risk being thrown into jeopardy by Rachel Reeves's tax raid. Just days before the Chancellor delivers her maiden Budget on October 30, the International Monetary Fund (IMF) predicted the UK economy would grow by 1.1pc this year.

It follows an earlier warning by the IMF that it would be "undesirable" for Ms Reeves to balance the books just through tax rises. While Mr Gourinchas [Chief Economist of the IMF] declared "the global battle against inflation is almost won", he added that "downside risks are increasing and now dominate the outlook".

The IMF's chief economist said: "An escalation in regional conflicts, especially in the Middle East, could pose serious risks for commodity markets. Shifts toward undesirable trade and industrial policies can significantly lower output relative to our baseline forecast. Monetary policy could remain too tight for too long, and global financial conditions could tighten abruptly."

Inflation, as measured by the consumer prices index, fell to 1.7pc in September, below the Bank's 2pc target, prompting investors to cement bets on a November rate cut. While the IMF stressed the dangers of keeping interest rates too high for too long, it added that price rises for services remained "too elevated". It added that the post-lockdown inflationary spike may have permanently entrenched a desire to ensure pay keeps up with prices. Read on at: Britain handed biggest growth upgrade in G7 days before Budget

- **24 October 2024**

Szu Ping Chan advises that Rachel Reeves has been warned that interest rates will stay higher for longer after the Chancellor said she will change Britain's debt rules to unleash a borrowing spree of up to £50bn. The Chancellor confirmed she will change how debt is calculated to take into account the benefits of investment spending at her maiden Budget next week, even as her plans triggered jitters in financial markets. She also pledged to get debt falling by the end of this parliament in an effort to reassure nervous investors that she will not go on a borrowing binge. Read on at: Reeves warned over £50bn 'debt fiddle'

- **25 October 2024**

However, following on from the above Ms Chan also commented from the IMF's annual meetings this week that "Looming tax rises and dour politicians are souring optimism about the UK economy." See: How Labour chaos left the global elite wary of Britain

- **27 October 2024**

Liam Halligan advises "that speculation has gone into overdrive about the Rachel Reeves's tax moves in her first Budget on Wednesday, the impact on households and businesses and the related political fallout. Amid claim and counterclaim, much of it is expectations management by Treasury press honchos, I'd like to say something that is not stressed often enough. The British state – government spending as a share of GDP – is simply too big. This isn't an ideological point – more a matter of the immutable laws of mathematics, financial stability and the overwhelming importance that those who govern us, in whom voters place trust, avoid causing yet another systemic crisis with all the related economic chaos and massive societal damage". Read on at: Liz Truss is about to relinquish her mantle as agent of economic chaos

Also Szu Ping Chan writes that Stand-offs over Whitehall budgets have created a pipeline of unrealistic and undeliverable projects that are wasting taxpayer cash, the National Audit Office (NAO) has warned. The NAO delivered a withering assessment of the way budgets are set just days before Rachel Reeves unveils her maiden Budget, including detailed spending envelopes for government departments next year.

The independent body, which is responsible for scrutinising public spending, blamed an "adversarial" Whitehall culture for a Spending Review process that pits departments against each other and "do[es] not support overall value for money". It added that this culture had become "entrenched", with decisions on spending that were often "rushed" and focused on big "good news" announcements rather than delivering for taxpayers. It added that even once projects had been approved, ministers and civil servants were often "reluctant to accept bad news" when budgets are blown or projects delayed. See: Taxpayer money being wasted in 'dog-eat-dog' Whitehall culture

- **30 October 2024**

Matt Oliver reports on the main take-aways from the Chancellor's speech in presenting her first budget.

"Rachel Reeves vowed to "restore stability" to the British economy as she unveiled £40bn of tax rises in Labour's first Budget in 14 years. The Chancellor vowed to stick to Labour's manifesto pledge and not raise taxes on "working people", defined loosely by Sir Keir Starmer as those with only "a small amount of savings". But she said a £22bn "black hole" left behind by the last government, added to other pressures, meant she would have to increase taxes by a colossal £40bn.

The single biggest revenue raiser by far – widely trailed ahead of her speech – was a £25bn increase in employer National Insurance contributions, derided by critics as a "jobs tax". She also raised billions through increases to capital gains tax, inheritance tax, stamp duty, alcohol duty, tobacco duty, air passenger duty and other measures such as means testing for pensioner winter fuel payments.

However, in one bright spot for households, she said fuel duty would not rise. She also pledged a £22bn boost for the NHS."

Source: The Telegraph. Read the details at: Budget 2024: Key points from Rachel Reeves's speech

- **31 October 2024**

We leave the final word to the Office for Budget Responsibility (OBR) as reported by Eir Nolsøe.

The official spending watchdog has cast doubt on claims that Rachel Reeves inherited a £22bn "black hole" from the Conservative Party. The Chancellor was handed £9.5bn of hidden costs from her predecessor Jeremy Hunt's final Budget, the OBR said, raising questions over Ms Reeves's claims of a £22bn gap. The verdict on Labour's inheritance, which covered the period up to spring, was published alongside the OBR assessment of Ms Reeves's record tax-raising Budget.

The head of the fiscal watchdog said that while he was "not an astronomer" and did not "deal with black holes", it was clear that the Treasury knew before the March Budget that its outgoings would likely be higher than it had told the OBR. Richard Hughes (Chairman of the OBR) said: "At the time we were preparing the March Budget, the Treasury had information about £9.5bn-worth of debt pressure on departments' budgets in 2024-25, which it did not share with us."

The review makes clear that Ms Reeves's predecessor did indeed leave a shortfall in the public coffers for this financial year. However, the figure accounts for less than half of the £22bn shortfall the Chancellor has used to justify the largest tax rises recorded in the UK's history. Mr Hughes said: "In this Government's Budget, they have added around £23bn to departmental expenditure limits in this financial year". Read on at: OBR casts doubt on Reeves's £22bn 'black hole' claim

AEROSPACE MANUFACTURING

Credit: Redline Group Ltd.

Industry Growth and Market Projections courtesy of the Redline Group

The aerospace industry is expanding rapidly. Currently valued at $328 billion, the global aerospace market is projected to reach $430.9 billion by 2025, with a compound annual growth rate of 7%. Despite a temporary decline during the Covid-19 pandemic, this marks significant growth from $276 billion in 2012, reflecting a $52 billion increase over the past decade. Looking ahead, analysts predict exponential growth, with some estimates suggesting the market could reach $1,233 billion by the 2030s. While forecasts vary, the consensus is clear: the aerospace industry is set for unprecedented expansion in the coming decade.

From sustainable aviation to autonomous systems, the future of aerospace promises to redefine how we think about air and space travel. Here, we explore the emerging trends and technologies shaping the next generation of aerospace and manufacturing innovation.

Sustainable Aviation

A major trend in aerospace is the drive towards sustainability, with the industry under pressure to reduce its carbon footprint in light of climate change. Key Developments are:

- ***Electric and Hybrid-Electric Aircraft*:** Companies like Airbus and Boeing are investing in electric and hybrid-electric propulsion systems, aiming to reduce emissions and lower operating costs. eVTOL aircraft promise quieter, cleaner, and more efficient urban air mobility solutions.

- ***Sustainable Aviation Fuels (SAFs):*** Derived from renewable sources such as plant oils and waste, SAFs significantly reduce lifecycle carbon emissions compared to traditional jet fuel. Airlines are increasingly integrating SAFs to meet international climate goals.

- ***Advanced Materials*:** Lightweight, durable materials like carbon fibre composites and advanced alloys are becoming more prevalent. These materials reduce the weight of the aircraft, leading to improved fuel efficiency and lower emissions.

The economic and environmental benefits of green aviation extend beyond the aerospace industry, driving economic growth, job creation in the engineering sector, and ecological sustainability.

embracing renewable energy and eco-friendly practices positions the industry for a prosperous, environmentally conscious future.

Autonomous and Unmanned Systems

Autonomous technology is rapidly advancing, bringing significant changes to both military and commercial aerospace sectors:

- ***Unmanned Aerial Vehicles (UAVs):*** UAVs, or drones, are becoming more sophisticated, with applications ranging from surveillance and delivery services to agriculture and disaster response. Enhanced AI and machine learning capabilities allow these systems to operate with greater autonomy and precision.

- ***Autonomous Flight Systems*****:** Advances in AI and machine learning are enabling the development of fully autonomous flight systems. These systems have the potential to increase safety, reduce pilot workload, and lower operational costs. Autonomous aircraft could revolutionise air cargo and passenger transport in the coming decades.

Advanced Propulsion Systems

The quest for faster, more efficient propulsion systems is another critical trend in aerospace innovation:

- ***Supersonic and Hypersonic Flight*****:** Companies like Boom Supersonic and Lockheed Martin are developing aircraft capable of travelling faster than the speed of sound, drastically reducing travel times and making global travel more accessible.

- ***Space Propulsion:*** Innovations in rocket technology are making space more accessible. Reusable rockets, pioneered by companies like SpaceX, significantly lower the cost of space exploration. Additionally, new propulsion methods, such as ion thrusters and nuclear propulsion, promise to enable longer and more ambitious space missions.

Digital Transformation and Industry 4.0

The integration of digital technologies is transforming aerospace manufacturing and operations:

- ***Additive Manufacturing:*** Also known as 3D printing, this technology allows for the production of complex parts with reduced lead times and lower costs. It is particularly valuable for producing lightweight components and reducing waste.

- ***Digital Twins:*** Virtual replicas of physical systems enable real-time monitoring and predictive maintenance of aircraft, enhancing safety and efficiency.

- ***Cybersecurity:*** As aerospace systems become more interconnected, cybersecurity is a growing concern. Protecting critical infrastructure from cyber threats is essential to maintaining the safety and reliability of aerospace operations.

Space Tourism and Exploration

Space tourism and exploration are becoming increasingly viable, driven by both private and public sector initiatives:

- ***Commercial Spaceflight:*** Companies like SpaceX, Blue Origin, and Virgin Galactic are making significant strides in commercial space travel. Suborbital and orbital flights for tourists are on the horizon, promising a new era of space tourism.

- ***Deep Space Exploration:*** NASA, ESA, and other space agencies are planning ambitious missions to the Moon, Mars, and beyond. Advances in robotics, propulsion, and life support systems are critical to the success of these missions, which aim to expand our understanding of the universe and establish a human presence beyond Earth.

Conclusion

The future of aerospace is filled with exciting possibilities, driven by technological advancements and a commitment to sustainability and innovation. As we look to the skies, we can anticipate a future where air and space travel are safer, more efficient, and more accessible than ever before. At Redline Group, we are dedicated to staying at the forefront of these developments, ensuring that our clients are well-positioned to navigate and thrive in this dynamic landscape. Stay tuned to our content hub for more insights and updates on the latest trends and technologies in the aerospace industry.

Turning now to news items we start with the launch of a major new commercial aircraft:

- **25 August 2024**

"After years of crisis, Boeing is about to launch a new long-haul jet" writes John Arlidge. He asks, can it pull the nose up? And goes on to advise that last week Jack Hayward, senior first officer at British Airways, tweeted: "Exciting times as BA announces the intention to operate Boeing 777-9 aircraft as part of our fleet. There has never been a better time to join us – flying the biggest and best jets to all four corners of the globe."

Boeing already has 481 orders for the new jet, which has a list price of £334 million. Qatar Airways and Emirates, which will be among the first carriers to fly it, will use the 777-9 to install brand new first-class cabins, just as they used the A380 to introduce halo products, such as suites, bars and showers. British Airways and Singapore Airlines will follow suit.

The jet is so large that most airlines will go for a four-class configuration: economy, premium economy, business and first. The width of the fuselage means that there will be 10 seats across in economy, arranged three-four-three across the cabin. Most passengers would prefer nine but Boeing insists the seats will still be roomier than most economy seats. Passengers in every cabin will have something of a view because the windows will be the largest on a jet of this size.

Boeing says the 777-9 will boast the most advanced air filtration systems to keep the air cleaner and less dry than on rival jets. The cabin will be pressurised at an altitude of 6,000ft, the lowest pressure possible, which will prevent passengers' legs and ankles swelling. LED lighting systems will enable airlines to change the brightness and tone from "sunrise" to "sunset", and even show a "starry night sky", to try to nudge travellers on to the time zone of their destination and reduce jet lag.

The 777-9's long wing span and GE9X engines mean it will be more efficient than competing aircraft, such as the Airbus A350-1000, and will have 10 per cent lower operating costs, Boeing claims.

Boeing hopes its 777-9s will be approved to go into service next year - Bloomberg

Brad Till, the firm's managing director of commercial aeroplanes product marketing and analysis, says: "This aircraft will have the lowest CO2 emissions per seat of any wide-body flying. The new engine technology also delivers lower NOx [nitrogen oxides] emissions and less noise, both in the cabin for the passengers and for our airport communities, compared to the aeroplanes that this will replace." Read on at: What to expect from the new Boeing 777-9 – the world's longest and widest passenger plane

- **29 August 2024**

James Titcomb explains that Schroders (the multi-national asset management company) has reduced its holdings in Reaction Engines by 87% amid slow revenue growth. He goes on to write that Reaction Engines - which has secured investment from Rolls-Royce, BAE Systems and the Government - is developing a hybrid jet and rocket engine, known as Sabre, which could lead to hypersonic space planes travelling at speeds of up to 19,000mph and offer flights from Britain to Australia in four hours. The company's groundbreaking pre-cooling technology prevents its engines from overheating as they get up to speed before activating the rocket portion of a flight.

Reaction Engines has sought to raise new funds after missing financial forecasts. Schroders, which took part in a £40m funding round last year, owns a 4.1pc stake in the company, according to Companies House records. The group said it had revalued its stake from £10.6m in December 2023 to £1.4m at the end of June 2024. On that basis, the company's total value has fallen from £256m to £33.8m.

The company has raised more than £150m to date and has secured research and development grants from the British and American governments. Other investors include a United Arab Emirates' sovereign wealth fund.

"Despite steps to commercialise its heat-exchanger technology and recent contract awards, revenue growth at Reaction Engines has been slower than management anticipated, and the company will require further investment and time to become cash positive," Schroders said. "Reaction Engines has appointed advisers to raise additional funds from new and existing investors." Rolls-Royce has said it was among the companies involved in the fundraising talks.

Philip Dunne, the Reaction Engines chairman and a former defence minister, has said that financing conditions were more difficult than when the company last raised funds in 2022. He told investors earlier this year that the company had cut jobs and that it had made a loss last year.

As well as offering the possibility of hypersonic travel, Reaction Engines' cooling technology has been tested by military customers. The group recently announced that its technology was being tested by BAE Systems on naval ships to recover waste heat and to cool exhausts. It is also working with US company Echogen Power Systems to produce high-efficiency heat pumps.

Schroders' stake in Reaction Engines is a legacy of an investment originally made by fund manager Neil Woodford. His trust, Woodford Patient Capital Trust, had been one of the original backers of Reaction Engines. Schroders took over running the trust in 2019 after the collapse of Mr Woodford's funds empire. The Woodford trust was rebranded to Schroders Capital Global Innovation Trust.

- **August 2024**

This month's edition of the RAeS publication AERO SPACE reported that £81.5 bn of business was secured at the 2024 Farnborough Air Show, this included 164 Airbus orders and 118 Boeing orders.

In addition, Robert Coppinger explained the Zero-Emission Next Generation of Integrated Technology for Hydrogen Storage (ZENITH) programme jointly funded by the Engineering and Physical Sciences Research Council and GKN Aerospace. And under the heading *Bursting the eVTOL Bubble*, Bill Sweetman suggests ten questions you should ask before investing in an eVTOL company.

Finally, Paul Adams reports on the problem of 'fracturing supply chains' and suggests that "what started as a symptom of the post-Covid ramp-up has now become part of the new order" and asks, "what is causing the supply chain disruption and will it ever end?"

- **September 2024**

Continuing on from the above, in the September edition Bella Richards discusses 'the Packed In-Tray of the new Boeing CEO', the ex-mechanical engineer, Robert Ortberg who took over from Dave Calhoun on 8 August; and Robert Coppinger asks the question "can condensed batteries deliver all that they promise?"

Furthermore, Tim Robinson, Stephen Bridgewater, Bella Richards, Jack Richardson and Katie Preston report on the news and highlights of the 2024 Farnborough Airshow. In summary, their report concluded that "*A new Labour Government, with a fresh energy and new vision made for a highly positive Farnborough this year in respect of strengthening old partnerships and forging new ones with international partners – particularly in military and spaceflight. Both Germany and Japan came to the fore – Japan via its partnership in GCAP and civil airline orders, and Germany with the new*

British Government's security partnership – which potentially could include co-operation in military aerospace.

In the civil field, orders were perhaps lower than some might have predicted, but both Airbus and Boeing are laser focused at the moment on delivery and, in Boeing's case, rebuilding shattered trust and strengthening its safety culture.

Finally, as ever, the show featured a strong focus on sustainability – particularly in advances in hybrid-electric and hydrogen-electric propulsion."

- **7 October 2024**

An artist's impression of the Venus Stargazer M4 hypersonic aircraft:(Venus Aerospace)

And staying with hypersonic flight, Jen Mills writes in the Metro that it is over 20 years since Concorde's last flight, and since then the idea of supersonic flight has mostly been grounded. Many countries have blocked planes from travelling at such high speed due to the disturbance from noisy sonic booms when they break the sound barrier, and the technology is expensive with tickets historically out of reach for all but the richest.

But now interest is again taking off in super speedy planes, and this time they could be more than twice as fast as Concorde. Last week, startup engineering company Venus Aerospace unveiled an engine it says is capable of 'hypersonic' flight. The Venus Detonation Ramjet 2000 lb Thrust Engine, also known as 'VDR2', can reportedly reach speeds of Mach 6, which is six times the speed of sound. This would be 3,600 miles per hour, making it possible to travel the distance from London to New York (3,400 miles) in just one hour.

Venus Aerospace say they are planning a test flight next year along with aerospace company Velontra, with the intention of 'unlocking the high-speed flight economy' for both commercial and defence aircraft. The plane will fly higher than traditional aircraft, taking off using jet engines but then

transition to rockets once it reaches altitude. While not technically on the edge of space, it will fly high enough to see the planet's curve and the blackness of space above it.

Unveiling the new engine at the Up.Summit, Venus Aerospace co-founder Andrew Duggleby said: 'This engine makes the hypersonic economy a reality. We are excited to partner with Velontra to achieve this revolution in high speed flight, given their expertise in high-speed air combustion.' Eric Briggs, Velontra's Chief Operating Officer, said: 'We can't wait to dig in, make the first one fly, and ultimately perfect an engine concept that has lived mostly in textbooks but never as a production unit in the air. 'We couldn't think of a better partner than Venus. Rocketry pioneers in their own right, and ready to tackle the hard problems, we are eager to fly the same path with them.'

These are not the only companies eager to pioneer the technology. Sierra Space and Hermeus are among those also working on the technology, while Chinese company Space Transportation is also reported to be developing a 'rocket with wings' for both space tourism and intercity travel. If such planes became available for commercial flights, they would be very different to the big planes we're used to in the EasyJet era. They would be much smaller, without windows, and have been designed to reduce the noise from sonic booms to more of a sonic thump, though would likely still have to take routes above the ocean to reduce noise disruption over land.

- **16 October 2024**

In an article by David Axe he advises that the US Air Force has paused its effort to develop a new manned stealth fighter. The US Navy, by contrast, is going full steam ahead with its own new manned stealth fighter. The result, it seems, will be a split in American air power as the Air Force and Navy – which currently use versions of the same warplane – pursue different air-power objectives. The Air Force has suspended its next-gen manned fighter programme while it considers a bigger investment in armed fighter drones. The Navy for its part has decided drones aren't ready to do what its next fighter needs to do.

The Navy expects to pick one of three contractors – Boeing, Lockheed Martin or Northrop Grumman – to develop and build its new F/A-XX stealth fighter, and soon. The fighter would replace today's F/A-18E/F Super Hornet on aircraft carrier decks starting in the 2030s.

The F/A-XX is likely to be big and fast, with a large weapons payload and enough internal fuel to range 500 miles or more across the vast expanse of the Pacific Ocean. It should be stealthy, with a small radar and infrared signature, and would be equipped to operate as a team with nearby drones. If the Air Force does decide against such a jet, the F/A-XX is likely to be the world's first sixth-generation fighter.

"We expect a sixth-generation platform to have advanced sensors, advanced lethality, advanced range and be able to integrate with manned and unmanned capabilities together," said Admiral Lisa Franchetti, the Navy's top officer. In that sense, the F/A-XX – which like most Navy fighters is likely to have two engines – is similar to the Air Force's now apparently defunct Next Generation Air Dominance (NGAD) manned fighter, which the flying branch put on hold this summer, citing its potentially $300-million-per-plane cost. That's three times what the current fifth-gen Lockheed Martin F-35 stealth fighter costs.

It seems the Air Force is comfortable suspending NGAD because it's increasingly confident that its new family of inexpensive stealth fighter drones, or "collaborative combat aircraft," are capable of taking over many of the missions the Air Force presently assigns to manned jets such as the F-35 and the bigger, older F-22 Raptor.

The Navy isn't nearly as confident in drones – especially when it comes to unmanned aircraft operating from the crowded decks of its 11 nuclear-powered flattops. The Navy so far has developed just one carrier-capable drone, the MQ-25 Stingray – and for now it's employed strictly as an unarmed aerial tanker, though it has a stealthy design and manufacturer Boeing has indicated that it could easily be armed. Read on at: The US Navy, not the US Air Force, will soon have the world's greatest fighter jet

Credit: Nationalinterest.org ***F/A-XX***

- **October 2024**

In the October edition of AERO SPACE in an article entitled 'Simulating the Future' Allyson Kukel of Aviate in Calm and Gordon Woolley of the RAeS Flight Simulation Group, look ahead to the RAeS' Flight Simulation Conference later in October. And Robert Coppinger under the sub-heading of 'Exploring Advances on the leading edge of aerospace' discusses the first digitally certified aircraft.

Finally, Naomi Allen asks "Is sustainable Aviation Fuel the silver bullet that some claim it is in reducing aviation's climate impact?" Ahead of the UK SAF mandate to be introduced in 2025, as Head of RAeS Research, she assesses its potential under the heading '100% SAF is not 100% of the solution'.

COMMERCIAL AVIATION OPERATION

Source: Shutterstock ***Heathrow Airport from the air***

We commence this quarter's section with an introduction to Heathrow Airport.

Overview

Heathrow Airport called *London Airport* until 1966 and now known as London Heathrow, is the main international airport serving London, the capital and most populous city of England, and the United Kingdom. It is the largest of the six international airports in the London airport system (the others being Gatwick, City, Luton, Stansted and Southend). The airport is owned and operated by Heathrow Airport Holdings. In 2023 Heathrow was the busiest airport in Europe, the fourth-busiest airport in the world by passenger traffic, and the second-busiest airport in the world by international passenger traffic. As of 2023, Heathrow is the airport with the most international connections in the world.

Heathrow Airport is used by over 89 airlines flying to 214 destinations in 84 countries. The airport is the primary hub of British Airways and is a base for Virgin Atlantic. It has four passenger terminals (numbered 2 to 5) and a cargo terminal. In 2021 Heathrow served 19.4 million passengers, of which 17 million were international and 2.4 million domestic. The busiest year ever recorded was 2019 when 80.9 million passengers travelled through the airport. Heathrow is the UK's largest port by value with a network of over 218 destinations worldwide. The busiest single destination in passenger numbers is New York, with over three million passengers flying between Heathrow and JFK Airport in 2021.

North of the northern runway and the former taxiway and aprons, now the site of extensive car parks, is the entrance to the access tunnel and the site of Heathrow's unofficial "gate guardian". For many years the home of a 40% scale model of a British Airways Concorde, G-CONC; the site has been occupied by a model of an Emirates Airbus A380 since 2008. There is a multi-faith prayer room and counselling room in each terminal, in addition to St. George's Interdenominational Chapel in an underground vault adjacent to the old control tower where Christian services take place. The chaplains organise and lead prayers at certain times in the prayer room.

The airport also has a resident press corps, consisting of six photographers and one TV crew, serving all the major newspapers and television stations around the world.

Most of Heathrow's internal road names are coded by their first letter: N in the north (e.g. Newall Road), E in the east (e.g. Elmdon Road), S in the south (e.g. Stratford Road), W in the west (e.g. Walrus Road), C in the centre (e.g. Camborne Road). The top cargo export destinations include the United States, China and the United Arab Emirates handling 1.4 million tonnes of cargo in 2022. The top products exported were books, salmon and medicine.

History

Heathrow was founded as a small airfield in 1930 but was developed into a much larger airport after World War II. It lies 14 miles (23 kilometres) west of Central London on a site that covers 4.74 square miles (12.3 square kilometres). Development of the whole Heathrow area as a much larger airport began in 1944 during World War II. It was intended for long-distance military aircraft bound for the Far East. By the time some of the airfield's runways were usable, World War II had ended, and the UK Government continued to develop the site as a civil airport. The airport was opened on 25 March 1946 as London Airport. The airport was renamed Heathrow Airport in the last week of September 1966 to avoid confusion with the other two airports which serve London - Gatwick and Stansted. The design for the airport was by Sir Frederick Gibberd. He set out the original terminals and central-area buildings, including the original control tower and the multi-faith Chapel.

In the 1950s Heathrow had six runways, arranged in three pairs at different angles in the shape of a hexagram with the permanent passenger terminal in the middle and the older terminal along the north edge of the field; two of its runways would always be within 30° of the wind direction. As the required length for runways has grown, Heathrow now has only two parallel runways running east–west. These are extended versions of the two east–west runways from the original hexagram. From the air, almost all of the original runways can still be seen, incorporated into the present system of taxiways.

Security

Policing of the airport is the responsibility of the aviation security team, a unit of the Metropolitan Police, although the British Army, including armoured vehicles of the Household Cavalry, has occasionally been deployed at the airport during periods of heightened security. Full body scanners are now used at the airport, and passengers who refuse to use them are required to submit to a hand search in a private room. The scanners display passengers' bodies as cartoon figures, with indicators showing where concealed items may be.

For many decades Heathrow had a reputation for theft by baggage handlers. This led to the airport being nicknamed "Thiefrow", with periodic arrests of baggage handlers. Following the widespread disruption caused by reports of drone sightings at Gatwick Airport, and a subsequent incident at Heathrow, a drone-detection system was installed airport-wide to attempt to combat disruption caused by the illegal use of drones.

Operations

Aircraft destined for Heathrow are usually routed to one of four holding points. Air traffic controllers at Heathrow Approach Control (based in Swanwick, Hampshire) then guide the aircraft to their final approach, merging aircraft from the four holds into a single stream of traffic, sometimes as close as 2.5 nautical miles (4.6 km; 2.9 mi) apart. Considerable use is made of continuous descent approach techniques to minimise the environmental effects of incoming aircraft, particularly at night. Once an aircraft is established on its final approach, control is handed over to Heathrow Tower.

When runway alternation was introduced, aircraft generated significantly more noise on departure than when landing, so a preference for westerly operations during daylight was introduced, which continues to this day. In this mode aircraft take off towards the west and land from the east over London, thereby minimising the impact of noise on the most densely populated areas. Heathrow's two runways generally operate in segregated mode, whereby landings are allocated to one runway and take-offs to the other. To further reduce noise nuisance, the use of runways 27R and 27L is swapped at 15:00 each day if the wind is from the west. When landings are easterly there is no alternation; 09L remains the landing runway and 09R the take-off runway due to the legacy of the now rescinded Cranford Agreement, pending taxiway works to allow the roles to be reversed. Occasionally, landings are allowed on the nominated departure runway, to help reduce airborne delays and to position landing aircraft closer to their terminal, thereby reducing taxi times.

Night-time flights at Heathrow are subject to restrictions. Between 23:00 and 04:00, the noisiest aircraft (rated QC/8 and QC/16) cannot be scheduled for operation. Also, during the night quota period (23:30–06:00) there are four limits: a limit on the number of flights allowed; a Quota Count system which limits the total amount of noise permitted, but allows operators to choose to operate fewer noisy aircraft or a greater number of quieter planes; QC/4 aircraft cannot be scheduled for operation; a voluntary agreement with the airlines that no early-morning arrivals will be scheduled to land before 04:30.

Inbound aircraft to London Heathrow Airport typically follow one of several Standard Arrival Routes (STARs). The STARs each terminate at one of four different VOR installations, and these also define four "stacks" where aircraft can be held if necessary until they are cleared to begin their approach to land. Stacks are sections of airspace where inbound aircraft will normally use the pattern closest to their arrival route. They can be visualised as a helix in the sky. Each stack descends in 1,000 feet (305 m) intervals from 16,000 feet (4,877 m) down to 8,000 feet (2,438 m). Aircraft hold between 7,000 and 15,000 feet (2,134 and 4,572 m) at 1,000-foot intervals. If these holds become full, aircraft are held at more distant points before being cleared onward to one of the four main holds. The following four stacks are currently in place: the Bovingdon stack for arrivals from the northwest; the Biggin Hill stack for arrivals from the southeast; the Lambourne stack for arrivals from the northeast; the Ockham stack for arrivals from the southwest.

Further development

In September 2012, the British government established the Airports Commission, an independent commission chaired by Sir Howard Davies to examine various options for increasing capacity at UK airports. In July 2015, the commission backed a third runway at Heathrow, which the government approved in October 2016. However, the Court of Appeal rejected this plan on the basis that the government failed to consider climate change and the environmental impact of aviation. On 16

December 2020 the UK Supreme Court lifted the ban on the third runway expansion allowing the construction plan to go ahead.

The airport was criticised in 2007 for overcrowding and delays; according to Heathrow Airport Holdings, Heathrow's facilities were originally designed to accommodate 55 million passengers annually. The number of passengers using the airport reached a record 70 million in 2012. In 2007 the airport was voted the world's least favourite, alongside Chicago O'Hare, in a TripAdvisor survey. However, the opening of Terminal 5 in 2008 has relieved some pressure on terminal facilities, increasing the airport's terminal capacity to 90 million passengers per year. A tie-up is also in place with McLaren Applied Technologies to optimise the general procedure, reducing delays and pollution.

With only two runways, and operating at over 98% of their capacity, Heathrow has little room for more flights, although the use of larger aircraft such as the Airbus A380 has allowed some increase in passenger numbers. It is difficult for existing airlines to obtain landing slots to enable them to increase their services from the airport, or for new airlines to start operations. To increase the number of flights, Heathrow Airport Holdings has proposed using the existing two runways in 'mixed mode' whereby aircraft would be allowed to take off and land on the same runway. This would increase the airport's capacity from its current 480,000 movements per year to as many as 550,000. The construction of a third runway to the north of the airport would significantly increase traffic capacity.

The Terminals

The airport's newest terminal, Terminal 2 officially known as the **Queen's Terminal**, was opened on 4 June 2014 and has 24 gates. Designed by Spanish architect Luis Vidal, it was built on the site that had been occupied by the original Terminal 2 and the Queens Building. The main complex was completed in November 2013 and underwent six months of testing before opening to passengers. It includes a satellite pier (T2B), a 1,340-space car park, and a cooling station to generate chilled water. There are 52 shops and 17 bars and restaurants.

Flights using Terminal 2 primarily originate from northern Europe or western Europe. It is primarily used by Star Alliance airlines (consolidating the airlines under Star Alliance's co-location policy "Move Under One Roof"). The terminal is also used by a few non-aligned airlines. Terminal 2 is one of the two terminals that operate UK and Irish domestic flights.

Terminal 3 opened as the **Oceanic Terminal** on 13 November 1961 to handle flight departures for long-haul routes for foreign carriers to the United States and Asia. At this time the airport had a direct helicopter service to central London from the gardens on the roof of the terminal building. Renamed Terminal 3 in 1968, it was expanded in 1970 with the addition of an arrivals building. Other facilities added included the UK's first moving walkways. In 2006, the new £105 million Pier 6 was completed to accommodate the Airbus A380 superjumbo; Emirates and Qantas operate regular flights from Terminal 3 using the Airbus A380.

Redevelopment of Terminal 3's forecourt by the addition of a new four-lane drop-off area and a large pedestrianised plaza, complete with a canopy to the front of the terminal building, was completed in 2007. These improvements were intended to improve passengers' experience, reduce traffic congestion and improve security. As part of this project, Virgin Atlantic was assigned its dedicated check-in area, known as 'Zone A', which features a large sculpture and atrium. As of 2013, Terminal 3 has 28 gates,

and in 2011 it handled 19.8 million passengers on 104,100 flights. Most flights from Terminal 3 are long-haul flights from North America, Asia and other foreign countries other than Europe.

Terminal 4 opened in 1986; it has 22 gates. It is situated to the south of the southern runway next to the cargo terminal and is connected to Terminals 2 and 3 by the Heathrow Cargo Tunnel. It has undergone a £200 million upgrade to enable it to accommodate 45 airlines with an upgraded forecourt to reduce traffic congestion and improve security. Most flights using Terminal 4 are those from/to East Europe, Central Asia, North Africa and the Middle East as well as a few flights from/to Europe. An extended check-in area with renovated piers and departure lounges and a new baggage system were installed, and four new stands were built to accommodate the Airbus A380; Qatar Airways operates regular A380 flights. Etihad Airways and Malaysia Airlines operate regular A350 flights. China Southern Airlines, El Al, Etihad Airways, Gulf Air, and Vietnam Airlines operate regular Boeing 787 flights.

Terminal 5 lies between the northern and southern runways at the western end of the Heathrow site and was opened by Queen Elizabeth II on 14 March 2008, 19 years after its inception. It opened to the public on 27 March 2008. Terminal 5 is exclusively used by British Airways as its global hub. Built for £4.3 billion, the terminal consists of a four-story main terminal building (Concourse A) and two satellite buildings linked to the main terminal by an underground people mover transit system. Concourse A is dedicated to British Airways' narrowbody fleet for flights around the UK and the rest of Europe, the first satellite (Concourse B) includes dedicated stands for BA and Iberia's widebody fleet except for the Airbus A380, and the second satellite (Concourse C), includes 7 dedicated aircraft stands for the A380. It became fully operational on 1 June 2011. Terminal 5 was voted Skytrax World's Best Airport Terminal 2014 in the Annual World Airport Awards.

The main terminal building (Concourse A) has an area of 300,000 square metres (3,200,000 sq. ft) while Concourse B covers 60,000 square metres (650,000 sq. ft). It has 60 aircraft stands and capacity for 30 million passengers annually as well as more than 100 shops and restaurants. It is also home to British Airways' Flagship lounge, the Concorde Room, alongside four further British Airways branded lounges. One of those lounges is the British Airways Arrivals Lounge which is located land-side.

A further building, designated Concourse D and of similar size to Concourse C, may yet be built to the east of the existing site, providing up to another 16 stands. Following British Airways' merger with Iberia, this may become a priority since the combined business will require accommodation at Heathrow under one roof to maximise the cost savings envisaged under the deal. A proposal for Concourse D was featured in Heathrow's Capital Investment Plan 2009.

The transport network around the airport has been extended to cope with the increase in passenger numbers. New branches of both the Heathrow Express and the Underground's Piccadilly line serve a new shared Heathrow Terminal 5 station. A dedicated motorway spur links the terminal to the M25 (between junctions 14 and 15). The terminal has a 3,800 space multi-storey car park. A more distant long-stay car park for business passengers is connected to the terminal by a personal rapid transit system, the Heathrow Pod, which became operational in the spring of 2011. An automated people mover (APM) system, known as the Transit, transports airside passengers between the main terminal building and the satellite concourses.

Source: Shutterstock ***Heathrow Self-Driving Travel Pods***

The Future

The future of Heathrow Airport is centred around its expansion plans, which include the construction of a third runway. This expansion aims to significantly increase the airport's capacity allowing for an additional 260,000 flights per year. The project is expected to create tens of thousands of jobs and bring £billions in economic benefits to the UK.

The expansion plan, which has faced various legal and environmental challenges, is currently paused but remains a key focus for the airport's future development. The new runway and associated infrastructure, including a new terminal west of Terminal 5, are part of a broader vision to enhance Heathrow's role as a major global hub.

Moving on to our regular news updates:

- **19 August 2024**

Christopher Jasper advises that London City Airport has been given the green light to fly millions more passengers each year after Angela Rayner overruled the Labour-run Newham Council. Ministers gave the go ahead for a near 40pc increase in passenger numbers at London City in one of the Government's first major infrastructure decisions since taking power last month. A capacity cap will be lifted from 6.5m to 9m passengers a year following the ruling from Angela Rayner, secretary of state for housing, communities and local government, and transport secretary Louise Haigh. The

Government also said that the airport should be permitted to offer three extra flights during the first half hour of operations during the week.

Newham council had earlier refused planning permission associated with the expansion plan, arguing that the proposals would lead to an increase in aircraft noise detrimental to the health and quality of life of residents. In an appeal against the rejection, London City said its application involved no increase in the permitted number of annual flights and included a commitment to allow only cleaner, quieter next generation aircraft to fly in any extended operating periods. The Planning Inspectorate had recommended that Newham's decision be overturned.

Ms Rayner and Ms Haigh stopped short of easing a partial weekend curfew on flights. Services must still halt at 12:30pm on Saturdays. The airport had sought to push the start of the curfew back to 6:30pm, with an extra hour and up to 12 more arrivals during the summer.

Alison FitzGerald, who took over as London City chief executive in May, welcomed the decision to approve the increase in passenger numbers but said the refusal of extra flights on Saturday would limit the switch to greener aircraft. She said: "Local residents would have had the added benefit of these aircraft operating at the airport throughout the week, not just in the extended operating hours." Continue reading at: Airport given green light for millions more passengers as Rayner approves expansion (telegraph.co.uk)

- **August 2024**

In this month's issue of the AERO SPACE publication, Jim Angus and Andrew Brown report from the RAeS Air Transport Group's recent conference at Cranfield University entitled 'Sustainable Hangar of the Future' and discuss the challenges facing the MRO sector as it attempts to decarbonise.

In the same issue Karl Southern from the RAeS's Human Factors Group asks – "as maintenance errors continue to contribute to accidents, delays and diversions – is it time to implement human centred design for maintenance?"

Finally, under the heading of 'Checking the SOP compliance code' Isaac Shareef asks, "are we analysing and quantifying safety culture as effectively as we might?"

- **22 September 2024**

Christopher Jasper writes that at the height of the pandemic, when planes around the world were lined up stationary as if in graveyards and airlines were battling to stave off bankruptcy, Heathrow declared that plans for a third runway had been put out to pasture. Passenger numbers would take so long to recover, executives reasoned, that moving ahead with the £14bn project would be foolhardy in the extreme. Such was the doom and gloom that the then chief executive, John Holland-Kaye, said Europe's largest aviation hub would probably not need a new landing strip for 15 years – and might not require one at all, depending on the severity of damage to the economy.

Yet just three years after the last Covid lockdowns were lifted, demand for flights has stormed back so strongly that the debate about the country's once-again crowded airports is about to be reignited. Heathrow is busy working on a revised blueprint for a third runway, together with more immediate measures to boost capacity. CEO Thomas Woldbye is expected to test the waters in meetings with key

government figures at the Labour Party conference this week. Furthermore, Heathrow is not the only airport eyeing expansion. Gatwick's plans to turn an emergency landing strip into a fully-fledged runway, currently being scrutinised by planners, will be put before the Government early next year.

Opponents of airport expansion, meanwhile, are dusting down their placards and preparing for legal challenges. The ranks of the anti-expansion brigade have been swelled by a new breed of protester who views air travel as a threat to the planet and is prepared to resort to extreme action to undermine it.

The confrontation is set to pit economic priorities against climate and environmental concerns. Labour's response will go to the heart of its vision for Britain and test Sir Keir Starmer's commitment to making the pursuit of growth his "number one mission". "Aviation is an enabler of everything else in the economy and an industry where Britain punches well above its weight, where we're genuinely world-class," said Tim Alderslade, the chief executive of trade group Airlines UK. Whether or not the Government signs off on the Heathrow third runway will be the biggest decision it makes on aviation. Alderslade said: "Heathrow was full 10 years ago and it's full again now. This isn't something that's going to go away." Read on at: British airports are full to bursting. Does Starmer dare act? (telegraph.co.uk)

- **23 September 2024**

John Arlidge writes that pride of place at Britain's Farnborough Air Show usually goes to the biggest airlines with the biggest jets. But at this year's jamboree in July, Virgin Atlantic, a David to British Airways' Goliath, stole the show with one of its new midsize Airbus A330neos parked next to the runway. Shai Weiss, Virgin Atlantic's CEO, emerged from the front door to announce an order for another seven A330neos, taking the total number in Virgin's fleet to 19 and making Virgin a majority Airbus carrier. That's quite a turnaround. Sir Richard Branson's carrier has mainly flown Boeing planes, notably its iconic 747 whose upper deck inspired Branson to call Virgin's business-class Upper Class.

Virgin is not alone in its embrace of the A330neo. Hong Kong-based Cathay Pacific, American giant Delta, Germany's Condor, Malaysia Airlines and Portugal's flag carrier TAP have all recently announced large orders for the plane. Cathay has ordered 30 with rights for another 30. Overall, in the four weeks after the Farnborough show, Airbus received 57 new firm orders for the A330neo and 60 options, overtaking other models as the most-ordered wide-body aircraft during that period. Airbus now has firm orders for 326 A330neos, 139 of which have been delivered.

It is a dramatic reversal of fortune for the twin-engine jet which first took to the skies in 2018. Until recently most airlines preferred Boeing's 787 "Dreamliner" or Airbus's larger A350, because both those aircraft are newer. The A330neo is the latest model based on the A330 family which first took to the skies in 1992.

What's behind the new-found popularity of the A330neo, and what does it mean for passengers? Many airlines are starting to favour it over the 787 because it burns less fuel. Fuel is an airline's single biggest operating cost. Airbus says the A330neo's new Rolls-Royce Trent 7000 engines burn 25 per cent less fuel per seat than the Boeing 777-200 and 14 per cent less fuel per seat than earlier A330 models. Overall, the A330neo has a seven per cent lower cost per seat than the 787.

Corneel Koster, Virgin Atlantic's chief customer and operating officer, points out that the A330neo's carbon emissions are 11 per cent lower than older models of the jet. He adds that it is also the quietest wide-body jet in the sky – not just for passengers but also for people on the ground. Airbus says the cabin is three decibels quieter than the 787 and the engines are half as noisy on take-off and landing as those on earlier models of the A330. Read further at: Airbus A330neo: the small but beautiful jet that's finally winning over airlines (telegraph.co.uk)

Source: Shutterstock ***Virgin Atlantic Airbus A330neo***

- **28 September 2024**

Christopher Jasper reports that nearly one in two British Airways flights have been delayed this year because of disruption linked to a staffing crisis at UK air traffic control. The flag carrier said 42pc of services had been hit by interventions from Britain's air traffic control provider NATS so far in 2024, a sharp rise from the 24pc recorded in 2019, the most recent year to see a similar number of flights. The level of disruption is significantly higher than that suffered by rivals Air France, Lufthansa and KLM, the airline said.

BA revealed the extent of the upheaval in a message to staff explaining how heavy downpours on Thursday had led to turmoil after NATS, formerly known as National Air Traffic Services, failed to cope with the situation. The carrier said that it had secured an extension to operations at Heathrow in order to ensure that passengers were still able to get away, only for many of its aircraft to be denied timely clearance to depart. It said: "The primary driver of this was air traffic delays to departing flights, which left us with no choice but to cancel those flights at late notice. This was incredibly frustrating for us and tough on our customers."

BA said in the message, obtained by The Telegraph, that the disruption amounted to "one of the toughest days we and our customers have faced for many months". It added that the upheaval

marked the culmination of a "difficult summer" and said it was working with NATS to boost resilience.

British Airways' comments mark an escalation in the crisis surrounding NATS, which has previously been attacked by discount airlines while avoiding direct criticism from Britain's dominant long-haul operator. BA is becoming increasingly exasperated with the situation because it has poured £106m into bolstering resilience at Heathrow and hired 600 extra operational staff.

Ryanair boss Michael O'Leary has repeatedly called on NATS chief executive Martin Rolfe to quit since staff shortages at the air navigation provider during last year's August bank holiday forced the carrier to cancel 370 flights at a cost of $25m (£18.7m). EasyJet joined in the criticism earlier this month, with boss Johan Lundgren demanding that the NATS board sack Mr Rolfe for downplaying problems at the company and providing misleading information about disruption.

NATS, which manages airspace over the UK and eastern Atlantic, as well as at a number of airports, is a public-private partnership owned by the Government, pension funds and a group of airlines including BA and easyJet.

- **September 2024**

Neelam Matthews in AERO SPACE reveals under the heading 'Saudia, the sleeping giant awakes' how the national carrier is preparing an holistic vision of the future of aviation.

- **9 October 2024**

And continuing with air traffic control, Christopher Jasper goes on to report that air traffic controllers have been dubbed the heart of the airport for their vital and challenging role in keeping flights running safely and efficiently. So when Ryanair boss Michael O'Leary demanded the resignation of Martin Rolfe, the head of Britain's National Air Traffic Services (NATS), his remarks came as a shock.

O'Leary's ultimatum followed an IT failure during last year's August bank holiday that ruined the summer's last holiday weekend for tens of thousands of people. The Ryanair chief claimed that a policy of allowing NATS engineers to work from home meant they were "sat watching Football Focus in their jim jams" at the time of the outage. O'Leary went on to compare NATS – which runs the airspace over Britain and the whole of the eastern Atlantic, as well as controlling flights at the country's busiest airports – to Dad's Army, and said that it was "short-staffed every summer."

He added: "It comes back to the same complacent mismanagement and an overpaid, underworked, ineffective CEO who should, in any properly functioning country, resign or be booted out." The remarks, though cutting, were not out of character for the outspoken Ryanair boss. Yet in the past month NATS has come in for more criticism from airlines that are generally far less willing to show their heads above the parapet. EasyJet and British Airways have joined the revolt, blaming NATS for what they say is an increase in delays and cancellations that has left them scrambling to fulfil timetables in the final weeks of the lucrative summer season.

NATS has hit back, saying the increased disruption stems mostly from a 4.4pc increase in the number of UK travellers compared with last year, combined with a particularly wet and stormy summer season. Read on at: How air traffic control flew into crisis (msn.com)

➢ **13 October 2024**

Christopher Jasper also reports that Gulf airline, Emirates, will keep its fleet of Airbus A380 super-jumbos flying for another 15 years following a mammoth $3bn (£2.3bn) upgrade. The United Arab Emirates flag carrier has announced plans to refurbish all 116 of its A380s after Airbus halted production of the world's biggest passenger jets in 2021, effectively denying it the opportunity to buy more.

Adnan Kazim, the airline's deputy president, said the revamp will allow Emirates to carry on operating the aircraft, which have up to 615 seats, until 2038 or 2039. He said: "With many airports not really investing or expanding, you need that uplift. "We cannot replace the A380 with any other type of aircraft, so it's important to keep it for as long as we can." Hanging onto the super-jumbos is also vital given that the 400-seat Boeing 777X is not now expected at the airline until mid-2026 onwards, he said, six years behind schedule.

The refurbishment programme, which is the industry's largest ever, effectively requires an entirely new interior to be built inside each aircraft. That includes fully enclosed first-class berths, revamped lounge bars and shower spas, as well as a new premium economy cabin that the airline hopes will tap into people's willingness to spend more on leisure travel post-Covid. Emirates announced in May that it would retrofit a further 43 A380s in addition to the 67 it had already pledged to upgrade. Another six, the most recently delivered to the airline, came with the new interior as standard. Read on at: Emirates to keep super-jumbos flying for another 15 years after $3bn upgrade (telegraph.co.uk)

Source: Shutterstock ***Emirates A380***

➢ **16 October 2024**

Continuing, Mr Jasper advises that Ryanair has warned it could axe hundreds of UK flights if Rachel Reeves raises aviation taxes in her Budget. Michael O'Leary, the low-cost airline's chief, said that any increase in air passenger duty (APD) would hurt customer demand and undermine the viability of some routes. This would spark inevitable cut-backs for Ryanair, he said, as he singled out the prospect of the Chancellor increasing APD on internal flights. Mr O'Leary said: "If they raise APD again on domestic flights then there will be a cut in capacity, no question. These routes are not particularly profitable, they barely break even."

His comments come after Ryanair slashed 12pc of its capacity in Germany in protest against higher taxes. The move demonstrated the carrier's willingness to shuffle planes around Europe when existing routes offer only marginal returns. The Chancellor is yet to announce what levies she will raise in the Budget later this month, although she has signalled that "difficult " decisions lie ahead as she attempts to fill a £22bn "black hole" in the economy.

Mr O'Leary said an increase in APD, which currently stands at £7 for internal flights, would come as a blow after the Irish airline recently poured investment into regional UK airports. He said: "We've put a lot of additional capacity into Glasgow, Edinburgh and Belfast." Speaking in Brussels at a gathering of European airline chiefs, he said that increasing APD would put more of a burden on ordinary passengers. He said: "APD is a penal tax on the poor. The rich don't care. In a post-Brexit environment, the UK needs to stimulate inward tourism."

Mr O'Leary said that while the Government was making encouraging noises about aviation and appeared serious about expanding Britain's airport infrastructure, he would be reserving judgement on the Chancellor until the Budget.

Also this day John Arlidge and Oliver Smith compare 90 airlines across more than 30 categories from legroom to punctuality to reveal 'The World's best airline'. Britain's best performer is Virgin Atlantic, ranked 16th overall, just ahead of British Airways in 19th. Their top 10 are:

1. Emirates
2. Qatar Airways
3. Singapore Airlines
4. Cathay Pacific
5. All Nippon Airways
6. Turkish Airlines
7. Japan Airlines
8. Air France
9. Etihad
10. Korean Air

The full rankings can be found on: The world's best airlines, ranked and rated

- **17 October 2024**

Reporting the next day, Christopher Jasper also advised that "Boeing must hold out against a strike by 33,000 workers even if it means aircraft deliveries are held up by several months", Ryanair boss Michael O'Leary said. Mr O'Leary said he backed Boeing chief Kelly Ortberg's decision to abandon talks after the machinists union rejected a sweetened 30pc pay offer. Further details at: Don't bow down to striking workers, Ryanair boss urges Boeing (msn.com)

- **27 October 2024**

Matthew Lynn suggests that "the French President is creating an old-style national flag-carrier, except this time on a Continental scale." Read: Air Macron is launching a stealth takeover of Europe's skies

- **31 October 2024**

Christopher Jasper reports that Riyadh Air has lodged a mammoth $8bn (£6bn) aircraft order as it ramps up efforts to take on established Middle Eastern carriers such as Emirates. The Saudi Arabian start-up airline, which is bankrolled by the Saudi state, has struck a deal to buy 60 A321neo short-haul jets from Airbus. This is in addition to an earlier agreement for 39 Boeing wide-bodies announced last year, which includes the option for another 33.

The Airbus order marks the latest step in Riyadh Air's bid to muscle in on a Gulf market dominated by some of the world's biggest airlines, including Dubai-based Emirates and Qatar Airways. Chief executive Tony Douglas said the Airbus jets will help "support economic growth" by establishing the comprehensive route network needed to transform the city of Riyadh into a global aviation hub.

The move to establish a new airline is a key element of Saudi Arabia's bid to reduce its reliance on oil by diversifying into new sectors such as transport and tourism. The airline, which plans to commence flights next year, is also understood to be pursuing an additional deal for more wide-body jets as it looks to expand its fleet further. It is also exploring plans to enter the cargo market.

- **October 2024**

In this month's AERO SPACE Nicholas Butcher and Dr John Barnett explain the importance of early reporting of aircraft accidents; and Oscar Zuniga Arroniz asks "Can 3D accident reconstruction revolutionise the way we investigate air accidents?"

Also, Martyn Cartledge explains that building new airports is never an easy challenge, but some nations achieve better results than others. He visits Istanbul and argues that success comes from developing an aviation ecosystem that caters to the needs of modern travellers and airlines alike.

SPACE

Credit: Space X ***Polaris Dawn Crew***

Opening this quarter's section, according to Wikipedia the Polaris program was announced by Jared Isaacman in February 2022, five months after the first all-private astronaut mission, Inspiration4, which was also backed by Isaacman. Development of technologies necessary for the mission was part of the program, including extravehicular activity (EVA) spacesuits, inter-satellite laser communication links between the Dragon spacecraft and the Starlink constellation, and accommodation for the lack of an airlock in the Dragon capsule.

Originally scheduled to fly in late 2022, the program suffered delays over the design of the EVA spacesuits and technical problems with SpaceX testing inter-satellite laser communication links. By October 2022 the launch had slipped to March 2023, and by February 2023 had slipped to no earlier than mid-2023. By mid-2023 the flight was delayed until 2024, with Isaacman confirming in December a launch date of April 2024. On 7 June, Isaacman announced that the launch was scheduled no earlier than 12 July 2024. Three weeks later the Polaris program announced on its X account that the earliest launch date was 31 July 2024.

The mission was delayed again following the failure of a Falcon 9 rocket's upper stage on 12 July 2024. After SpaceX addressed the cause of the mishap, SpaceX's Dragon mission management director Sarah Walker announced in a 26 July news conference that Polaris Dawn would launch "in late summer" after the Crew-9 mission for NASA which, before its delay had been scheduled to launch no earlier than 18 August. SpaceX then said on 7 August that it was targeting a 26 August launch date. SpaceX pushed the launch date back a day to 27 August in order to allow "additional time for teams to complete preflight" checkouts. The flight was further delayed by weather at the landing site and was scheduled for the early morning of September 6, 2024.

A number of design changes were made to Dragon capsule *Resilience* before the launch. Additional nitrogen and oxygen tanks were installed, a hatch with mechanical supports called the "skywalker" replaced the docking port, and the forward hatch was motorized.

Crew Dragon *Resilience* arrived at the horizontal integration facility at LC-39A on 21 August where it was integrated with Falcon 9 booster B1083 and a second stage. The transporter erector rolled out of the horizontal integration facility in the early morning of 24 August to transport the rocket up to the pad and erect it next to the tower. The crews completed a dry dress rehearsal and static fire tests on 25 August. After a series of further delays - mostly related to capsule recovery weather conditions in the landing zones five days following launch - Polaris Dawn was launched on 10 September 2024.

SpaceX designed the EVA suits for this mission based on the intravehicular activity (IVA) suits typically worn during launch and landing. The EVA suits are designed to keep astronauts safe in the vacuum of space while also being comfortable and flexible enough for launch and landing thereby eliminating the need for separate IVA suits. Flame-resistant, stretching fabric and soft joints provide mobility, while boots are made from the same thermal material used on Falcon 9's interstage and Dragon's trunk. Compared to the IVA suits, thermal management has been improved and the helmet has received thermal insulation and an anti-fog treatment. A heads-up display was added to the helmet to provide real-time information on suit metrics during the spacewalk. An umbilical provided life support for these suits, similar to early Gemini suits, as opposed to the self-contained EMUs used on the ISS.

To validate their procedures, SpaceX subjected *Resilience* to multiple cycles of venting and re-pressurization in a large vacuum chamber. The crew also spent two days in a chamber at the Johnson Space Center to validate their pre-breathing protocol and on another occasion also tested their EVA suits in full vacuum in the chamber. The mission also saw the first crewed operational test of Dragon laser interlink communication via Starlink. SpaceX hopes that the technology can decrease communication latency and increase data bandwidth for human spaceflight.

Within an hour after launch the crew began a pre-breathing protocol to reduce nitrogen in their bodies and minimize the risk of decompression sickness during the planned spacewalk on day three. Over three days, the cabin pressure gradually decreased from 14.5 to 8.6 pounds per square inch (100 to 59 kPa) while oxygen levels increased. During this first hour in space, the crew conducted thorough checks of the Dragon capsule for any launch-related damage. Afterward, the Draco thrusters fired, propelling them to their highest apogee of the mission, 1,400 kilometers (870 mi) away from Earth, the highest orbit of the planet ever flown by a crewed spacecraft, breaking the record set by Gemini 11, and the farthest anyone has been from Earth since the 1972 Apollo 17 mission of NASA's Apollo program. Because these earlier missions had all-male crews, Menon and Gillis broke a record, flying further from Earth than any women before them.

On flight day two, the Dragon's apogee was lowered to its "cruising orbit" of 730 kilometers (450 mi) while the crew prepared their EVA suits and conducted experiments. On this day, the crew also contributed to breaking the record for the most people (19) simultaneously in space, set after the Soyuz MS-26 mission launched on 11 September along with the nine crew members of the International Space Station and the three crew members of China's Tiangong space station.

Flight day three was dedicated to the first-ever extravehicular activity (EVA) on a commercial spaceflight mission. After extensive preparations, all four crew members donned their EVA suits, which are pressurized with 100% oxygen at 5.1 pounds per square inch (35 kPa). Since the Crew Dragon lacks an airlock, the entire capsule was depressurized during the EVA, exposing all crew members to the vacuum of space, though only two partially exited the spacecraft. Depressurization of the capsule took about 30 minutes. Isaacman went first, spending seven minutes and 56 seconds outside. Gillis went next, spending seven minutes and 15 seconds outside. From hatch open to hatch close the EVA took about 26

minutes and 40 seconds. During the EVA Isaacman and Gillis performed several tests of their suit mobility including trials of hand/body control, vertical movement, and using a foot restraint, only their lower legs were still inside the spacecraft. Gillis, at 30 years old, became the youngest person to date to participate in a spacewalk.

At the end of the final day in orbit, the crew jettisoned the Dragon's trunk module at 06:35 UTC and carried out a seven minute de-orbit burn at 06:41 UTC. The capsule splashed down in the Gulf of Mexico near Florida's Dry Tortugas islands on 15 September 2024 at 07:36:54 UTC (3:36:54 am EDT, local time at the landing site). The landing site was one of two new options SpaceX added for this mission as it planned for challenging weather conditions.

Continuing with our news updates:

- **13 August 2024**

Sarah Knapton, Science Editor of The Telegraph reports that NASA astronauts stranded on the International Space Station (ISS) after the failure of Boeing's Starliner may be stuck there until 2025, the US space agency has admitted. Commander Barry 'Butch' Wilmore and pilot Sunita 'Suni' Williams arrived at the ISS in June in what was supposed to be an eight-day mission and first human test flight for Starliner. But after problems with the propulsion system and thrusters, the pair were unable to get home and NASA is unsure whether Starliner – which remains attached to the space station – can be fixed.

This week, NASA said it was considering using the upcoming SpaceX Crew-9 mission to bring Mr Wilmore and Ms Williams home. Under the rescue plan, just two astronauts instead of four would travel to the space station in a reconfigured SpaceX Crew Dragon. Mr Wilmore and Ms Williams would then travel back in the spare seats, but the return journey is not scheduled until February 2025, leaving the pair facing another six months in space.

No one is quite sure when Barry Wilmore and Sunita Williams will be able to return to terra firma. The ISS usually holds a long-term crew of seven, but with Mr Wilmore and Ms Williams on board there are currently nine astronauts crammed into the limited facilities. Ken Bowersox, NASA's director of space operations, said: "At some point we need to bring Butch and Suni home. While they're up there we have extra crew, we have extra hands and they can do a lot more work, but they're also using up more consumables, more supplies, so we have to maintain that balance. We are in a situation where we've got multiple options. We don't just have to bring a crew back on Starliner, we could bring them back on another vehicle."

Read on at: Astronauts on eight day mission to space station could be stuck until 2025 (telegraph.co.uk)

- **17 August 2024**

Ruth Hallows writes that UK Space Command has successfully launched its first dedicated Earth-imaging satellite to support military operations from orbit. The satellite, named Tyche, can capture daytime images and videos from the Earth's surface and will strengthen the UK's intelligence, surveillance and reconnaissance (ISR) capabilities. It will also monitor natural disasters and track climate change around the world, the Ministry of Defence said.

Tyche, which is around the size of a washing machine, was launched on Friday, using a rocket owned by SpaceX, the company co-founded by Elon Musk, the technology entrepreneur and billionaire. It was designed and built in the UK through a £22 million contract awarded to Surrey Satellites Technology Limited (SSTL) and is the first satellite to be fully owned by the MoD.

SSTL received the first signals from Tyche a few hours after lift-off confirming a successful launch from Vandenberg space force base, in California, on a SpaceX Falcon 9 rocket as part of the Transporter 11 mission. In a statement, the MoD said the war in Ukraine demonstrated how "crucial" the use of space was to military operations. Over a five-year life span the 150kg satellite will provide imagery to support the UK armed forces. See: WATCH: MoD launches Tyche, UK's first military satellite, on Elon Musk's rocket (telegraph.co.uk)

Credit: SSTL ***Tyke***

- **20 August 2024**

Matthew Field reports that a rocket engine has exploded during a test at Britain's newest spaceport in the Shetland Islands. The rocket body, developed by German start-up Rocket Factory Augsburg (RFA), burst into flames seconds after ignition while on the launch pad on Monday night.

The start-up said the "hot fire" test of the first stage rocket resulted in an "anomaly" and the loss of the spacecraft. "No one was injured in the process," the start-up said. "The launch pad has been saved and is secured." The test was being carried out at Shetland's SaxaVord spaceport, which gained a licence to host rocket missions in December last year. The spaceport said the site had been evacuated prior to the test and no staff had been at risk. It added the rocket base would assist with an investigation into the failure.

A spokesman for SaxaVord said: “This was a test, and test campaigns are designed to identify issues prior to the next stage. We will work with RFA to understand and learn from the causes and support them as they move forward to the next phase of their preparations.” Read on at: Rocket explodes during test at new Shetland spaceport (telegraph.co.uk)

- **24 August 2024**

The Telegraph advises that Elon Musk will help bring two astronauts trapped on the International Space Station (ISS) back to Earth early next year. Commander Barry “Butch” Wilmore and pilot Sunita “Suni” Williams have been left stranded on the ISS because of problems with the Boeing Starliner spacecraft in which they arrived for an eight-day mission in June. NASA said on Saturday that the astronauts are now expected to return in February on a SpaceX Crew Dragon spacecraft. The spacecraft, which is manufactured by SpaceX, Boeing’s rival founded by Mr Musk, is due to launch next month as part of a routine astronaut rotation mission.

Mr Wilmore and Ms Williams, both former military test pilots, became the first crew to ride Starliner on June 5 when they were launched to the ISS. But Starliner’s propulsion system suffered a series of glitches beginning in the first 24 hours of its flight to the ISS, triggering delays lasting until next year. Five of its 28 thrusters failed and several leaks of helium, which is used to pressurise the small rockets, were detected, with NASA deeming the issues too risky to carry its first crew home.

Following NASA’s decision, Boeing’s Starliner chief, Mark Nappi, said in an email to company employees: “I know this is not the decision we had hoped for, but we stand ready to carry out the action’s necessary to support NASA’s decision. “The focus remains first and foremost on ensuring the safety of the crew and spacecraft.” Starliner will undock from the ISS without a crew and attempt to return to Earth as it would have with astronauts aboard.

Starliner will undock from the ISS without a crew | Credit NASA via AP

Tariq Malik writes in SPACE.com that the two Falcon 9 launches — which lifted off from Florida's Cape Canaveral Space Force Station and California's Vandenberg Space Force Base, respectively — delivered a total of 42 Starlink internet satellites into orbit, with each rocket's first stage acing an offshore landing. The successful SpaceX landings followed a failed Falcon 9 rocket landing on August, 28 during a booster's 23rd flight, a record for SpaceX.

A SpaceX Falcon 9 rocket carrying 21 Starlink satellites streaks into space from Florida on Aug. 31, 2024, while another Falcon 9 waits to launch the Polaris Dawn mission. (Image credit: SpaceX)

The space action began in Florida with the stunning predawn launch of SpaceX's Starlink 8-10 mission, which lifted off at 3:43 a.m. EDT (0743 GMT) of a Falcon 9 rocket carrying 21 Starlink satellites, 13 of which are equipped with new "Direct to Cell" capabilities to connect directly with smartphones on Earth. (SpaceX has a deal with T-Mobile to provide direct-to-cell access as it builds a vast mega constellation of Starlink satellites.)

The first-stage booster on the flight completed its 18th launch and landing after flying 13 Starlink missions, a Dragon cargo flight for NASA and three commercial satellite missions. It touched down on the SpaceX drone ship 'Just Read The Instructions' in the Atlantic Ocean.

- **August 2024**

AERO SPACE this month notes that two decades on from SpaceShipOne's historic flight, the space tourism sector remains largely unregulated. Tereza Pultarova argues that the time has come for the sub-orbital industry to outgrow its Wild West years.

- **10 September 2024**

Imane El Atillah reports in Euro News that an aircraft that can carry passengers and payloads out of the Earth's atmosphere and back is set to revolutionise space missions. Radian Aerospace, a US-based company, is preparing to test a scale model of its "spaceplane" this year, which could impact the way space travel is conducted if successful. The company was founded in 2016 with the goal of reviving

the dream of a Single-Stage-To-Orbit (SSTO) spaceplane - a goal that NASA attempted through the Lockheed Martin X-33 programme before ceasing funding in 2001.

The new spaceplane, called Radian One, is set to be fully reusable and is designed to replace traditional vertical launches with a rocket-powered sled system. "We believe that widespread access to space means limitless opportunities for humankind," Richard Humphrey, CEO and co-founder of Radian Aerospace, said in a statement. "Over time, we intend to make space travel nearly as simple and convenient as airliner travel. We are not focused on tourism, we are dedicated to missions that make life better on our own planet, like research, in-space manufacturing, and terrestrial observation, as well as critical new missions like rapid global delivery right here on Earth". Read on at: The reusable 'spaceplane' that could replace rockets and fly humans to space and back (msn.com)

Radian One | Credit: Radian Aerospace

- **8 October 2024**

Marcia Dunn writes in The Independent that a spacecraft blasted off on Monday to investigate the scene of a cosmic crash. The European Space Agency's Hera spacecraft rocketed away on a two-year journey to the small, harmless asteroid rammed by NASA two years ago in a dress rehearsal for the day a killer space rock threatens Earth. Launched by SpaceX from Cape Canaveral, it's the second part of a planetary defense test that could one day help save the planet.

The 2022 crash by NASA's Dart spacecraft shortened Dimorphos' orbit around its bigger companion, demonstrating that if a dangerous rock was headed our way, there's a chance it could be knocked off course with enough advance notice. Scientists are eager to examine the impact's aftermath up close to know exactly how effective Dart was and what changes might be needed to safeguard Earth in the future.

"The more detail we can glean the better as it may be important for planning a future deflection mission should one be needed," University of Maryland astronomer Derek Richardson said before launch.

Read on at: A spacecraft is on its way to a harmless asteroid slammed by NASA in a previous save-the-Earth test | The Independent

- **13 October 2024**

Joe Pinkstone reports that Elon Musk's SpaceX successfully caught a booster from its Starship rocket for the first time in a lift to humanity's hopes of travelling to Mars. The first-stage booster returned to the launch pad after the fifth test flight of the marquee rocket on Sunday.

The "super heavy booster" contains fuel to propel the 3,000-tonne rocket off the launchpad. After being emptied and detaching from the main body of the Starship rocket, the booster flew itself back to the launchpad where it was plucked out of the air by a set of giant mechanical fingers.

Thrusters within the booster ensured the 233 ft tall tank approached the launch apparatus slowly and vertically so the "Mechazilla" pincers or "chopsticks" could grab it safely. "This is a day for the engineering history books," a SpaceX spokesman said in a livestream of the procedure.

Starship is seen by many as the best option for interplanetary travel between Earth and Mars and being able to reuse components, such as the boosters, is essential for this to occur. "The tower has caught the rocket!!" Musk posted on X following the launch. "If civilization is reasonably stable for the next ~30 years, a self-sustaining city of a million+ people will be built on Mars."

The large mechanical arms have generated considerable excitement among space enthusiasts. Eric Gay/AP

Lift-off occurred at 7:25am (13:25 BST) in clear weather. The launch saw the main body of the Starship go into space and complete a successful splashdown in the Indian Ocean an hour after launch. SpaceX achieved its first successful splashdown with Starship during its last flight in June.

NASA is also keenly awaiting a modified version of Starship to act as a lander vehicle for crewed flights to the Moon under the Artemis program later this decade.

SpaceX said its engineers have "spent years preparing and months testing for the booster catch attempt, with technicians pouring tens of thousands of hours into building the infrastructure to maximise our chances for success." Teams were monitoring to ensure "thousands" of criteria were met both on the vehicle and at the tower before any attempt to return the Super Heavy booster.

Had the conditions not been satisfied, the booster would have been redirected for a splashdown in the Gulf of Mexico, as in previous tests. Instead, having been given the green light, the returning booster decelerated from supersonic speeds and the powerful "chopstick arms" embraced it. The Super Heavy booster produces 16.6m pounds (74.3 meganewtons) of thrust, about twice as powerful as the Saturn V rockets used during the Apollo missions.

SpaceX's "fail fast, learn fast" strategy of rapid iterative testing, even when its rockets blow up spectacularly, has ultimately accelerated development and contributed to the company's success. Founded only in 2002, it quickly leapfrogged aerospace industry giants and is now the world leader in orbital launches, besides providing the only US spaceship currently certified to carry astronauts. It has also created the world's biggest internet satellite constellation – invaluable in disaster and war zones.

- **25 October 2024**

Marcia Dunn reports that four astronauts returned to Earth on Friday after a nearly eight-month space station stay extended by Boeing's capsule trouble and Hurricane Milton. A SpaceX capsule carrying the crew parachuted before dawn into the Gulf of Mexico just off the Florida coast after undocking from the International Space Station mid-week.

The three Americans and one Russian should have been back two months ago. But their homecoming was stalled by problems with Boeing's new Starliner astronaut capsule, which came back empty in September because of safety concerns. Then Hurricane Milton interfered, followed by another two weeks of high wind and rough seas.

SpaceX launched the four — NASA's Matthew Dominick, Michael Barratt and Jeanette Epps, and Russia's Alexander Grebenkin — in March. Barratt, the only space veteran going into the mission, acknowledged the support teams back home had "to replan, retool and kind of redo everything right along with us ... and helped us to roll with all those punches." Their replacements are the two Starliner test pilots Butch Wilmore and Suni Williams, whose own mission went from eight days to eight months, and two astronauts launched by SpaceX four weeks ago. Those four will remain up there until February.

- **October 2024**

'A new dawn in space' is the heading of Kate Arkless-Gray's report in the October edition of AERO SPACE where she discusses the "giant leap for commercial spaceflight" when the crew of the Polaris Dawn mission conducted the world's first 'spacewalk' in September 2024.

UK DEFENCE

Source: Shutterstock ***An RAF Typhoon in National Colours***

We commence this section with an article published by the Royal United Services Institute concerning the Strategic Defence Review instigated by the new Labour Government under the heading: The New Approach to the UK Strategic Defence Review: Tests for Success | Royal United Services Institute

"The Strategic Defence Review now underway has been described as a 'root and branch review' of the whole UK defence enterprise, pointing the way to 'a new era for defence'. Can the different approach being taken this time around produce significantly better results than other recent reviews?

The announcement shortly after the general election that the government's Strategic Defence Review (SDR) would be conducted by three independent figures came as a surprise to the Ministry of Defence (MoD) and the wider UK national security community. Traditionally, UK defence and security reviews have been led by officials. Apparently taking their cue from the way Australia's Defence Strategic Review of 2023 was conducted, the prime minister and the new defence secretary, John Healey, appointed Lord Robertson, a former defence secretary and NATO Secretary General, to lead the review. He is being supported by retired General Sir Richard Barrons and Fiona Hill, a British-born Russia expert who worked for many years inside the US national security system. Six additional senior-level experts were recently added to the review team. They are being supported by an internal MoD secretariat team.

The terms of reference say that the SDR will 'determine the roles, capabilities and reforms required by UK Defence to meet the challenges, threats and opportunities of the twenty-first century, deliverable and affordable within the resources available to Defence within the trajectory [to spending] 2.5% [of GDP on Defence]'. The scope is customarily expansive. The terms of reference also set out some clear parameters: commitment to the independent UK nuclear deterrent; a 'NATO first' approach; reinforcing homeland security; continuing support for Ukraine; maintaining defence ties with the Indo-Pacific region, the Gulf and the Middle East; and delivering AUKUS.

Inputs to the review have been sought from within Defence, other government departments, industry, allies and partners, academia and members of the public. These will feed into a process intended to deliver a final report to the defence secretary in early 2025. It is yet to be announced how this will be translated into government policy, including its treatment in the second phase of the Spending Review, which is due to completed by the Spring Budget – although at the outset the government said the review would be complete by next summer.

In 2020 we developed five tests against which the claim that the Integrated Review would be the deepest and most radical review of UK foreign, defence and security policy since the end of the Cold War, could be assessed. They can equally be applied to this SDR.

1. Accuracy & Quality

The first of these tests relates to the accuracy of assessments about changing risks to the UK and international security and stability, and the quality of the headline policy responses. The scale and immediacy of both threats and risks to UK national security continues to grow. The SDR will need to consider both the pressing threats to European security and longer-term challenges, particularly from China. It will also need to factor in conflict and instability in the Middle East and the potential for escalation into a major war, and contingencies with respect to Taiwan and the Korean peninsula. The growing risk of hybrid attacks, challenges in the new domains of space and cyberspace, and the potential recurrence of international terrorism will also have to be on the menu.

All the post-Cold War reviews have tended to focus on the threats and risks that were more immediately present and occupying the time and energy of the government of the day, devising headline policy responses that seemed appropriate at the time. Events sometimes then required these responses to be re-thought quite quickly. The need to 'refresh' the Integrated Review and Defence Command Paper within two years of their publication, after Russia's full-scale invasion of Ukraine, is the most recent case in point. Briefings associated with the SDR suggest that it will focus on China as the 'pacing threat' to plan against (borrowing US language).

Planning against an apparently longer-term threat rather than more immediate ones would mark a significant departure in approach, so it will be interesting to see how the review gives substance to this notion. The UK and other Western governments have so far struggled to strike the right balance between cooperation, competition and confrontation with China – and the policy and resource implications of potentially correcting this go way beyond Defence. A clear and convincing case will need to be made to the public to explain the rationale for doing so and the impact on steps needed to counter more immediate threats from Russia.

The Strategic Defence Review will need to consider both the pressing threats to European security and longer-term challenges, particularly from China

Two major policy choices will flow from decisions about which threats to focus planning against. The first is the balance between the Euro-Atlantic and Indo-Pacific regions. With its 'NATO first' mantra, the government may appear to have settled the matter. But a China focus would imply that the UK will expect to share some of the burden in the Indo-Pacific, particularly if it wants the US to continue to invest in the security of the Euro-Atlantic area. The SDR will need to find a way of squaring this circle. We expand on the second major policy choice – striking the right balance between meeting short-term and longer-term risks – in the section below on force structure and capabilities.

2. Defence Planning Responses

Our second test relates to the success of the defence planning responses that lie below these headline policy choices, and their impact on activities, posture and capability/force structure planning. In 2020 we picked out 'jointery', international coordination and a 'comprehensive approach' as the three most important themes in post-Cold War defence planning.

The Review Team posits a transition to an 'Integrated Force'. As a concept, this is a natural development of 'multi-domain integration' as outlined in the 2021 Defence Command Paper. But it is not clear what it means – and how, in practical terms, it will differ from what exists now. Presumably this will emerge from the Review itself. Otherwise, we should expect an acceleration of the technology-led modernisation that has been a goal of all the UK's recent reviews. This approach will presumably be based on an updated operational concept for how the UK Armed Forces will expect to fight in the future. General Barrons has spoken and written extensively on this topic. It remains to be seen whether the Integrated Force design that results from the SDR can be implemented more successfully than the model (in reality, little more than a one-page diagram) proposed in the 2021 document.

The Reviewers have invited views on how UK defence can build relationships with allies, partners and international groupings as a strategic strength for the UK. The SDR will need to make practical proposals for how a 'NATO first' approach will be enacted. The change of government also represents an opportunity to reset the UK's defence relationship with the EU. AUKUS Pillar 1 is well defined, but Pillar 2 is not; the SDR represents a good opportunity to ameliorate this.

Successive reviews have provided exhaustive lists of bilateral defence relationships. The outcome of the US presidential election will influence how the UK–US defence relationship develops – and, potentially, even the future of NATO. It is already clear that the UK will wish to further strengthen defence relations with France and Germany. The SDR could choose a relatively small number of other bilateral relationships and invest in them heavily in ways that would really move the dial, while still maintaining others.

We understand that the government chose to conduct a defence-focused review because of the scale of the steps it believes will be required to transform the MoD and the Armed Forces. The outcome of the SDR will need to be integrated with the range of other reviews already underway, including those on national resilience and the global impact of the Foreign, Commonwealth and Development Office.

3. Capabilities and Force Structure

Our third test relates to choices on capabilities and force structure. The rhetoric about transformation that accompanied the launch of the review implies some significant shaking up of defence capabilities and force structure. That begs the question of how much scope there is to make substantial changes in a meaningful timeframe. The long-term nature of defence procurement means that most of the capabilities that will be on the front line a decade from now are either already in service or on contract. The previous government emphasised the need to innovate and invest in the latest military capabilities, including 'AI, robotics and cyber … laser weapons and autonomous drones'. It is hard to fault this general approach to making the most of the platforms that already exist, drawing on lessons from the war in Ukraine. But there are two big, related questions that the SDR will need to address: timeframe and spectrum of capability versus role specialisation.

By timeframe we mean the period over which improvements to force structure and capabilities would be put in place. Most post-Cold War defence reviews have had the luxury of being able to look ahead over several decades and plan for a future force that would take 10 years to create. Today's dangerous world calls for greater urgency. This does not mean abandoning all lengthy procurement programmes. Some capabilities, such as nuclear-powered submarines, are critically important but take a long time to build.

But, in our view, it does involve giving greater priority to preparing for (and hopefully thereby deterring) nearer-term threats by replenishing stockpiles and enhancing readiness, including through the rapid addition of affordable combat capabilities to regenerate the 'mass' that is missing from the UK's force structure and to plug some key gaps, including in air and missile defence. Finding cost-effective solutions, given the widespread availability of inexpensive drones, presents a stiff challenge. And all of this needs to be done without discarding the seed-corn for capabilities that might be needed for the likely continuing confrontation with Russia and prospective longer-term challenges from China. Space seems a strong candidate for modest additional expenditure in the SDR. All of this will have major implications for the overhaul of the defence industrial base.

Spectrum of capability is related to the timeframe question. In past reviews it was possible to retain a broad (but thin) spectrum of capability and force structure over the long-term by taking calculated risks with so-called 'capability holidays'. That was on the basis that, with sufficient warning time, it would be possible to regenerate and reconstitute the forces needed. Governments do not enjoy this luxury today. This may mean the MoD will have to be more selective in its choice of new capabilities to develop and existing ones to retain. For example, an unsentimental examination of the role and vulnerability of aircraft carriers will be required. There will also presumably be some consideration of the timelines and scope of the Global Combat Air Programme, given that Typhoon should serve well for another 20 years (provided it is fitted with the latest weapons and sensors). Lessons from the Ukraine and Middle East conflicts will inform judgements on future land platforms and wider capabilities.

A narrower spectrum of capability would not necessarily lead to role specialisation. It would still be possible to field a 'whole force' constituted of a smaller number of different capabilities. But it at least raises the question of whether the loss of sovereignty involved in greater reliance on shared NATO capabilities and greater role specialisation by the UK and its European allies would be worth accepting if it led to less duplication of industrial effort and a bigger bang for buck overall.

4. Balancing Policy, Plans, Commitments and the Defence Budget

It is a cliché to say that defence reviews should be policy-led, not financially driven. But all governments have to strike a balance between policy requirements and fiscal responsibility. Before 2015, the conclusion to defence reviews was marked by an argument with the Treasury about how much money would be made available to fund policy commitments. Since 2015, governments have announced the size of the budgetary envelope ahead of defence and security reviews. Neither approach has resulted in a sustained balance between programme and budget. Our fourth test is whether the SDR will be able to achieve such an outcome.

One approach would be to provide the MoD with a long-term commitment to a given level of expenditure growth, against which the Department could plan more effectively. Shortly before calling the general election, the previous government committed to raising the defence budget to 2.5% of

GDP by 2030. The current government has committed to 2.5% but has yet to set out publicly a timeline or any profile for the increase.

Whether an increase to 2.5% would be enough to meet the growing threats to UK security and the ambitions that have been stated for the SDR seems doubtful. To illustrate the point, an increase from the current level of 2.32% by 2030 would generate some £6 billion a year in today's money. That would represent an increase of circa 10% in the size of the defence budget. But not all of this will be available for the technology-led modernisation described above: nuclear and submarine spending, which now accounts for almost 40% of planned equipment spending, is expected to rise further in the years ahead, limiting the resource available for other areas.

The rhetoric about transformation that accompanied the launch of the review implies some significant shaking up of defence capabilities and force structure. Malcolm Chalmers set out the short-term pressures on the defence budget in his recent commentary (including pay increases and the nuclear enterprise), and noted that further cuts might be required imminently. Removing further capabilities from service now would be very hard to square with the ambitious goals of the SDR. Looking ahead, the reviewers will need to resist optimism that significant financial 'efficiencies' can be created and that new capabilities can be developed and fielded at bargain basement prices to square this circle at the end of the review. Like all defence reviews, the SDR will need to offer clear recommendations on priorities. Decisions on these recommendations will be for the government to make in the first part of 2025.

5. Organisation

The 1998 SDR was unusual among the canon of post-Cold War reviews in paying considerable attention to organisation, the fifth and final of our tests. A series of major and generally positive organisational changes resulted. In the authors' view, these reforms were subsequently partially undermined by the 'Levene' model introduced in 2012, which disaggregated capability-planning and associated budgeting decisions to the single Services. There has been a steady erosion of the joint approach, and the strategic prioritisation necessary in this new era has been largely absent.

As shadow defence secretary, John Healey set out his views on this issue in a Policy Exchange speech in late February, advocating the need for clearer strategic authority over the capability the Armed Forces have and how it is procured. His answer was a 'stronger defence centre' including: a 'full-functioning Military-Strategic Headquarters within the MoD'; greater authority for the Chief of Defence Staff over the single Service Chiefs of Staff; 'more policy muscle' for the MoD civil service; and the appointment of a 'fully-fledged National Armaments Director'.

While the speech promised to implement these changes immediately rather than wait for the outcome of the SDR, in practice they are taking time to plan and enact. We have previously counselled against rushing major organisational redesign. In this case, the SDR will need to view the question of organisation in the context of the other issues it is addressing – including the 'Integrated Force' concept, the digital enablement of that Force, and the right balance of regular, reserve, civil servant and industry personnel across defence. But some adjustments to the new defence operating model – such as to the arrangements for capability planning – will need to be in place by the time the SDR concludes in order to enact the transformative changes that it promises.

Prospects

This survey of just some of the major issues the SDR will need to tackle highlights the challenge involved in conducting a genuinely transformative review, securing the financial resources to pay for it and then quickly implementing its key conclusions and recommendations. As the Australian government has found, appointing independent reviewers to conduct defence reviews is not a silver bullet. Aligning defence policy, plans, commitments and resources at the conclusion of reviews is hard enough. Keeping them in balance is harder still. We hope that this framework helps to provide benchmarks against which the review can be assessed as it progresses and once it is published."

We turn now to individual news items:

- **6 August 2024**

Matt Oliver and James Titcomb advise that sensitive British military projects face disruption from the threatened closure of one of the Country's last remaining microchip factories. Coherent, a US semiconductor company, has ceased taking orders at its facility in County Durham and said the 310,000 sq. ft site may have to be sold after Apple dropped the business as a supplier.

It can now be revealed that the factory's customers also include Leonardo, the Italian defence giant that makes radar systems, electronic warfare devices and helicopters in the UK. It is understood the plant has previously supplied chips used for radar power amplifiers in Typhoon jets and other British military platforms. Coherent is not thought to have any outstanding orders with Leonardo, but sources suggested the plant may still be needed for future, unspecified programmes. This is because the site, which specialises in photonics, is understood to be one of just two in the country that are currently geared for commercial processing of gallium arsenide semiconductors.

The factory's closure threatens to reduce the UK's domestic capabilities and potentially force Leonardo to source the chips from elsewhere. It would represent a blow to the UK at a time when the Government is seeking to build up the domestic industry for making semiconductors, a key technology underpinning everything from smartphones to complex computer systems and high-precision missiles. Read on at: British defence projects at risk as one of last microchip factories ceases taking orders

- **8 August 2024**

The Transport Correspondent of The Telegraph, Gareth Corfield, reports that a radar station for tracking satellites in space is to be built in Wales as the Royal Air Force gears up to tackle "reckless" space threats from the likes of China and Russia. Cawdor Barracks in Pembrokeshire, formerly known as RAF Brawdy, will be the site of the UK's newest long range satellite-tracking radar station. Known as the Deep Space Advanced Radar Capability (Darc), the station is intended to help protect essential satellite communication and navigation networks.

John Healey, Defence Secretary, said: "This new radar programme will not only enhance our awareness of deep space, but also help protect our space assets alongside our closest partners. Space plays a crucial role in our daily lives – used by everything from our mobile phones to banking services. It is also used by UK Defence to conduct vital tasks such as supporting military operations, navigating forces and gathering intelligence."

Three years ago when plans to build Darc were first announced, the then-head of the RAF said the radar station was a national priority. Air Chief Marshal Sir Mike Wigston warned of "irresponsible and reckless testing by Russia and China" of anti-satellite weapons while speaking to The Telegraph at the US Space and Missile Systems Center, in Los Angeles.

Building the radar station at Brawdy will keep the site open beyond its currently-planned closure date of 2028, the Ministry of Defence said. Cawdor Barracks is home to the Army's secretive 14 Signal Regiment, an electronic warfare unit. Darc is a multi-national project with its origins in the AUKUS defence pact between the UK, US and Australia. Continue at: RAF to build satellite station to track 'reckless' China and Russia in space

- **13 August 2024**

Ben Riley-Smith advises that Ministers have been accused of "cutting" the RAF's next generation fighter programme by 10 per cent this year as Rachel Reeves seeks budget savings. The Ministry of Defence has confirmed £160 million less than expected will be spent on the Tempest project amid wider fears about its future. It comes after Labour was accused of downgrading its pre-election commitment to increase military spending to 2.5 per cent of GDP "as soon as possible". James Cartlidge, the shadow defence secretary, said the move amounted to a "cut" to the project that "sends entirely the wrong message to our adversaries". An MoD spokesman said suggestions the programme had been cut were "false" and that the underspend had been agreed with the defence industry.

In a written parliamentary answer Luke Pollard, the Armed Forces minister, admitted that the actual level of funding has been reduced to £1.3 billion. Responding to James Cartlidge, the shadow defence secretary, he wrote: "At the start of this financial year, it was expected that the Ministry of Defence would spend up to £1.46 billion. "The forecast was reduced to £1.3 billion due to revised estimates of programme activity from industry throughout the year."

Sources told The Telegraph the reduction was a result of ministers failing to sign off on the full £1.46 billion budget, rather than industry underspend. But the MoD disputed that claim and said such a one-year underspend, which does not affect the project's overall long-term budget, was common for a project of this size. Read further at: Labour cuts £160m from next-generation fighter jet programme this year amid concerns over future

- **August 2024**

Under 'Blueprint' in the August edition of AERO SPACE the RAeS 'unveils the new concept' for the tri-national Global Combat Air Programme future fighter by the UK, Italy and Japan as featured at the Farnborough Air Show in July. Also this month Dr Sophy Antrobus argues that an Israeli-style Iron Dome is not the right answer to an integrated air and missile defence for the UK.

- **11 September 2024**

Danielle Sheridan writes that the Royal Navy is considering nuclear-powered surface ships that could stay at sea for years. As part of what is understood to be a "long-term" plan, the Navy has asked the defence industry to explore nuclear power in its surface ships. In the UK, nuclear propulsion is only used on submarines, however the Ministry of Defence (MoD) has issued a Request for Information (RFI) for updates on the use of Generation IV, an advanced nuclear technology. The request will look

at how Generation IV nuclear technologies, including larger nuclear reactors and micro-modular reactors, could power surface fleets.

The US has a number of nuclear-powered aircraft carriers, including Nimitz and Gerald R. Ford-class ships. France's Charles de Gaulle carrier is also nuclear-powered. At a cost of $13 billion (£10 billion), the nuclear-powered USS Gerald R. Ford was commissioned in 2017 and is the US navy's newest and costliest warship.

Tom Sharpe, a former Navy commander, described the RFI as "prudent planning" by the MoD, although cautioned the costs behind such a development. "It isn't about building a fleet of nuclear-powered cruisers any time soon," he said. "That there is someone in a corner of the Naval Headquarters looking this far ahead, and not getting consumed by the day-to-day running of the fleet, is good news." Nuclear power is all about cost vs gains. In submarines, the gains are massive, which is why many are powered that way. In surface ships the operational gain is much less and so cost comes in earlier." Read on at: Royal Navy considers nuclear-powered surface warships

- **16 September 2024**

Christopher Jasper reports that Airbus is preparing to revive plans for a new helicopter factory in the UK as part of its attempt to secure a £1bn contract from the Ministry of Defence (MoD). The manufacturing giant has indicated it could proceed with the plant after reversing its decision to pull out of the bidding to replace the RAF's Puma helicopter fleet last month.

At the time of its withdrawal, Airbus said the terms of the MoD's tender weren't sufficiently attractive for it to proceed. However, Bruno Even, Airbus Helicopters' boss, has unveiled a sweetened proposal which he hopes will satisfy obstacles relating to the Government's defence spending review. As part of its new approach, Airbus will resurrect plans to build a new factory in Broughton, Flintshire, creating hundreds of jobs in the process.

It is at this plant that Airbus, if successful in the tender, would build a fleet of H175M helicopters. To reduce costs, it would also keep the RAF's existing Puma fleet flying for several years longer through its maintenance programme. The company hopes this will deliver enough savings to convince the Government to award Airbus the £1bn contract as the MoD seeks to cut costs as part of its ongoing spending review. See: Airbus revives plans for UK helicopter factory

- **3 October 2024**

Nick Gutteridge advises that Nigel Farage has claimed that "our American allies will be furious and Beijing delighted" after Sir Keir Starmer gave up the Chagos Islands. The Reform UK leader said the decision to hand over the archipelago to Mauritius was a "strategic disaster" and that "Labour are making the world a more dangerous place". His remarks came after the decision to end 200 years of British rule in the Indian Ocean Territory was announced at 11.04am with the ping of an email alert.

In a humdrum press release titled "UK-Mauritius deal to protect national security", the Foreign Office revealed that the UK was giving away the strategic archipelago. With Parliament still in its post-conference slumber, the timing meant that David Lammy avoided having to unveil the move in the Commons cauldron. The announcement was seemingly rushed out to get ahead of the Mauritian election campaign, which starts on Friday. As such it came as a shock to much of the outside world,

which had not been expecting the new Labour government to wrap up a deal so quickly. It was, after all, only nine months since Lord Cameron, the former foreign secretary, had halted talks on the handover amid security concerns over Chinese influence.

Chagos, at a strategic waypoint in the Indian Ocean, is home to the Diego Garcia air base, which is a major military asset for both Britain and the US in the region. The archipelago has been in British hands for more than 200 years but is claimed by Mauritius, an island nation which lies almost 1,400 miles away. Under the Tories those claims were initially entertained, but then rejected over concerns about the influence China wields on the Mauritian government. Read further at: 'America will be furious and Beijing delighted': How Starmer handed Chagos to China

➢ 4 October 2024

Naval News reports that HMS Agamemnon, the penultimate Astute-class submarine built for the UK's Silent Service, has been formally launched at BAE Systems' facility in Barrow, following a delicate operation to move the 7,400-tonne boat from the construction hall into the neighbouring basin. Nicknamed 'Awesome Aggie', the sixth of seven Astute-class submarines built for the Royal Navy over the past quarter of a century, takes her name from the legendary Greek king who besieged Troy.

Source: Royal Navy News

When she joins the Fleet, Agamemnon will serve at the leading edge of submarine operations into the second half of the 21st Century, shielding the UK's nuclear deterrent and aircraft carrier task groups from hostile threats, gathering intelligence, launching Royal Marine raids and, where necessary, striking at the UK's enemies on land with pinpoint accuracy through her Tomahawk cruise missiles. See: Royal Navy launches the 6th Astute-class SSN, HMS Agamemnon - Naval News

➢ 10 October 2024

Danielle Sheridan advises that ChatGPT-style software is to be used to speed up the Government's review of the military, amid fears that the system could be attacked by adversaries. The Strategic Defence Review announced by Sir Keir Starmer will focus on the changing nature of conflict. As part of it, serving military, veterans, MPs, industry, academia and the wider public were invited by the Ministry of Defence to give submissions on how the Armed Forces are best placed to meet the changing nature of conflict. However, because of the sheer number of responses – thought to be in the hundreds – AI will be enlisted to wade through them.

Prof. Mariarosaria Taddeo, an Oxford University academic specialising in the ethics of defence technologies, told Politico: "Even if the AI is internal to an organisation, are we basically creating a huge Trojan horse? AI is really fragile – it can be attacked."

The Telegraph understands that the Government considers such an attack to be a low-level threat because the software will be stored on an MoD system, which is monitored. A defence source familiar with the plans said the "sophisticated language model" will be able to answer substantial questions by the user and use the submitted evidence to formulate its response. The source said, fundamentally it is a summarising tool. It is not producing data for a decision, it's providing millions of words and summarising them."

As part of the Strategic Defence Review, participants were invited to respond to 24 questions on topics ranging from the future of defence to the culture of the services and how best to support Nato. The responses, which were between 2,000 to 4,000 words per question for those directly involved in defence, and 500 words per question for the public, will be inputted into the AI system so that they can be discussed over the next two months.

The software – purpose-built by Palantir, the US data giant that secured a contract with the defence business Babcock to help build the Royal Navy's new fleet of warships – will crunch the responses into a more digestible format. The software marks the first time the Government has used AI to assist with a significant review. It is understood that the MoD believes AI technologies will transform every aspect of defence so that large datasets can be navigated more easily.

➢ 9 October 2024

The UK Defence Journal reports that Babcock has officially commenced construction on HMS Formidable, the third of five Type 31 Inspiration Class frigates being built for the Royal Navy. The steel-cutting ceremony, held at Babcock's Rosyth facility in Scotland, marks the start of the ship's build programme.

The progress on the Type 31 programme has been notable, with this milestone arriving just 20 months after steel was cut for the second vessel, HMS Active. Babcock's efforts underscore the swift pace at which the new class of frigates is taking shape, reinforcing the UK's sovereign defence capabilities. The company's Rosyth facility is also home to the nearly complete HMS Venturer, the first ship in the class, which now sits alongside HMS Active in the assembly hall.

The event gathered Babcock employees, including apprentices and recent graduates, as well as senior representatives from the UK Government and Royal Navy. Among the attendees were union leaders

and guests from international industry partners, reflecting the broad support and collaboration behind the project.

David Lockwood, Babcock's Chief Executive Officer, highlighted the significance of the milestone, stating: "Today, we are proud to mark yet another milestone in this important defence programme for the Royal Navy. These frigates will play a significant role in protecting the UK and supporting international partnered defence operations. This programme is a real demonstration of UK sovereign shipbuilding capability and is delivering positive economic impact within Scotland and in communities across the UK. It is a privilege for our teams across Babcock to be delivering these platforms for the nation."

In line with its growth strategy, Babcock is set to create 1,000 new roles at Rosyth over the next four years, including 400 apprenticeships and 350 production support positions. Many of these roles will directly support the Type 31 programme, contributing to the local economy and fostering new skills within the UK workforce. Read further at: Steel cut on new Type 31 Frigate HMS Formidable at Rosyth

Source: Babcock International ***RN Type 31 Frigates***

- **22 October 2024**

Max Channon writes that at least ten warships are currently at sea around the UK as Britain's armed forces gear up a significant global deployment - and NATO allies ramp up their presence as tensions with Russia continue to escalate. The UK's Royal Navy Carrier Strike Group is undertaking critical preparations, and one elite unit has been in action for the first time since the Falklands conflict.
A second carrier strike group is also going through British waters as NATO partners confirm their combat readiness. It comes as a third aircraft carrier returns to sea after completing major repair work. Royal Navy aircraft carrier HMS Prince of Wales has been off the coast of Scotland in the North Sea, at the heart of the Carrier Strike Group, for Exercise Strike Warrior.

The exercise is a military drill to confirm that the task force is ready for operations. Meanwhile, her sister ship, HMS Queen Elizabeth, left HMNB Portsmouth yesterday afternoon for routine sea trials and training.

The other huge aircraft carrier off Britain's coast is the USS Harry S. Truman. Its Carrier Strike Group recently made its way through the Strait of Dover into the North Sea to participate in exercises with NATO Allies and regional partners. The USS Harry S. Truman is accompanied by the Arleigh Burke-class guided-missile destroyers USS Jason Dunham (DDG 109) and USS Stout (DDG 55) and the guided-missile cruiser USS Gettysburg (CG 64).

Admiral Daryl Caudle, commander of the US Fleet Forces Command, said, "The Truman Carrier Strike Group will contribute to the ongoing training and combat readiness of our naval forces. The operational experience gained through these deployments is invaluable for maintaining a deep bench of skilled war fighters with trust and confidence in their systems' reliability, adaptability, and lethality in a rapidly changing security environment." For further details see: Royal Navy battle ready as UK and US assemble huge carrier strike groups in NATO waters

- **24 October 2024**

Danielle Sheridan writes that "Conservative Party leadership hopeful [Robert Jenrick] says the 'age of freeloading has come to an end' as he calls for extra spending to deter Russia". He goes on to say that all NATO countries should spend 3 per cent of their gross domestic product (GDP) on defence. The Conservative Party leadership hopeful warned that with a war between China and Taiwan on the horizon – and continued Russian "belligerence" in Ukraine – all members of the alliance should be investing more in defence.

Speaking to The Telegraph, Mr Jenrick said: "Peace comes through strength. To deter a Russian invasion of NATO we must spend 3 per cent of GDP on defence and make that the new NATO standard for all member states. "We must prepare for an American pivot to the Indo-Pacific to contain China, which means the UK and Europe stepping up to defend against Russian belligerence. The age of freeloading has come to an end."

The former immigration minister made the comments ahead of 2 November when the results of the Tory leadership election will be announced. His call for an increase in defence spending follows similar comments made by James Cleverly, who was knocked out of the leadership contest earlier this month. Mr Cleverly said he wanted more spent on the military because "the defence of our nation is the first duty of Government". Read on at: All Nato countries should spend 3pc of GDP on defence, Tory leadership candidate Robert Jenrick says

- **October 2024**

Under the heading 'May the holes in your Swiss cheese never line up, in AERO SPACE this month Air Marshal Sean Reynolds discusses the risk mitigation lessons associated with an RAF C-17 team's successful emergency mission to evacuate almost 200 people from South Sudan. And Tim Robinson reports from the RAF Chief of the Air Staff's Global Air and Space Chiefs' conference last July under the heading of 'Can Air Power deter the next war?'

CYBER

Credit: Sanjeev cybercafé

According to Cyber-crime and harm - POST an horizon scan consultation of researchers revealed significant concern about the expanding landscape of cyber-crime and its harm, including:

- Entities gaining unauthorised access to digital devices or networks, for example to commit fraud or collect and leverage confidential data to extort money. Entities include individuals, organised criminal groups, states and state-aligned groups.
- Online bullying.
- Assault.
- Cyber-stalking.
- Coercive control.
- The spread of mis and disinformation.
- Radicalisation.

In April 2024, a Cyber Security Breaches Survey by the Home Office and Department for Science, Innovation and Technology of 2000 businesses and 1004 charities found half of the businesses and a third of the charities experienced cyber-crime in the last 12 months. This was despite organisations increasingly adopting protections against the most common cyber-attacks.

Motivations for cyber-crime can include financial gain, to gather confidential information, or to influence political discourses. The UK Government has identified China and Russia as the greatest state-based cyber threats, with Iran and North Korea also possessing cyber capabilities.

Various technologies relate to cyber-crime and harm

Cryptocurrencies are a digital means of financial exchange not overseen by a central authority.

- Cryptocurrencies are increasingly used by criminals for money laundering, investment fraud and in the online trade of illicit goods. Consumer exchanges can be hacked and there are many cryptocurrency scams, such as fraudsters encouraging consumers to invest in non-existent new coins.

- The metaverse is a range of technologies that allow users to interact in believable virtual worlds and each other. Cyber security risks include identity fraud, virtual assaults, online child sexual exploitation and abuse, the recruitment and training of people to extremist organisations and manipulation from users' personal and biometric data being collected.

- Attackers can use generative AI to generate realistic images and videos, known as 'deepfakes' and realistic texts and responses to victims quickly and to manipulate them into providing access to systems or information for online fraud.

- Social media is increasingly being used by state actors and other organised groups to gather sensitive political and military information, spread fake online information and radicalisation which presents a profound challenge for democratic institutions.

Experts in the horizon scanning consultation highlighted how technical and legislative solutions could address the challenges raised by criminality in an increasingly online world. Typical challenges and opportunities are:

- Unauthorized access to digital devices and networks could breach sensitive datastores, threaten personal privacy and put individuals at risk from physical harm such as stalking.

- In June 2024, 300 million pieces of blood test patient data were exposed from two NHS Trusts. This was attributed to hacker-group Qilin, thought to be located in Russia. It is not known how much money the hackers demanded from NHS provider Synnovis or if the company entered negotiations for individuals and society.

- Analysts at the Internet Watch Foundation are particularly concerned about a rise in AI generated child sexual abuse material for sale on the dark web. This poses the risk of re-victimisation of known victims where perpetrators use AI to manipulate existing child sexual abuse material into media featuring famous children and those already known to abusers. Cryptocurrencies are also particularly prevalent in the trade of child sex abuse material.

- There have been numerous incidents of deepfake pornographic content of individuals, predominantly women, being shared online, leading to harassment, humiliation and distress for individuals. Sharing of non-consensual pornographic deepfakes has been criminalised by the Online Safety Act 2023 along with various other online harms.

- Further legislation that makes it an offence to create sexually explicit deepfake images was planned through an amendment to the Criminal Justice Bill but was halted at report stage in the House of Commons due to parliamentary prorogation in May 2024.

- Some reports have found that users, including children, have experienced intense trauma or distress following virtual assaults in the metaverse. UK laws, such as on sexual assault, may cover some but not all legal issues experienced in the metaverse and are yet to be tested in UK courts.

- In evidence provided to the Department for Culture, Media and Sport, UK online safety charity Glitch noted how increasing online interactions since the Covid-19 lockdowns have led to new forms of online abuse, such as attackers joining video calls to display violent or pornographic material.

- Experts from the horizon scanning consultation also noted the increasing role of online technology in coercive control, emotional abuse, online stalking, and online bullying. Domestic violence charity Refuge reported in 2020 that 72% of service users experienced online abuse.

- Researchers found criminal organisations increasing their online efforts to recruit children into drug gangs during lockdowns. These criminal organisations developed strategies for recruitment via social media that persisted after the pandemic.

- Finally, many researchers have highlighted concerns about potential impacts of mis and disinformation on society and democratic institutions:

  - Online misinformation and disinformation could undermine legitimate public health initiatives. For example, during the COVID-19 pandemic, research by KCL found false claims of 5G masts spreading the virus led to adherents neglecting social distancing guidelines.

  - An increasing proliferation of mis or disinformation could erode trust in online news, democratic institutions and election processes and outcomes.

  - Online radicalisation and the spread of extremist ideology presents an acute threat to democratic debate and a risk of enabling domestic terrorism or violent disorder.

Cyber experts, such as academics and government entities, have identified several opportunities for combatting cyber-crime and harm:

- The National Cyber Security Centre noted AI has potential applications for cyber security, for example, AI effectively identifying fraudulent emails.

- Designing technologies to be "secure-by-design and default" can embed security considerations at each stage of development, and is a strategic priority in the Government Cyber Security Strategy. Secure-by-design technologies are likely to be required for critical UK infrastructure such as telecommunications, supply chains and the energy grid. Smart devices may require certification processes, particularly in cases where a cyber-attack poses a threat to human life, such as in a self-driving vehicle.

- Industry and academic experts have highlighted how governments regulating how AI is developed and used could help to ensure models are developed safely to protect against malicious action outside of intended purposes, such as AI being used to generate disinformation.

- In 2023, the NSPCC recommended the Government "review legislation on a rolling basis to ensure that immersive environments are adequately covered" from online harms.

- Policy considerations for countering mis and disinformation could include limiting its spread once published, preventing people from engaging with disinformation and producing good information.

Key uncertainties/unknowns

- There is very little evidence on the impact of misinformation and disinformation campaigns on people's beliefs and behaviours and some researchers have said measuring its influence is a "notoriously difficult task". Some researchers argue that small groups of voters can be swayed enough to influence election results, while others believe the scale of the problem is overstated.

- The Internet Watch Foundation noted a potential legal ambiguity around AI-generated child sexual abuse material. Creation and possession of such images may straddle two pieces of legislation – the Protection of Children Act 1978 and the Coroners and Justice Act 2009 – and a risk of shortened sentences if an existing victim cannot be identified. There is no current legislation prohibiting the publishing of guides to the creation of AI-generated child sexual abuse material.

- Experts noted that attributing cyber-crimes to their perpetrators can be difficult and time-consuming. This can make legal proceedings challenging, especially if entities are operating with the backing of foreign governments. This has been exacerbated by the rise of cyber-crime "as-a-service", which may make uncertain the responsibility between the developer and the user of malicious software. Consultation respondents suggested legal frameworks may need to acknowledge shared culpability between users and creators of AI models for cyber-crime.

- Changing international landscapes can affect cyber-crime, harm and security. For example, the war in Ukraine has made cyber-attacks and disinformation campaigns a more critical strategic objective for some states (cyber security of elections).

Continuing with our routine news releases:

- **14 August 2024**

Micah McCartney reports in Newsweek that dozens of systems used by government bodies and IT companies in Russia have reportedly become the targets of Chinese hackers. Moscow-based cyber-security provider, Kaspersky Lab, revealed that the backdoor malware used to gain access to the systems was "GrewApacha," a Trojan used since at least 2021 by the Chinese cyber-espionage group known as APT31 (Advanced Persistent Threat 31).

A Trojan is a type of malware disguised as legitimate software to trick users into installing it. Once installed, Trojans can perform malicious actions on the infected system, such as spying on users, stealing data and providing cybercriminals with unauthorized access. The SecureList report said the method observed in the recent cyber-attacks was similar to the one previously used to target a U.S. organization.

A SecureList report released last month called the updated CloudSorcerer malware "a sophisticated toolset targeting Russian government entities." Its "ability to dynamically adapt its behaviour based on the process it is running in, coupled with its use of complex inter-process communication through Windows pipes, further highlights its sophistication."

Last year, the intelligence chiefs of the Five Eyes intelligence alliance—the U.S., the U.K., Canada, Australia and New Zealand—warned of the threat posed by China's use of cutting-edge technology to carry out hacking and intellectual property theft on a large scale.

An anonymous source earlier this year leaked evidence of a massive surveillance campaign by I-Soon, an MSS-affiliated Chinese contractor, whose targets ranged from foreign governments, politicians and think tanks to private Chinese citizens. Read further at: Chinese Hackers Hit Russia in Cyberattack

- **9 September 2024**

Andrew Orlowski comments in The Telegraph that every day our businesses and government organisations are being clobbered by cyber-attacks. So what's the last thing we want them to do? Probably make the attacks easier, and park the most valuable secrets in front of the house with a "take what you want" sign. As companies experiment with artificial intelligence (AI), they are flinging open doors that really should be locked very tight – and in many cases, they don't even know they've done it.

To picture the potential damage, security expert Michael Bargury talks me through an example using Microsoft's own demonstration site for Microsoft 365. He quietly alters the business's bank details; staff are oblivious to the change. Bargury, chief technology officer of Tel Aviv-based security firm Zenity, is one of the leading experts in exploring how business AI can be used for mischief.

The attacks exploit one of AI's key selling points to business: automating repetitive tasks. Previously, getting a hack to work required knowledge of a scripting language. Now, anyone can create a bot with a couple of clicks – and it's turning hacking into a public sport. In the past, many hacks also required hundreds of hours of social engineering – tricking an individual into clicking on something. But with Microsoft's Copilot and other business AI bots, people can simply say a set of words and open a Pandora's box. Bargury calls it "promptware".

The typical Fortune 500 company already runs around 3,000 Copilot AI bots, Zenity found, and some 63pc of private business chatbots can be operated by the public. "All of the defaults are insecure," an astonished Bargury discovered. Things are about to get much worse.

While Microsoft has changed the defaults, the underlying problem is not fixable, which is that AI can't distinguish between data and computer instructions. I may send you a one-line message wishing you happy birthday that contains hidden hacking instructions – and the AI will obliviously let it happen. Microsoft says it is constantly revising the "guard rails" on its large language models, but Bargury isn't impressed. "Guard rails aren't enough because it's not a solvable problem," he tells me. No wonder Copilot has earned the nickname "Coparrot" – it simply repeats what it hears.

Worse, companies are being encouraged to pour everything they have into the pot. An AI model devours everything it can: supplier contracts, employee salaries, redundancy lists, strategy papers, or the directors' very private Teams chats. AI breaks down boundaries we have traditionally maintained in the offline world, where information was privileged, and was only shared on a need-to-know basis. Now we're making everything accessible to anyone.

In summary, it's a lethal combination: we're allowing far more people to do more stupid things far more easily, while exposing far more private information to the bad people. Read on at: Our most valuable secrets are being exposed to a million eyes

- **8 October 2024**

Dominic Nicholls reports that Ken McCullum, Director General of MI5, has said that Vladimir Putin's intelligence agencies are targeting businesses to undermine the UK's security and economy. His comments came as he gave his annual threat briefing, in which he warned that Russian operatives are "on a sustained mission to generate mayhem in British streets".

In May, the Polish authorities arrested an alleged Russian spy ring planning attacks on commercial premises in the country. Donald Tusk, the prime minister, said at the time: "We currently have nine suspects detained and indicted, who have been directly implicated in the name of Russian [intelligence] services in acts of sabotage in Poland."

Earlier this year, Thomas Haldenwang, the head of German domestic intelligence, warned that "we assess the risk of state-controlled acts of sabotage [by Russia] to be significantly increased".

In the UK, seven people were charged over a Russia-linked arson attack on a Ukrainian business at an industrial unit in Leyton, east London, on March 20. Two were charged under the National Security Act 2023 – the first case to involve alleged offences under the new legislation.

Giving his annual speech from the Government's Counter-Terrorism Operations Centre in west London, Mr McCallum gave a stark warning to anyone considering working for states hostile to British interests. He said: "If you take money from Iran, Russia or any other state to carry out illegal acts in the UK, you will bring the full weight of the national security apparatus down on you. It's a choice you'll regret." Read further at: Russian spies targeting UK with Cold War-style sabotage, warns MI5 boss

Sophie Dickinson writes that British pilots are in demand. Riyadh Air, Saudi Arabia's fledgling airline, has been accused of poaching our pilots – offering higher salaries and better perks. This, in combination with a post-Covid retirement boom, means that airlines like Virgin Atlantic, British Airways and easyJet are facing a struggle to keep their rosters full. And Riyadh Air isn't the only airline tempting the Country's pilots away from home-grown carriers, with Gulf rivals Emirates, Etihad and Qatar Airways all expanding in recent years.

It seems there's never been a better time to be a pilot. But how do you actually become one? For those hoping to earn their wings, the process is lengthy – and often costly, comprising examinations, medical tests and many hours of flying practice.

It starts at school. Pilots are required to have good GCSEs in science, maths and English, and usually A-levels too. A university degree is not necessarily needed, although most employers stress that anything which helps candidates stand out is to be encouraged – some airlines even reference Duke of Edinburgh Awards as desirable.

A medical examination is needed too. Alongside a questionnaire on family health, would-be pilots have their eyesight, hearing, and lung function tested, plus take echocardiograms and X-rays. Contrary to popular belief, glasses-wearers can get their licence. Other conditions, like angina or heart failure, neurological conditions that require medication, diabetes, chronic lung disease and more may mean a medical certificate isn't issuable.

A critical part of the process, of course, is the number of flying hours you've clocked up. How many? To meet these requirements applicants usually enrol in a private flying school, with most offering modular courses that allow candidates to reach the requisite number (at least 195 hours). While the length and cost of these training sessions vary, a committed learner could likely complete a course within 18 months.

It isn't easy, however. Brian Smith, a pilot who has flown with multiple operators, says there were days when he didn't want to train. "I would pray for cloud cover because I didn't want to go out. The instructors were not very forgiving, and it was tough."

An alternative option is the airline-run training academy. EasyJet has an 18-22 month course, with trainees taking their first flight in Phoenix, Arizona, and graduating directly to a co-pilot position. Ryanair's "Future Flyers" scheme operates similarly, as does Virgin Atlantic's equivalent (where first flights also take place in Arizona or else New Zealand).

The British Airways Speedbird Pilot Cadet Programme is particularly popular: some 20,000 people applied for just 100 places last year, all vying for their training fees to be covered. It's understandable, as the process can be prohibitively expensive. The career website 'Prospects' recommends budgeting up to £130,000, citing course fees and certification charges.

"It's very often funded through the bank of mum and dad," says Smith. "Or it's young men and women taking out huge loans, and it takes a while to pay it back. And it's not the sort of industry where jobs are guaranteed all the time – Covid proved that." During this period, would-be pilots also have to take a series of gruelling examinations, in topics like aviation law, aerodynamics, propeller theory and navigation systems. "It's a bit like drinking from a fire hose, it can be very intense," says Smith.

Regardless of whether candidates learn to fly independently or with a flying school, they will, eventually, graduate with a Commercial Pilot Licence (CPL) and an Instrumental Rating (IR). Combined, these make a "frozen" Airline Transport Pilot Licence (ATPL).

Once pilots have their licence, it's through to the interview stage. While airlines are facing a retention crisis in the UK, positions are still over-subscribed, which means demonstrating a willingness to work unsociable hours is often key. For many candidates, the flexibility of short haul is ideal; others prefer the opportunity to travel the world that long haul provides. Regardless, the hiring process – and the job itself – are difficult. Social media sharing has heightened the scrutiny pilots face, and with incidents of severe turbulence on the rise, diligence is more important than ever.

To discern an applicant's ability to cope with in-cabin pressures, aptitude tests are often used to reveal intangible characteristics like the use of logic, crisis management and spatial awareness. No standardised testing is used, which means budding captains are subject to the whim of the employer. Nevertheless, online services offer practice sessions that vary from reading comprehension tasks to personality trait quizzes; a typical test shows a series of moving blocks that potential candidates have to quickly record.

Mathematical aptitude also matters. Typically, this means calculating the area of shapes, demonstrating the use of standard algebra formulas, and using percentages. Often, the first few interview stages are outsourced. Only candidates who make it through to the final part will be questioned by airline employees.

After this final stage, a "capacity test" on a flight simulator is used, requiring candidates to complete various in-cockpit tasks across two displays. Complete those, and you'll likely be asked more airline-specific questions, including flight routes and the history of the company. The process is extremely arduous but, if a pilot passes every stage, they could be on their way to captaining a plane.

The newly graduated pilot will be on a starting salary of around £40,000. "But this has the potential to rise quickly," says Smith, with captains earning up to £150,000 as their responsibilities increase. And while the process is difficult, there's a sense that the modern process produces particularly conscientious pilots. "I really admire their resilience," Smith says.

As for the current climate? Smith thinks now is a great time to start the application process. Budding pilots should take a trial flight and speak to other pilots before starting the process, he says. "I've never met anyone who doesn't enjoy it. The sense of satisfaction is immense."

However, why are there so few female pilots? Only six per cent of pilots worldwide are female, although operators are keen to alter this. Schemes like the Amy Johnson Flying Initiative, run jointly by easyJet and the British Women Pilots' Association, aim to encourage women to apply for a licence. The programme offers underwritten loans for six female applicants while working with schools and colleges to encourage women to consider aviation careers.

It seems to be working. Numbers remain small, but the UK's Civil Aviation Authority (CAA) reports that between 2019 and 2023, there was a 26 per cent increase in pilot licences issued to women. That includes a 43 per cent increase in the number of licences issued to women for commercial flying.

Research by easyJet shows that twice as many men (32 per cent) have considered becoming a pilot compared to women (15 per cent). Experts cite the prohibitive costs, in addition to cultural preconceptions, as the reasons why the numbers remain low. Schemes like the CAA's STEM programme, aimed at getting women and girls into science and engineering, are looking to change this.

As an example, and perhaps a start point? View British Airways' Speedbird Pilot Academy Candidate Preparation Materials – The On-line Application: PowerPoint Presentation

Additionally, the following is an extract from the RAeS 'Careers in Aerospace' website: 7 top tips on How to become a Pilot in the United Kingdom

What does a Commercial Pilot Do?

Commercial pilots are those who are tasked to fly and navigate commercial aircraft and helicopters. Airline Pilots fly aircraft for airlines – full service, charter and low cost – which transport passengers and cargo on a fixed schedule. They are responsible for transporting passengers who are either going on holiday or travelling for business, and generally work for commercial airlines. Their primary responsibility is to operate the aircraft. Pilots are also responsible for the safety of all crew and passengers onboard the aircraft.

What are the Main Responsibilities of a Pilot?

The responsibilities of pilots vary from day to day, depending on factors such as whether the flight is a long haul, international, or a one-hour internal flight.

General pilot duties include:

- Pre-flight checks of all the instruments, engines, fuel and safety systems aboard the aircraft.
- Working with flight dispatchers to create the best flight path.
- Supervising the loading of cargo, baggage and fuel.
- Briefing the cabin crew members before flight.
- Following the instructions given by air traffic control.
- Adjusting the flight path in case of weather emergencies.
- Informing the cabin crew and passengers and crew about journey progress.
- Writing end-reports about in-flight issues.
- Making regular checks on the aircraft's technical performance, pre-flight safety checks on navigation and operating systems.

What Qualifications & Skills Do I Need to Become a Commercial Pilot?

In order to work as a commercial pilot, you need to first gain an Airline Transport Pilot Licence (ATPL). Training for this can take around two years and can cost over £100,000.

To get on to a pilot training course you will need to have performed well at school. E.g. grades A*-C (9-4) and A-levels in at least English and Maths. Subjects including science or a second language would be a great advantage.

You must also be at least 21 years of age to apply for an ATPL, and you'll need to pass a background security check. You will also need to have a Class 1 Medical Certificate.

Most Approved Training Organisations (ATOs) will put you through their own testing to make sure that you have the right personality and skills to be a successful pilot. Over a series of written papers, interviews, group tests, and simulator tests, you will be expected to demonstrate skills such as problem solving, spatial awareness, and people skills.

Some of the core skills commercial pilots must possess include: strong leadership skills, the ability to remain focused and level-headed under pressure, complex problem solving skills, decisiveness and excellent communication skills.

What's the Career Path for a Commercial Pilot?

Typically, airline pilots start their flying career as first officers with a regional carrier. All pilots will have progressed through a vigorous flight training programme and have earned a commercial pilot's license or an airline transport rating. Most will also have completed one or more advanced ratings such as instrument, multi-engine or aircraft type ratings depending on the requirements of their particular flying role and airline.

Commercial Pilot vacancies advertised today are often specified by the aircraft to be flown – B777 first officer or captain, B737 first officer or captain, A320 first officer or captain, A340 first officer or captain, and so on.

Pilot, and especially captain, jobs often specify minimum requirements such as '2000 hours total flying time' and/or '1000 hours PIC on commercial aircraft'. Hiring airlines will also want to see accident and violation free records from applicants for pilot jobs.

All commercial pilots, including captains, are required to attend training and simulator checks once or twice a year.

Some airlines, such as Lufthansa make it possible for their pilots to get involved with flight operations related projects so that they gain management experience outside of the cockpit.

How Much Does it Cost to Train as a Pilot?

Training to become a pilot can cost as much as £130,000. This is a critical aspect of the career that you should consider. Some of the main UK airlines have fully sponsored training such as the Virgin Atlantic Future Flyers Programme (Future Flyers Programme at Virgin Atlantic | Virgin Atlantic Careers). Places on such schemes are limited and highly contested, but are great opportunities if you manage to secure a spot.

How Much Could I earn as a Pilot?

Starting salary for those entering the airline industry range between £35,000 and £45,000. Experienced first officers can earn anywhere from £45,000 to £65,000 and captains from £75,000 to £135,000. The most highly experienced pilots at the world's largest carriers can expect to earn £250,000 and above.

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.

To conclude this section, Ollie Corfe writes in The Telegraph that Apprentices can land higher salaries than university graduates – and avoid being lumbered with £45,000 of student debt, according to Telegraph analysis. Graduate salaries fall short compared to those of their contemporaries who did apprenticeships in subjects including engineering and construction. Not only do these apprentices out-earn their peers, they avoid being saddled with huge levels of debt and actually make money as they learn. Read on at: These apprenticeships offer university-beating salaries (without £45k in student debt)

RECOMMENDED FURTHER 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)