



VR Pilot introduces a sense of touch

The Schools’ Aerospace Careers Programme Newsletter

Spring 2024

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COVER PICTURE

VRpilot ApS is a Danish company that designs, develops and sells virtual reality training applications for professional use. Designed for maximum immersion and realism, their solutions are efficient tools for procedure training, cockpit familiarization and other uses for airlines, military air forces and private individuals. As a supporter of the ACP they very kindly provide the software for the 10 sets of Meta Quest 3 mixed reality systems we use during our roadshow presentations to groups of schools.

Virtual reality (VR) is a simulated experience that employs 3D near-eye displays and pose tracking to give the user an immersive feel of a virtual world. Applications of virtual reality include entertainment (particularly video games), education (such as medical, safety or military training) and business (such as virtual meetings). VR is one of the key technologies in the reality-virtuality continuum.

A person using VR equipment is able to look around the artificial world, move around in it, and interact with virtual features or items. The effect is commonly created by VR headsets consisting of a head-mounted display with a small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. Virtual reality typically incorporates auditory and video feedback, but may also allow other types of sensory and force feedback through haptic technology.

Mixed reality (MR) is a term used to describe the merging of a real-world environment and a computer-generated one. Physical and virtual objects may co-exist in mixed reality environments and interact in real time. Mixed reality that incorporates haptics has sometimes been referred to as Visuo-haptic mixed reality.

Augmented reality (AR) is an interactive experience that combines the real world and computer-generated content. The content can span multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory. AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds; real-time interaction; and accurate 3D registration of virtual and real objects. The overlaid sensory information can be constructive (i.e. additive to the natural environment), or destructive (i.e. masking of the natural environment). As such, it is one of the key technologies in the reality-virtuality continuum.

This experience is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment. In this way, augmented reality alters one's ongoing perception of a real-world environment, whereas virtual reality completely replaces the user's real-world environment with a simulated one. Augmented reality is largely synonymous with mixed reality. There is also overlap in terminology with extended reality and computer-mediated reality.

The primary value of augmented reality is the manner in which components of the digital world blend into a person's perception of the real world, not as a simple display of data, but through the integration of immersive sensations which are perceived as natural parts of an environment.

The earliest functional AR systems that provided immersive mixed reality experiences for users were invented in the early 1990s, starting with the Virtual Fixtures system developed at the U.S. Air Force's Armstrong Laboratory in 1992. Commercial augmented reality experiences were first introduced in entertainment and gaming businesses. Subsequently, augmented reality applications have spanned commercial industries such as education, communications, medicine, and entertainment.

In education, content may be accessed by scanning or viewing an image with a mobile device or by using markerless AR techniques.

AR can be used to enhance natural environments or situations and offers perceptually enriched experiences. With the help of advanced AR technologies (e.g. adding computer vision, incorporating AR cameras into smartphone applications, and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulated. Information about the environment and its objects is overlaid on the real world. This information can be virtual.

AR is any experience which is artificial and which adds to the already existing reality, e.g. seeing other real sensed or measured information such as electromagnetic radio waves overlaid in exact alignment with where they actually are in space. AR also has considerable potential in the gathering and sharing of tacit knowledge. Augmentation techniques are typically performed in real-time and in semantic contexts with environmental elements. Immersive perceptual information is sometimes combined with supplemental information like scores over a live video feed of a sporting event. This combines the benefits of both augmented reality technology and heads up display technology (HUD)

In VR the users' perception of reality is completely based on virtual information. In AR the user is provided with additional computer generated information within the data collected from real life that enhances their perception of reality. For example, in architecture VR can be used to create a walk-through simulation of the inside of a new building, and AR can be used to show a building's structures and systems super-imposed on a real-life view. Another example is through the use of utility applications. Some AR applications, such as Augment, enable users to apply digital objects into real environments allowing businesses to use augmented reality devices as a way to preview their products in the real world. Similarly, it can also be used to demonstrate what products may look like in an environment for customers.

In summary, AR differs from VR in that in AR part of the surrounding environment is 'real' and AR is just adding layers of virtual objects to the real environment. On the other hand, in VR the surrounding environment is completely virtual and computer generated. A demonstration of how AR layers objects onto the real world can be seen with augmented reality games. Such applications have many uses in the world, including in activism and artistic expression, the latter being demonstrated to students by Lee Mason during our roadshow presentations.



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INTRODUCTION

Welcome to the Spring 2024 edition of The Schools' Aerospace Careers Newsletter in which we are delighted to announce that our presentations to groups of schools around the UK continue to grow in both quantity and what we are able to offer our audiences. Indeed, in this quarter the total number of students and teachers/careers advisors who have attended a presentation has now reached 4,500, and the extensive amount of new audio-visual and hands-on electronic equipment once a few initial teething problems had been overcome has been very successfully integrated to the considerable benefit and acclaim of the young people involved.

Regarding Technology, we open with an article explaining Artificial Intelligence, and then go on to explain the makeup of the UK Economy using, for the first time, research undertaken by Microsoft Copilot. Turning to Aerospace Manufacturing we include an article by Deloitte on their A&D Industry outlook for 2024 which contains a particular emphasis on talent, and with Commercial Aviation Operation we start with an explanatory article of the work of the UK's Commercial Aviation Authority, and go on to detail two very important reports: one on Heathrow Airport, and the other of the world's first drone superhighway.

Our section on Space commences with an article on NASA's Artemis programme and advises that the ACP has joined NASA Engages, and our usual Cyber section includes exposés on hacking, blackmail and disinformation activity by governments and gangs. Again using Copilot our comment on Aerospace and the Environment include an informative article by NASA on propulsion, and we highlight within it electric, hydrogen and Bio-fuel powered flight.

Finally, with the increasingly dangerous geopolitical situation in the world today we include a substantial section on UK Defence; and to conclude we have enhanced our list of recommended contacts. As always, all sections include relevant news updates.

We trust all readers find this edition both useful and enjoyable and invite you to send any comments and questions you may have, including interest in supporting the ACP Charity #1190721) in terms of finance and/or assistance in kind, to chairman@aerospacecareersprogramme.co.uk

In the meantime click on the link below to watch our latest video on YouTube: 'A Typical ACP Schools Presentation'



THE SCHOOLS' AEROSPACE CAREERS PROGRAMME



Credit: Red7Productions

Nat West, an engineer with Hybrid Air Vehicles, explains Airlander, the first carbon zero aircraft

Since the Winter 2023/24 Newsletter was published the ACP has conducted five presentations to a total of 611 students and teachers from 20 schools. This takes the total number of students and teachers attending an ACP presentation so far to in excess of 4,500. There are two more presentations this academic year followed by a break in August, and then the 2024/25 programme begins on 19 September at Park School in Barnstaple.

The current year's programme would have involved one more presentation but the train the morning's principal speaker was travelling on was derailed! That presentation has already been included in the 2024/25 programme which will be limited to 20 presentations; so far 16 have been confirmed with seven more under discussion with the host schools concerned. Those not agreed for 2024/25 will be held over until the 2025/26 programme.

In the meantime, we extend our most grateful thanks to Emily Maczka, Reece Legg and Alex Maggs from GKN Aerospace, Manasvi Chandrakant from Babcock International, Vincent White from AtkinsRéalis, and Craig Jones and Nat West from Hybrid Air Vehicles, who joined us during our presentations in March and April this year.

During August the presentation team will carefully consider the detailed feedback we receive via our website which students can now link into directly via a QR code, and via tablets we invite accompanying teachers to use so they can do likewise before leaving at the end of a presentation. This information will be taken into account when discussing and finalising all aspects of the next academic year's presentation.

Turning to digital support, the website continues to be developed and improved. In addition to the existing pages concerning ACP News, further Useful Contacts, Articles of Interest and direct links to our supporting companies, social media platforms have been added and our new YouTube channel is

about to feature our second video. Filming for the latter took place at The Knights Templar School and included Hybrid Air Vehicles (see photo above) - one of our supporting companies. Production was undertaken by Airborne Platforms UK and Red7Productions.



A typical breakout session with approximately one-quarter of the presentation audience in a picture taken by the ACP's drone mounted camera.

Furthermore, we are currently preparing two new pages: one dedicated to explaining the technologies of the Fourth Industrial Revolution such as AI, 3D printing, 5G, VR, etc.; and another dedicated to early careers opportunities with our supporting companies on the one hand, and typical types of future jobs on the other.

Regarding the Network, our survey of schools to establish what they would like from an ACP Network has now commenced and shortly we will advise companies of the outcome so that we can commence building the foundations of a permanent and active ACP Network incorporating both an Alumni and an ACP evaluation system. It is intended to launch these three interrelated aspects in the Spring of 2025.

And with schools in mind, our quarterly reviewed schools database is now well in excess of 600 and will soon approach 1,000 as one of our current research programmes is identifying all educational trusts in England plus associated academies and foundation schools. We are also researching their 'cousins' in the Scottish, Welsh and Northern Ireland educational systems. To assist this project considerable use is being made of IT not only to assist research and maintenance, but also to enhance the value of the resultant database. The eventual database should include the majority of secondary schools in the UK.

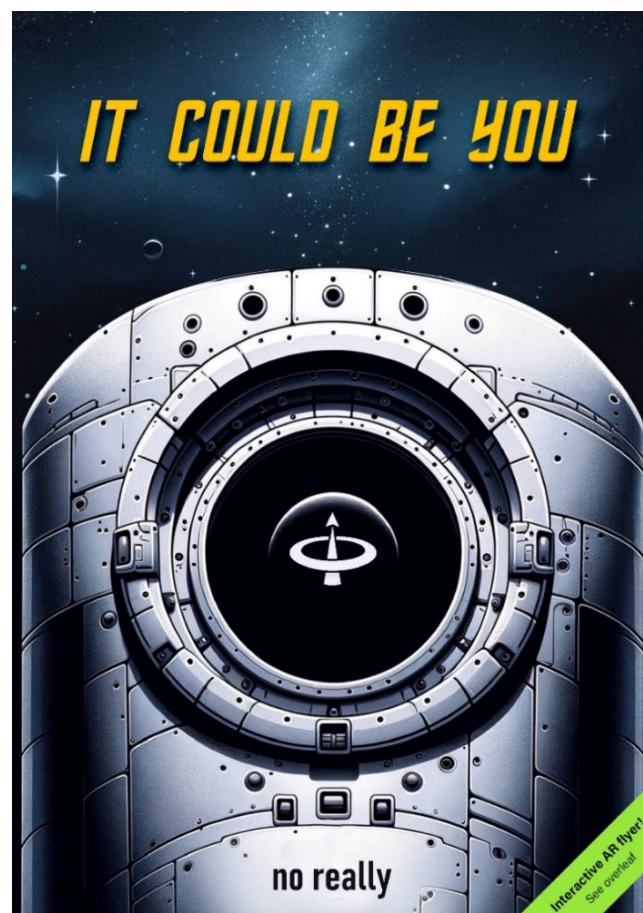
Two new activities we have trialled during the quarter that has just completed have been the use of our Chairman's Speakers for Schools talks in state schools to discuss the ACP, ably assisted by Spot, and the inclusion of some selected students from Years 8 & 9. Both of these have been very well

received so, on the one hand we will continue with the former, and on the other we will trial a specially adapted presentation to a full audience of 12 to 14-years old students.

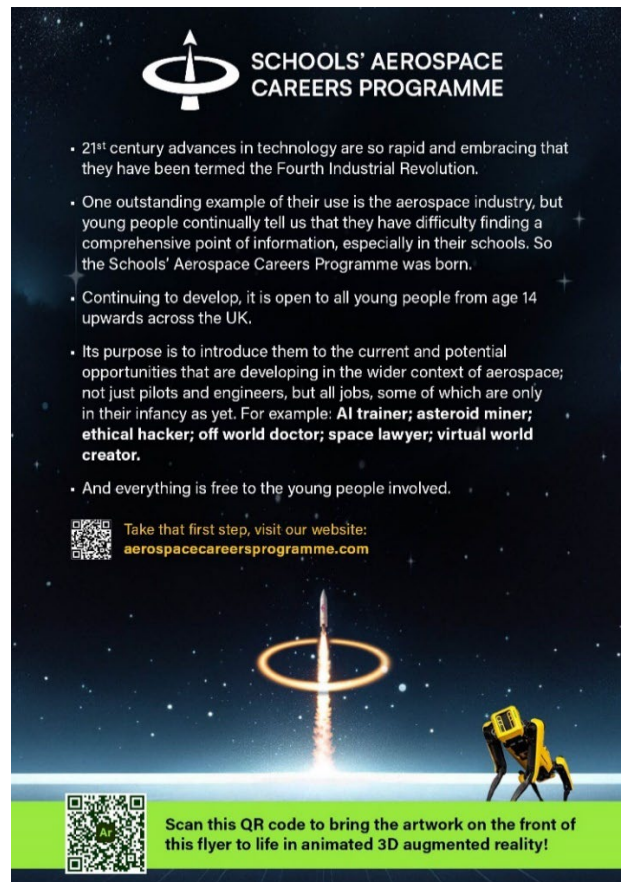
In the meantime, we are delighted to announce that the ACP has: been joined by SaxaVord Spaceport, the first and only spaceport in the UK to receive a license for vertical launch of satellites to sun synchronous and polar orbit; entered a charitable partnership with the Halldale Group, a market leader in the B2B events and media space, and a training and simulation partner to global safety training industries; joined NASA Engages, an initiative aimed at attracting, engaging and educating students while supporting educators and educational institutions with the aim of building the next generation of technologists, innovators and explorers. Furthermore, we are in discussion with Farnborough International regarding working together in respect of outreach to schools.

Moreover, because of the continuing growth of the ACP we have commenced a recruitment programme to find two additional Trustees. Also, fund raising continues unabated, as does our programme to encourage companies to provide assistance-in-kind. We emphasize that the latter does not need to involve finance.

We conclude this edition with details of the interactive AR flyer we now hand out to all presentation attendees. Scan the QR code below to bring the artwork on the front of the flyer to life in animated 3D Augmented Reality. Because the flyer is, in reality, A5 size we have included an enhanced copy of the code in the Newsletter below for ease of use:

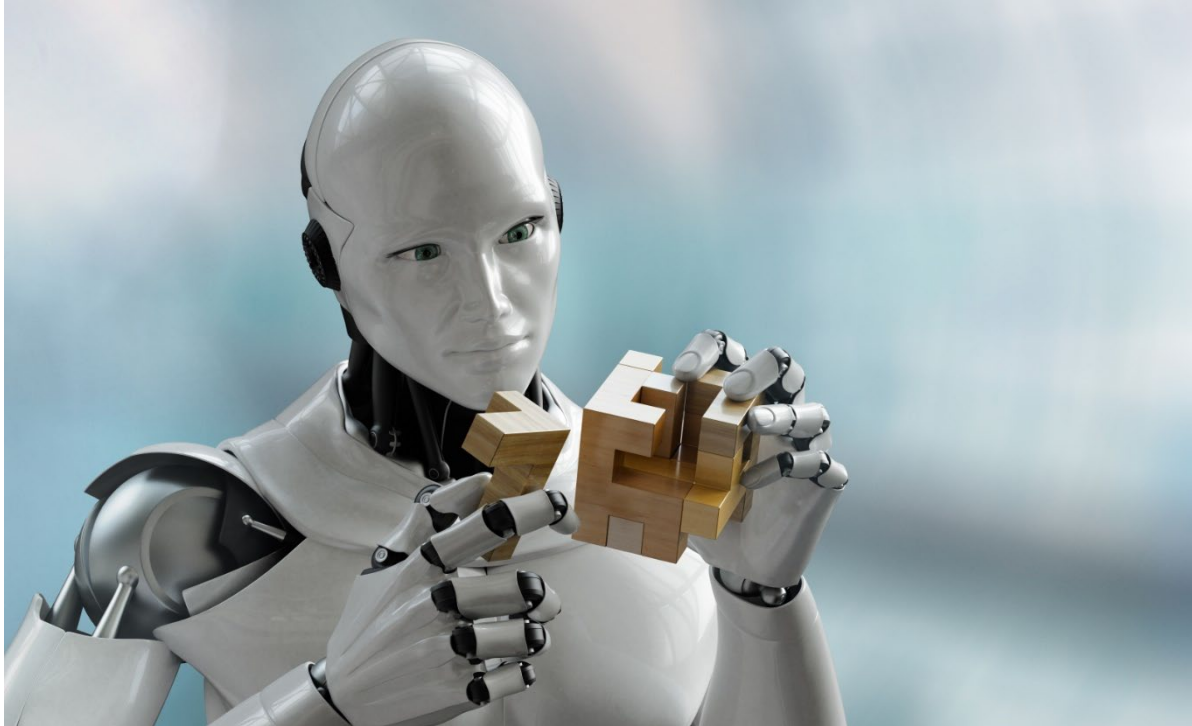


Credit: Lee Mason



When scanning the code in this document, if you are viewing it on a tablet or laptop lay the screen flat as you would with the flyer on a table and then with your camera directly above the screen activate from that position. If you are viewing the code on a PC try to avoid creating an angle between the phone and the PC screen otherwise the full effect of the 3D/AR will not be realised.

TECHNOLGIES OF THE FOURTH INDUSTRIAL REVOLUTION



In the last edition (Winter 2023/24) we introduced this section with an extract from Wikipedia on Robotics. Continuing that formula we commence this edition with an extract from the same source on Artificial Intelligence.

Artificial intelligence (AI), in its broadest sense, is intelligence exhibited by machines, particularly computer systems, as opposed to the natural intelligence of living beings. It is a field of research in computer science that develops and studies methods and software which enable machines to perceive their environment and uses learning and intelligence to take actions that maximize their chances of achieving defined goals.

AI technology is widely used throughout industry, government, and science. Some high-profile applications include advanced web search engines (e.g., Google Search); recommended systems (used by YouTube, Amazon, and Netflix); interacting via human speech (e.g., Google Assistant, Siri and Alexa); autonomous vehicles (e.g., Waymo); generative and creative tools (e.g. Chat GPT and AI art); and superhuman play and analysis in strategy games (e.g. chess and Go). However, many AI applications are not perceived as AI.

Alan Turing was the first person to conduct substantial research in the field that he called machine intelligence. Artificial intelligence was founded as an academic discipline in 1956. The field went through multiple cycles of optimism, followed by periods of disappointment and loss of funding. Funding and interest vastly increased after 2012 when deep learning surpassed all previous AI techniques. This led to the AI boom of the early 2020s with companies, universities and laboratories, overwhelmingly based in the United States, pioneering significant advances in artificial intelligence.

The growing use of artificial intelligence in the 21st century is influencing a societal and economic shift towards increased automation, data-driven decision-making, and the integration of AI systems into various economic sectors and areas of life, impacting job markets, healthcare, government, industry, and education. This raises questions about the long-term effects, ethical implications, and risks of AI, prompting discussions about regulatory policies to ensure the safety and benefits of the technology.

The various sub-fields of AI research are centred around particular goals and the use of specific tools. The traditional goals of AI research include reasoning, knowledge representation, planning, learning, natural language processing, perception, and support for robotics. General intelligence - the ability to complete any task performed by a human on an at least equal level - is among the field's long-term goals. To reach these goals, AI researchers have adapted and integrated a wide range of techniques, including search and mathematical optimization, formal logic, artificial neural networks, and methods based on statistics, operations research, and economics. AI also draws upon psychology, linguistics, philosophy, neuroscience, and other fields.

The general problem of simulating (or creating) intelligence has been broken into sub-problems. These consist of particular traits or capabilities that researchers expect an intelligent system to display. The traits described below have received the most attention and cover the scope of AI research.

Reasoning and problem solving

Early researchers developed algorithms that imitated step-by-step reasoning that humans use when they solve puzzles or make logical deductions. By the late 1980s and 1990s, methods were developed for dealing with uncertain or incomplete information, employing concepts from probability and economics. Many of these algorithms are insufficient for solving large reasoning problems because they experience a "combinatorial explosion": they became exponentially slower as the problems grew larger. Even humans rarely use the step-by-step deduction that early AI research could model. They solve most of their problems using fast, intuitive judgments. Accurate and efficient reasoning is an unsolved problem.

Knowledge representation

Knowledge representation and knowledge engineering allow AI programs to answer questions intelligently and make deductions about real-world facts. Formal knowledge representations are used in content-based indexing and retrieval, scene interpretation, clinical decision support, knowledge discovery (mining 'interesting' and actionable inferences from large databases), and other areas.

A knowledge base is a body of knowledge represented in a form that can be used by a program. An ontology is the set of objects, relations, concepts, and properties used by a particular domain of knowledge. Knowledge bases need to represent things such as: objects, properties, categories and relations between objects; situations, events, states and time; causes and effects; knowledge about knowledge (what we know about what other people know); default reasoning (things that humans assume are true until they are told differently and will remain true even when other facts are changing); and many other aspects and domains of knowledge.

Among the most difficult problems in knowledge representation are: the breadth of commonsense knowledge (the set of atomic facts that the average person knows is enormous); and the sub-symbolic

form of most commonsense knowledge (much of what people know is not represented as ‘facts’ or ‘statements’ that they could express verbally). There is also the difficulty of knowledge acquisition, the problem of obtaining knowledge for AI applications.

Planning and decision making

An ‘agent’ is anything that perceives and takes actions in the world. A rational agent has goals or preferences and takes actions to make them happen. In automated planning the agent has a specific goal. In automated decision making the agent has preferences – there are some situations it would prefer to be in, and some situations it is trying to avoid. The decision making agent assigns a number to each situation (called the ‘utility’) that measures how much the agent prefers it. For each possible action, it can calculate the ‘expected utility’: the utility of all possible outcomes of the action, weighted by the probability that the outcome will occur. It can then choose the action with the maximum expected utility.

In classical planning the agent knows exactly what the effect of any action will be. In most real-world problems, however, the agent may not be certain about the situation they are in (it is ‘unknown’ or ‘unobservable’) and it may not know for certain what will happen after each possible action (it is not ‘deterministic’). It must choose an action by making a probabilistic guess and then reassess the situation to see if the action worked.

In some problems the agent's preferences may be uncertain, especially if there are other agents or humans involved. These can be learned (e.g., with inverse reinforcement learning) or the agent can seek information to improve its preferences. Information value theory can be used to weigh the value of exploratory or experimental actions. The space of possible future actions and situations is typically intractably large, so the agents must take actions and evaluate situations while being uncertain what the outcome will be.

A Markov decision process has a transition model that describes the probability that a particular action will change the state in a particular way, and a reward function that supplies the utility of each state and the cost of each action. A policy associates a decision with each possible state. The policy could be calculated (e.g., by iteration), be heuristic, or it can be learned. Game theory describes rational behaviour of multiple interacting agents, and is used in AI programs that make decisions that involve other agents.

Learning

Machine learning is the study of programs that can improve their performance on a given task automatically. It has been a part of AI from the beginning. There are several kinds of machine learning. Unsupervised learning analyses a stream of data to find patterns and make predictions without any other guidance. Supervised learning requires a human to label the input data first, and comes in two main varieties: classification (where the program must learn to predict what category the input belongs in) and regression (where the program must deduce a numeric function based on numeric input).

In reinforcement learning the agent is rewarded for good responses and punished for bad ones. The agent learns to choose responses that are classified as ‘good’. Transfer learning is when the knowledge gained from one problem is applied to a new problem. Deep learning is a type of machine learning

that runs inputs through biologically inspired artificial neural networks for all of these types of learning. Computational learning theory can assess learners by computational complexity, by sample complexity (how much data is required), or by other notions of optimization.

Natural language processing

Natural language processing (NLP) – [not to be confused with Neuro-Linguistic Programming] – allows programs to read, write and communicate in human languages such as English. Specific problems include speech recognition, speech synthesis, machine translation, information extraction, information retrieval and question answering. Early work, based on Noam Chomsky's generative grammar and semantic networks, had difficulty with word-sense disambiguation unless restricted to small domains called 'micro-worlds' (due to the common sense knowledge problem). Margaret Masterman believed that it was meaning, and not grammar, that was the key to understanding languages, and that thesauri and not dictionaries should be the basis of computational language structure.

Modern deep learning techniques for NLP include word embedding (representing words, typically as vectors encoding their meaning), and transformers (a deep learning architecture using an attention mechanism) and others. In 2019, generative pre-trained transformer (or GPT) language models began to generate coherent text, and by 2023 these models were able to gain human-level scores on the bar exam, SAT test, GRE test, and many other real-world applications.

Perception

Machine perception is the ability to use input from sensors (such as cameras, microphones, wireless signals, active lidar, sonar, radar, and tactile sensors) to deduce aspects of the world. Computer vision is the ability to analyze visual input. The field includes speech recognition, image classification, facial recognition, object recognition, and robotic perception.

Social intelligence

Affective computing is an interdisciplinary umbrella that comprises systems that recognize, interpret, process or simulate human feeling, emotion and mood. For example, some virtual assistants are programmed to speak conversationally or even to banter humorously - it makes them appear more sensitive to the emotional dynamics of human interaction, or to otherwise facilitate human-computer interaction. However, this tends to give naïve users an unrealistic conception of the intelligence of existing computer agents. Moderate successes related to affective computing include textual sentiment analysis and, more recently, multi-modal sentiment analysis, wherein AI classifies the affects displayed by a videotaped subject.

General intelligence

A machine with artificial general intelligence [AGI] should be able to solve a wide variety of problems with breadth and versatility similar to human intelligence. However, not all AI researchers believe that it is even possible to develop an AGI system, and the field is divided on what factors constitute and can accurately measure "intelligence."

We resume now our chronological review of related news items.

➤ 12 February 2024

James Titcomb reports that a quantum supercomputer will be used to find ways to make Britain's trains run on time under tests from the Department for Transport aimed at overhauling rail schedules. The Australian company Q-CTRL and Britain's Oxford Quantum Circuits are developing a quantum algorithm designed to more efficiently organise train timetables.

The billions of potential ways to arrange train schedules in a large network mean simulating them on conventional supercomputers rapidly becomes impossible. Quantum computers, meanwhile, promise a major boost in performance that could allow them to simulate different scenarios. Quantum computers take advantage of the peculiar characteristics of quantum physics to process a vast number of possibilities at once. This means they are theoretically capable of easily outpacing modern "classical" computers at tasks such as codebreaking or developing new chemistry.

Q-CTRL was last week awarded part of a £15m government computing fund to develop "quantum-optimised train schedules". Read on at: [Quantum supercomputer to tackle train delays in UK trial \(telegraph.co.uk\)](https://www.telegraph.co.uk/technology/2024/02/12/quantum-supercomputer-to-tackle-train-delays-in-uk-trial/)

➤ 16 February 2024

Mr Titcomb also writes that "Their British Library office may look unsuspecting, but Aria [Advanced Research and Invention Agency] has some ambitious ideas – and funding – to create a bold new future.

He continues: The internet, satellite navigation and Covid vaccines have one thing in common. They all owe their existence to a secretive US research agency set up in one of the tensest moments of the Cold War. In 1957, the ghostly beeps of the Soviet Union's Sputnik satellite orbiting the world shocked America into an explosion of scientific research. The following year, the US government set up the Advanced Research Projects Agency, a lavishly-funded skunkworks initiative designed to ensure Uncle Sam had a technological lead on its superpower rival. "Arpa" led to an explosion in invention. Self-driving cars, the computer mouse and drones also owe their existence in some way to the lab and its defence-focussed successor, Darpa.

Now the Cold War is over, researchers worry that the rate of scientific progress has stalled. We are simply not inventing any more. But in a nondescript office tucked in a corner of the British Library, there is a bold project to change that. This is the headquarters of the Advanced Research and Invention Agency, otherwise known as Aria. The agency, the UK's answer to Arpa, is an £800 million effort to beat our scientific stagnation and get Britain inventing again. "Over the last five, six years there's a growing momentum around the idea that good ideas seem to be getting harder to find," says Matt Clifford, Aria's chairman. "There's this sense that, to maintain a constant output of great science, we're having to spend more and more." Now read on at: [The high-risk agency dreamt up by Dominic Cummings – and its seven big ideas to save the world \(msn.com\)](https://www.msn.com/en-gb/science/story/the-high-risk-agency-dreamt-up-by-dominic-cummings-and-its-seven-big-ideas-to-save-the-world) And learn about Aria's seven big ideas.

➤ 13 March 2024

Ambrose Evans-Pritchard writes that it is time to drop the old joke that fusion is 30 years away, and always will be. A poll at the International Atomic Energy Agency's forum in London found that 65pc of insiders think fusion will generate electricity for the grid at viable cost by 2035, and 90pc by 2040.

Commercial nuclear fusion has gone from science fiction to science fact in less than a decade. Even well-informed members of the West's political class are mostly unaware of the leap in superconductors, lasers, and advanced materials suddenly changing the economics of fusion power. Britain's First Light Fusion announced last week that it had broken the world record for pressure at the Sandia National Laboratories in the US, pushing the boundary to 1.85 terapascal - five times the pressure at the core of the Earth.

Days earlier, a clutch of peer-reviewed papers confirmed that Commonwealth Fusion Systems near Boston had broken the world record for a large-scale magnet with a field strength of 20 tesla using the latest high-temperature superconducting technology. This exceeds the threshold necessary for producing net energy, or a "Q factor", above 1.0. "Overnight, it basically changed the cost per watt of a fusion reactor by a factor of almost 40," said Professor Dennis Whyte, plasma doyen at the Massachusetts Institute of Technology (MIT).

The magnets are used to fuse hydrogen isotopes by squeezing super-hot plasma inside a tokamak device. The temperature must be several times hotter than the sun in order to replicate solar fusion because the earth's gravitational force is that much weaker. The "old" low-temperature magnets are made of niobium alloys operating near absolute zero at -270C. The new magnets lift the temperature from 4 kelvins to 20 kelvins using rare earth barium copper oxide (ReBCO) with a radical new design. They combine superconductivity with extreme magnetic power. This leverages a "multiple order-of-magnitude increase" in fusion capability.

Commonwealth's chief executive, Bob Mumgaard, told me the game-changing technology scarcely existed 10 years ago, and was still in its infancy five years ago. "The breakthrough is in superconductors. Much stronger magnets mean that we can build a plant that is 40 times smaller," he said. Read further at: Nuclear fusion for the grid is coming much sooner than you think ([telegraph.co.uk](https://www.telegraph.co.uk))



Credit: Commonwealth Fusion Systems

➤ 1 April 2024

James Titcomb reports on Elon Musk's prediction that one day Earth will have more robots than humans. Last year, the Tesla chief executive said the number of two-legged robots on Earth would one day surpass the 8 billion humans on the planet. "I think we might exceed a 1:1 ratio of humanoid robots to humans," Musk told shareholders at Tesla's investor day last March, predicting that the arrival of the machines would dramatically upend the global economy.

Despite Tesla being the world's most valuable carmaker, Musk predicted that the company's robotics work would be "worth significantly more than the car side of things, long term". It is a bold statement. In 2021, When Musk first announced plans to produce a 170cm-tall droid designed to do "boring, repetitious and dangerous" work, he did not even have a prototype. Instead, he brought out an actor in a bodysuit and helmet, who danced for a few seconds before shuffling off the stage. It was a neat illustration of the gap between the promise and the reality of robots.

Humanoids – bipedal machines that mimic the human body – have been a science fiction staple since the genre's creation, and an engineering ambition since Renaissance Italy (Leonardo da Vinci's notebooks contain several drawings of mechanical knights). In the 1980s and 1990s, the Japanese company Honda ploughed hundreds of millions into ASIMO, a humanoid that largely became known for viral videos of it failing to master stairs.

However, the robots we have today are typically single-purpose machines, such as the arms on robot production lines or the spinning platforms in Amazon warehouses that resemble large Roombas. Humanoid robots that can sense their environments, walk on two legs and grasp objects in their hands – requirements that could see them replace humans in manual jobs – would be a potential game changer but progress has remained elusive.

Robots have repeatedly struggled to master tasks that seem elementary to humans. Take walking – humans learn to totter around on two legs with moderate success at around 12 months, but the task has turned out to be a fiendishly difficult science problem for robots. Darpa, the US military's big-spending research lab, ran a robotics challenge in 2015 in response to the Fukushima nuclear disaster, with the aim of producing a robot that could handle the sort of dangerous environments that humans would wish to avoid. The challenge pitted robots against a rudimentary obstacle course of door handles and stairs; the majority failed spectacularly, unable to stay on their feet.

The recent boom in artificial intelligence, however, has revived hopes that we will soon live in a world full of droids that will clean our houses, carry out dangerous tasks – and potentially take our jobs. Developments in artificial intelligence systems such as ChatGPT are translating into robots that better understand the world. In 2022, a year after Musk had announced his robot plans with a man in a suit, he unveiled a real robot, one that could walk, wave, and carry boxes. Musk has said the robot, called Optimus, would cost around \$20,000 (£15,800) and said Tesla planned to start using it in its own factories before a public release. Read on at: [Why Elon Musk thinks Earth will have more robots than humans \(telegraph.co.uk\)](https://www.telegraph.co.uk)

➤ 4 April 2024

Matthew Field reports that an investigation into a US State Department hack lays bare fears over quantum advances. He goes on to advise that a cyber security official at the Department had noticed

something unusual. An internal IT security system, nicknamed “Big Yellow Taxi”, had flagged unusual activity on its corporate Microsoft account. The tech team quickly raised its concerns to Microsoft, hopeful that the alert was just a false positive.

What rapidly emerged, however, was that a Chinese government hacking group – codenamed Storm-0558 – had compromised the emails of hundreds of US government officials. An official US government post-mortem included one frightening possibility: that China had developed a quantum supercomputer, capable of cracking all Western encryption and rendering cyber defences useless. Victims of the hack, discovered on 15 June last year, included Gina Raimondo, the US commerce secretary, the US Ambassador to China, and dozens of high ranking officials and politicians across America and the UK.

Nine months later and experts at Microsoft and US officials at CISA – the US cyber defence agency – are still unpicking what happened. China’s hackers had been able to steal or forge a digital key – the “cryptographic equivalent of crown jewels”, US officials said in a report. This key could be used to unlock crucial parts of the US government’s digital infrastructure, cracking open email accounts belonging to high-ranking officials around the world. The hackers stole 60,000 emails from the State Department alone, although it is still unclear how this was achieved.

On June 26, 10 days after the US government discovered the Chinese hack, Microsoft launched an “all-hands-on-deck” investigation that ran overnight, uncovering the loss of the secret key. “Microsoft developed 46 hypotheses to investigate,” the CISA report said, “including some scenarios as wide-ranging as the adversary possessing a theoretical quantum computing capability to break public-key cryptography.” The CISA report adds: “As of the date of this report, Microsoft does not know how or when Storm-0558 obtained the signing key.” Another possibility raised in the government report is that an insider stole the information years ago.

Cyber security sources note that a quantum-powered hack would be the “least likely” scenario. One industry source says the probability China has cracked such a huge technical problem is less than zero. Given the catastrophic nature of the attack, experts say Microsoft had to rule out a range of possible causes. In a March blog post, Microsoft said: “Our leading hypothesis remains that operational errors resulted in key material leaving the secure token signing environment.” But the disclosures by US officials shows how seriously the threat of China’s quantum advances are being taken by the world’s most valuable technology company. Read further at: [Why the threat of a 'nightmare' Chinese supercomputer just got a step closer \(telegraph.co.uk\)](https://www.telegraph.co.uk)



THE UK ECONOMY



Utilising Microsoft's AI based co-pilot for the first time, we commence this section with a summary of the UK economy's facts & figures. First, the key *facts*. The economy is dominated by the Services industries which include:

- ❖ **Finance** – London as a global hub plays a pivotal role; it is the second largest financial centre globally following New York. The city hosts major banks, insurance companies and investment firms. Services such as banking, insurance and asset management are vital exports.
- ❖ **Professional services** – The UK excels in providing professional services such as legal, accounting and consulting; these services are in high demand globally.
- ❖ **Education and Training** – British universities attract international students, contributing to the economy through tuition fees and related services.
- ❖ **Creative industries** – This sector includes film, music, fashion and design; these have a global audience.
- ❖ **Tourism and Hospitality** – The UK's rich history, cultural heritage and iconic landmarks draw substantial numbers of tourists; services related to tourism, hospitality, leisure and travel are significant exports.
- ❖ **Information Technology and Software** – The UK is a hub for tech start-ups, software development and IT services.
- ❖ **Healthcare and Pharmaceuticals** – The UK is a major player in medical research and healthcare services.
- ❖ **Retail** – everything from high street shops to on-line sales.

In addition, at least four other industries should be mentioned:

- ❖ **Manufacturing** – in particular, aerospace, automobiles and pharmaceuticals for the domestic and international markets.
- ❖ **Construction** – including infrastructure, residential properties and commercial spaces.
- ❖ **Agriculture** – smaller in comparison with the other industries above, but essential for food production and rural communities.
- ❖ **Utilities** – especially energy, water supply and waste management.

The UK economy is a highly developed social market economy. Now, the key *figures*:

- ❖ **Gross Domestic Product** – The UK has the sixth largest nominal GDP in the world, amounting to £3,332 Trillion in 2023. When considering purchasing power parity (PPP) it ranks tenth globally with a GDP of £3,872 Trillion.
- ❖ **GDP Growth** – In 2022 the UK experienced a 4.1% GDP growth, but this slowed down to 0.5% in 2023, and is projected to be 0.6% in 2024.
- ❖ **GDP per Capita** – The nominal GDP per capita stands at £38,519 while the PPP adjusted figure is £44,78.
- ❖ **Inflation** – As of January 2024 the Consumer Price Index inflation rate was 4%.
- ❖ **Unemployment** – 3.8% with approximately 1,320,000 people unemployed.
- ❖ **Exports** - £855.4 Billion in the 12 months leading up to end-January 2024.
- ❖ **Imports** – £891.9 Billion in the same period.

Additionally, recent developments indicate that the UK economy has shown resilience. Contrary to earlier estimates of contraction the economy grew by 1.8% since the pandemic began with 0.3% growth in the first quarter of 2024.

Now we continue with our chronological news reports since the Winter 2023/24 Newsletter:

➤ **4 February 2024**

Peter Lilley writes in The Telegraph that “Controlling our own trade policy means we are able to negotiate the right deals for Britain”. He highlights the Government’s Brexit - 4th Anniversary (publishing.service.gov.uk) published by Kemi Badenoch, the Business and Trade Secretary. See: Don’t be fooled by the Blob, Brexit is already paying dividends ([telegraph.co.uk](https://www.telegraph.co.uk))

On the same day Matthew Lynn reports that “Big tech is about to change the stock market forever, and that the transformation of industry giants will be a watershed moment for global markets”. Read: Big tech is about to change the stock market forever ([msn.com](https://www.msn.com))

➤ 24 February 2024

Staying with Matthew Lynn on the economy, he writes that: The Office for Budget Responsibility and the Bank of England were against her. The quangos were intent on sabotaging her plans. And the civil service set itself against her plans, as did the IMF and even US President Joe Biden. Liz Truss did not mince her words in her speech in the United States this week, blaming the “deep state” for blocking her attempt to drag the British economy out of stagnation.

Sure, Truss bears part of the blame for her own failure. The timing and presentation of the mini-Budget, and more pertinently the huge energy bills support package, gave financial markets fright. But she is also on to something. The “wokenomics” she called out in her speech is fatally undermining the economy. Until we find a way to fix that, we will never get back to the 2pc-plus growth rates we surely need if we are to have any hope of maintaining our standard of living.

It was a more sympathetic audience than one she is likely to find in the UK anymore. In her speech in Maryland, Truss took apart the forces that, in her view, blew up her short Premiership. “There’s a whole bunch of people – and I describe them as the economic establishment – who fundamentally don’t want the status quo to change because they’re doing quite fine out of it. They don’t really care about the prospects of the average person in Britain and they didn’t want things to change and they didn’t want that power taken away.”

In short, the lesson she has learnt from her short time in office is that the “deep state”, as the Americans call it, was so horrified by the assault on its privileges that it was actively working to undermine her. True, it might be self-serving, and the reality may be more nuanced, but in fact Truss is making a valid point. In the 18 months since spineless Tory backbenchers evicted her from office, her fundamental point about Britain’s miserable growth rate has become more and more glaringly obvious to everyone. The idea that simply stabilising the economy with tax rises to balance the books would restore growth has been exposed as a complete sham. Instead we have destroyed incentives with huge increases in tax rates, but we have still collapsed into a recession, with a shrinking labour force, and miserable levels of investment. Read on at: [The ‘greedy good’ are destroying Britain’s economy \(msn.com\)](#)

➤ 13 March 2024

James Titcomb reports that the Government is cracking down on exports of quantum computers to foreign buyers amid mounting concerns that the technology could be weaponised by foreign militaries. Exporters will be banned from selling powerful quantum computers unless they obtain a licence from the start of this month. The technology has been added to a list of “dual use” items that could have military uses maintained by the Export Control Joint Unit which scrutinises sales of sensitive goods. It comes as both China and Russia make substantial investments in quantum technology as part of what has been described as a global race.

Quantum computers harness the peculiar qualities of quantum physics in a way that could see them vastly outpace traditional supercomputers in some areas, such as developing chemicals and cracking secure communications. A national quantum computer strategy published last year described the technology as being “critically important” for defence and national security and said the UK was in a “global race” to develop it.

The Department for Business and Trade updated export rules this week to add multiple technologies related to quantum computers. They include any quantum computer featuring more than 34 “qubits” – a measure of how advanced and powerful quantum computers are. Google has developed a 70-qubit quantum computer while IBM has built a machine with 1,121 qubits. Several companies have ambitions to build million-qubit computers, which could reshape science by inventing new materials and chemicals, modelling climate change and running advanced artificial intelligence systems.

There are also concerns that the systems will make it simple to decode secret communications, and intelligence agencies are believed to be harvesting encrypted messages today in the hope they will one day be able to read them. The restrictions also include semiconductors that work at the ultra-low temperatures close to absolute zero at which quantum computers typically operate, and the cryogenic cooling systems used to keep the systems cold. Read on at: [Britain curbs quantum computer exports over weaponisation fears \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/technology/2024/03/22/britain-curbs-quantum-computer-exports-over-weaponisation-fears/)

➤ 22 March 2024

Ambrose Evans-Pritchard suggests that Britain is trying to launch a nuclear renaissance on the cheap. He writes that it can pioneer small modular reactors, or push its world-class breakthroughs in nuclear fusion, or make a giant national bet on a fleet of old-style reactors, but it cannot do all three under the current fiscal regime without spreading itself too thin.

The Government’s nuclear plans are a formula for scattering taxpayer money in an attempt to keep everybody happy, without reaching critical mass on any front. It risks ending in a familiar British U-turn when funds run short. Given that the Treasury plans to cut public investment to the bone by the late 2020s (to 1.8pc of GDP), the strategy is not credible. Labour has been so coy about its plans that we are left no wiser about what it would do.

The rule of thumb for big gigawatt nuclear power is that you must either commit hard, or leave well alone. It takes a fleet of new reactors to reap serious economies of scale - the strategy pursued with success by South Korea, or by France in the 1970s. “You have to do this properly. You need several projects of two reactors each of the same design to get this going,” said Dr Tim Stone, chairman of the Nuclear Industry Association.

The worst policy is to dabble in ones or twos, as seems to be happening with the over-complicated EPR plant at Hinkley Point C, now expected to cost £31bn-34bn (2015 prices) with a further delay of four years, followed by something similar at Sizewell C. It is true that Hinkley’s exorbitant strike price of £128 MWh (inflation-adjusted) is not a fair reflection of cost. Each successor should be cheaper. The strike price expires after 35 years. “Modern reactors have a design life of 60 years, but they could well run for 80 or even 100 years. That cuts long-term energy costs dramatically,” said Dr Stone.

Made in Britain: The Pathway to a Nuclear Renaissance, a joint report by the Commons and the Lords, spells out what a coherent strategy should look like. The Government should outline the full list of projects to 2050, make it a critical national priority, provide real money and require the use of British supply chains.

Scale would make Big Fission cheap enough to be competitive. But the power would not arrive until after 2035, by which time offshore wind coupled with gas peaker plants will already be the backbone of the system, and the UK will have decarbonised the grid – a glaring contradiction flagged by the

Environmental Audit Committee. So unless the strategy is to export nuclear power to Europe via a nexus of yet-unbuilt interconnectors, or use it 24/7 to make green hydrogen – both plausible – we will often have a surfeit of inflexible baseload power, leading to a host of headaches.

The larger question is whether Big Fission will be yesterday's technology by then. Bill Gates's TerraPower is already far along with its sodium-cooled SMR in the US, claiming that it will halve nuclear costs and supply dispatchable power at just \$50-\$60 MWh. Read on at: [Britain could be a world leader in nuclear power, but not with old technology \(telegraph.co.uk\)](https://www.telegraph.co.uk/business/2024/04/05/britain-nuclear-power-technology/)

➤ 5 April 2024

Tom Rees reports for Bloomberg UK that the UK economy's rebound from recession appeared to be gathering momentum in March, with a key industry survey showing growth across all three main sectors for the first time in almost two years. The report was the last of the major sectors covered by the PMI — services, manufacturing and construction — to show growth and marked the first time since June 2022 that they expanded together. Read on at: [UK Economy Is Growing Again in All Major Sectors, Survey Shows - Bloomberg](https://www.bloomberg.com/news/articles/2024-04-05/uk-economy-is-growing-again-in-all-major-sectors-survey-shows-bloomberg)

➤ 9 April 2024

Ambrose Evans-Pritchard write that: The wheel of economic fortune in Europe is turning. Britain is no longer the default poster-child of everything going wrong at once. Rating vigilantes are switching their sights to the spending excesses of Emmanuel Macron, once the acclaimed *Mozart de la finance* but now facing the prospect of a parliamentary inquiry and a vote of censure on charges of fiscal ruination.

They will soon take a closer look at Italy too as the fallout from a subsidised construction bubble becomes clear. The Italian growth “miracle” of the last two years is the mechanical consequence of a “superbonus” for fixing up homes – including eight private castles – that is expected to cost the taxpayer almost €200bn (£171bn) when the damage is revealed this week. The budget deficit for 2023 may ultimately hit 10pc of GDP. If that can't buy you a false boom, nothing can. Scope Ratings says Italy could become ineligible for bond purchases under the European Central Bank's spread control tool (TPI). That in turn brings Italian solvency back into focus. Meloni mania is over.

It is churlish to pick on President Macron on the 120th anniversary of the Entente Cordiale, as he lavishes warm words on Britain and buries the Brexit hatchet. The Garde Républicaine took part in the Changing of the Guard on Monday. Nor should one underestimate the deep economic and strategic strengths of France. To do that would be the mirror reflex of those prone to catastrophising about everything in post-referendum Britain.

Yet fiscal largesse has clearly flattered France's economic growth since the pandemic – just as Joe Biden's mega-deficits have flattered US growth. Not much of the borrowing has been used for public investment with a high economic multiplier. It has mostly been “bad” transfer debt rather than “good” productive debt. The Cour des Comptes says Mr Macron has allowed a careless degradation of the public finances, and will now face a reckoning. “The budget for 2025 is going to be the most brutal since the financial crisis,” it said.

Both France and Italy face the long grind of retrenchment, again governed by the EU Stability Pact. It is bad enough to endure your own austerity, it is worse yet to have it imposed by ordoliberal budget commissars in Brussels.

Britain will also have to retrench but it will do so under its own institutions, led by a newly elected Labour government with a fat majority and a stock of political capital. Fitch Ratings upgraded the UK's sovereign debt to AA- in March, lifting the negative outlook imposed after the Truss accident in 2022. They waited too long. The striking feature of that episode is how skilfully the Bank of England contained the damage, and how quickly Britain's political machinery restored order.

Fitch's argument is not just that the UK's budget deficit is on a downward glidepath but also that the country still scores well on the World Bank Governance Indicators, covering regulatory quality, rule of law, corruption, stability, and even 'government effectiveness' – believe it or not. The UK slipped badly in 2022 but still ranks higher than France, and much higher than Italy or the US. Read further at: [Britain is on the mend while France and Italy head for trouble \(msn.com\)](https://www.msn.com/en-gb/news/economy/budget/budget-2023-uk-fitch-rates-uk-credit-rating-stable-at-aaa-but-downgrades-outlook-to-negative/pager-ref=msn.com)

➤ **10 April 2024**

An increase in Services trade has lifted the UK into the position of the World's fourth largest exporter according to new data published by the UN Conference on Trade and Development (UNCTAD). As reported by City AM, a boom in exports of professional services has played a major role in the increase, with the value of research, consulting and technical and trade services contributing £185bn to the numbers.

The UK ranked seventh in 2021 according to UNCTAD’s figures, and its progress up the rankings was welcomed by business and trade secretary Kemi Badenoch. She said: “These new figures show how the UK is punching above its weight on trade, and is on track to reach our ambition of exporting a trillion pounds of goods and services a year by 2030. The appetite for world-class UK produce continues to grow and this government will keep supporting our brilliant businesses, helping to create more jobs, pay higher wages and grow the economy.”

Travel services were also among those whose value increased in the latest figures, with exports hitting £59bn, making the UK the world's third-largest exporter in the sector in 2023. Telecoms and computer services exports also hit £40bn. See the full report at: [UK becomes world's fourth largest exporter as services boom](#)



AEROSPACE MANUFACTURING



Credit: Spirit AeroSystems

Now that Spring has arrived we commence this section with an extract from Deloitte’s ‘2024 aerospace and defense industry outlook’. Please note that whilst this global consultancy focuses the outlook on the USA, the aerospace & defence (A&D) industry itself is very global, so the contents can most certainly be read across to the rest of the ‘western’ world at least. Indeed, the USA, UK, France, Germany and Canada combined account for 75% of the world’s entire aerospace industry.

In 2023, the A&D industry witnessed a revival in product demand. In the aerospace sector, domestic commercial aviation revenue passenger kilometres surpassed pre-pandemic levels in most countries. This surge in air travel led to an increased demand for new aircraft and aftermarket products and services. In the US defense sector, new geopolitical challenges, along with the prioritization of modernizing the military, drove robust demand in 2023, particularly for weapons and next-generation capabilities.

The demand for A&D products and services is expected to continue into 2024. On the commercial side, travel is likely to continue its upward trajectory. In the defense segment, demand for products is expected to continue to increase as geopolitical instability grows. Furthermore, companies in emerging markets, such as advanced air mobility, are expected to advance testing and certification as they prepare for commercialization.

While these trends are likely to drive both domestic and international spending, the increased demand may cause A&D companies to deal with new challenges as they grapple with ongoing ones such as supply chain issues, longer lead times, and a talent shortage.

To address these challenges, A&D companies may further embrace digitalization and adopt emerging, advanced technologies and, thus, could achieve profitability by both addressing their cost challenges and initiating the development of novel revenue streams. Such technologies may be foundational for A&D companies in creating a more resilient supply chain, mitigating logistical issues, attracting new talent, and rapidly creating new products. As A&D companies prepare for the year ahead, there are some key trends they may consider focusing on to take on the challenges and capitalize on emerging opportunities, with digitalization being the unifying theme across the trends.

Recognising the purpose of the ACP this Newsletter focuses on one of those challenges – **Talent**.

The A&D industry is facing a new talent landscape that is mainly driven by increasing salary levels, increased employee mobility, a re-evaluation of employee relationships with the workplace, and an intensely competitive job market. Evolving employee expectations, which have only amplified since the pandemic, have often made it challenging for A&D companies to attract, retain, and develop a skilled workforce. These workforce issues could prove to be a significant pain point for A&D companies as they begin to scale production operations to meet growing demand across the industry.

Attracting talent

The US A&D industry has surpassed pre-pandemic levels in terms of employment. In 2022, US-based A&D companies increased their workforce by 101,700 to 2.2 million, marking a 4.87% increase from 2021 and surpassing pre-pandemic 2019 levels of 2.18 million.

Despite the rise in workforce numbers, A&D companies are likely to face talent shortages. These shortages may hamper production demands resulting from domestic travel increases and nations increasing their armament stockpiles. Currently, the industry is struggling to attract talent, ranging from technicians and manufacturers to engineers. One leading Asia-based engineering company noted that the shortage of technicians may lead to increased maintenance costs and impact fleet expansion forecasts. Furthermore, in the National Association of Manufacturers' (NAM) 2023 third quarter manufacturers' outlook survey, about three out of four surveyed US manufacturers stated that attracting and retaining a quality workforce is their primary business challenge.

The manufacturing industry, including A&D manufacturing, is increasingly competing with other industries for skilled talent. A&D companies recognize this, as top talent with digital skills can be drawn to digital jobs within a multitude of areas, including automotive (for example, the battery electric vehicle and autonomous vehicle segments) and life sciences (for example, medical technology, and biotechnology).

A&D companies may need to expand their strategies beyond compensation to accommodate the changing needs of the workforce. The US A&D industry has an annual average salary of US\$108,900 which is approximately 55% above the national average. That said, many Gen Z employees are keen to have careers with broad impact and a purpose. These companies may attract talent with mission-focused marketing campaigns and undertake more strategic recruitment to ensure that the values of the employees and the company align.

Retaining talent

Despite a significant number of new hires, job openings in the manufacturing industry were still 604,000 in August 2023. Additionally, quits accounted for about 68% of total separations. To compete in a tightening labor market, A&D companies will likely address both talent attraction and, potentially more significantly, talent retention issues. The A&D industry has high requirements and expectations for its employees, including specific educational criteria and security clearances. This could necessitate a focus on retaining talent, especially with the increasing number of retirees.

Historically, these companies have succeeded with a workforce that possesses deep experience and a strong connection to the company culture. Therefore, given the competitive state of the job market, it is important for the industry to retain highly qualified workers. A&D companies are using compensation and flexible work arrangements to enhance retention and turn the tide of employee attrition.

This approach has been adopted by the manufacturing segment of the A&D industry where, according to Deloitte's 2024 manufacturing industry outlook, there was a rise of 4% in the average hourly earnings of employees between the first quarter of fiscal year 2022 and the first quarter of fiscal year 2023. Additionally, the manufacturing industry has undergone a significant shift toward remote work over the last two years, during which there has been a 19% reduction in the average number of quits.

The retention levels of A&D companies could plateau at a certain point if they continue to only offer flexibility benefits. According to the NAM's 2023 second quarter manufacturers' outlook survey, inflexible production, shift needs, and the creation of differences between workforce populations are some major challenges manufacturers face when offering such flexibility to workers. The industry will likely explore new avenues to both attract and retain talent.

Pursuing and implementing emerging technology can help not only address profit margins, but also invigorate a workforce. Regardless of an employee's job description, A&D companies may begin to consider initiating new programs that allow employees to engage with advanced technologies, which may include tech-based rotational programs or designated time to pursue passion projects within the company.

Developing talent

With an increasing number of retirements and an aging workforce (about 26% of the A&D workforce is over the age of 55), the industry should train younger professionals for long-term sustainable operations and security. A&D companies can upskill their workforce by developing more learning avenues in alignment with the technological evolution within the industry. These avenues may include:

- ❖ Working closely with colleges to create novel training and workforce development programs.*
- ❖ Expanding internships, apprenticeships, and other career development initiatives.*
- ❖ Furthering cooperative research agreements with tier one research universities.*

Employees in the A&D sector, across all career levels, should be educated on the importance of cybersecurity and should possess a clear understanding of their specific responsibilities in upholding a secure environment. And in line with that, A&D companies' workforce development strategies will not only attract and retain talent but can also help ensure a secure environment for them.

We continue below with our chronological news reporting:

➤ **1 February 2024**



Source: BAE Systems

T-650 Heavy Lift Electric UAS Concept Vehicle

Matt Oliver, Industry Editor of The Telegraph, reports that BAE Systems is developing a new generation of heavy-lift military drones that can evacuate wounded troops and deliver supplies after snapping up a fast-growing British manufacturer.

The FTSE 100 defence giant on Thursday sealed a takeover of Malloy Aeronautics for an undisclosed sum, The Telegraph can reveal. Berkshire-based Malloy is behind drones that the UK government has bought and supplied to Ukraine during the country's war with Russia. The takeover bolsters BAE's presence in the rapidly growing market for unmanned aircraft, with the technology seen as having huge potential for both military and civil applications.

BAE is working with Malloy to develop the electric-powered T-650 drone which can transport payloads of up to 300 kilograms – about the typical weight of a grand piano. The T-650 will be able to have a range of attachments and different uses, including a “pod” that could eventually be used to safely transport wounded soldiers away from the front line of battle.

Malloy's drones have been used in Ukraine to deliver supplies and may be used in future to deploy missiles. Neil Appleton, a BAE executive who is now taking over as chief executive of Malloy, said the heavy-lift quadcopter drones had the potential to become “the Land Rover of the air” because of their versatility. Read on at: [BAE developing ‘Land Rover of the sky’ that can transport troops \(telegraph.co.uk\)](https://www.telegraph.co.uk/technology/2024/02/01/bae-developing-land-rover-of-the-sky-that-can-transport-troops/)

➤ 18 February 2024

Matthew Lynn explains why Airbus [may be] poised to seize control of the skies. He writes that for almost half a century, Airbus and Boeing have been fighting each other for control of the civil aerospace market, with the European consortium typically the plucky underdog in that contest. And yet, there are now signs that Airbus is pulling ahead. The trouble is, when it released its results last week, Airbus was far too forgiving of its arch-rival. In reality, this is the moment for it to go in for the kill. It should finish off Boeing for good – and its shareholders should get behind that.

For a company that has often been written off as a vanity project of the French state, and one that was hooked on subsidies and handouts, Airbus reported very robust results last week. Its revenues climbed by 11pc to €65bn (£46bn), while operating profits rose by 4pc to €5.8bn. Its chief executive, Guillaume Faury, confirmed that it would be stepping up production of its best-selling A320 model to 75 planes a month by 2026, and that in total it planned to deliver 800 aircraft this year, 65 more than in 2023. Along the way, shareholders would be rewarded with a special dividend.

The company, which still has a major presence in the UK with the wings for its planes made at its factory in Broughton near [Chester] is finally coming into its own. It has a clear lead over Boeing, and has turned itself into the world's dominant plane maker.

The contrast with Boeing could hardly be more painful. The company's 737 has been dogged by safety issues. Only last month the door [plug] blew off an Alaska Airlines 737-9 Max jet, the latest in a long line of issues with the plane. Regulators have started putting its manufacturing facilities under greater scrutiny, while much of the Max fleet was grounded for almost two years after crashes in Indonesia and Ethiopia. In an industry where safety is paramount, it has squandered a reputation for both innovation and excellence that it took a century to create.

The divergence in the fortunes of the two companies can be clearly seen in their respective share prices. Airbus's shares are up by 30pc over the last five years, while Boeing's are down by 50pc, and that is starting to accelerate. Read more at: [Airbus should finish off its rival while it has the chance \(telegraph.co.uk\)](https://www.telegraph.co.uk/business/2024/02/18/airbus-should-finish-off-boeing-while-it-has-the-chance/)

➤ 21 February 2024

Matt Oliver reports that “Western countries face a years-long battle to rebuild their defence industries as they scramble to re-arm in the face of Russian aggression”, the boss of BAE Systems has said. Charles Woodburn warned that ramping up production of munitions, guns and vehicles “takes time”, after post-Cold War cuts to European defence spending forced companies to scale back their capacity. BAE on Wednesday said it had amassed a record £70bn backlog of orders by the end of last year, as global tensions spurred demand for weapons and military equipment.

In Europe, governments have been urging arms manufacturers to increase production of ammunition as fast as possible, so they can continue to support Ukrainian forces against Russia while also replenishing their own diminished stockpiles. But that effort has so far taken longer than hoped, with the European Union currently on course to deliver only half of the one million 155 millimetre artillery shells it has promised Kyiv by March.

Asked whether manufacturers were able to meet demand, Mr Woodburn said: “What we [manufacturers] are all doing is adding capacity and we’ve said since the beginning of the conflict in Ukraine that you can add capacity just by adding people and getting more out of your existing footprint - that might give you, at best, maybe double your output out of a facility”.

“But of course, what people are looking for now is multiples of that, particularly on munitions, and that then requires investments around machinery, footprint, foundries, and all of that takes time to put into place. With the best [will] in the world, it’s a year and a half or two years by the time you’ve built that. We’re working as rapidly as possible, but it does take a bit of time.”

For its part, BAE has ramped up production of Nato-standard 155mm shells at its factory in Washington, Sunderland, following new orders from the Ministry of Defence. The site’s output has already been doubled with extra shifts but BAE is ultimately aiming to increase the figure eight-fold through investment in new factory lines. Mr Woodburn added that defence companies needed “a clear picture of requirements” over the long-term from western governments, amid questions over future levels of support for Ukraine. Read on at: [The West faces years-long battle to rearm, warns BAE Systems \(telegraph.co.uk\)](https://www.telegraph.co.uk/news/ukraine/2024/02/06/bae-systems-ukraine-arms-production/)

➤ **February 2024**

With companies around the world floating the idea of a seaplane comeback, in this month’s edition of AERO SPACE Jack Richardson investigates the candidates hoping to fly from lochs, lakes and oceans in the future.

And in the same edition Stephen Bridgewater talks with Shigeya Watanabe, Deputy Director General of the Japanese Aerospace Exploration Agency’s Aviation Technology Directorate to learn more about the research organisation’s current programmes.

Finally, Chris Wright reports from the UK General Aviation Group’s annual Light Aircraft Design Conference held last November at the RAeS premises in 4 Hamilton Place, London.

➤ **10 March 2024**

Isabelle Stanley reports that the US Air Force has launched a \$6 billion contract for 1,000 AI-piloted fighter jets that can fly 30ft above the ground at 600mph and make moves that are too dangerous for manned planes. The jets will bolster the current ailing and outdated fleet that leaders say is the smallest and oldest since the Air Force became a separate service in 1947.

The new fleet will be able to perform riskier manoeuvres than current unmanned aircraft, and will escort and protect crewed planes, carry weapons to attack targets on the ground and in the air and act as scouts. Five companies are bidding for the contract: Boeing, Lockheed Martin, Northrop Grumman, General Atomics and Anduril Industries, but only the Boeing Ghost Bat has been flown publicly. The Pentagon will choose two of the companies by summer to start building the jets and hopes to have hundreds completed within five years at an estimated cost of \$10 to \$20 million per plane. See: [Pentagon's plan for AI piloted ghost fighter jets: Air Force is backing \\$6BILLION program for 1,000 robot 'mini fighters' that can fly 30ft above the ground at 600mph | Daily Mail Online](https://www.dailymail.co.uk/science-technology/article-12345678/Pentagon-AI-piloted-ghost-fighter-jets-Air-Force-backing-6-billion-program-1000-robot-mini-fighters-30ft-ground-600mph/)

➤ 25 March 2024

Michael Crossland writes in the Yorkshire Post that the City of Doncaster Council has announced it has agreed a location for the production of a new multi-function helium filled airship, titled the Airlander 10. The council has announced that the production facility will be located at Carcroft Common, with Hybrid Air Vehicles – the company behind the plan to build Airlander 10 – set to acquire the 50-hectare site to create its new centre for production, testing and certification operations. Hybrid Air Vehicles said the plans will create over £1bn in export and more than 1,200 green jobs. Airlander 10 is a new type of ultra-low emissions aircraft capable of carrying 100 passengers, or ten tonnes of payload. The reserved orderbook for Airlander 10 stands in excess of £1bn, with the first aircraft set to enter service from 2028 with the likes of Air Nostrum Group. Read further at: [Airlander 10: Doncaster council announces site for production of new low emissions aircraft \(yorkshirepost.co.uk\)](https://www.yorkshirepost.co.uk/news/airlander-10-doncaster-council-announces-site-for-production-of-new-low-emissions-aircraft/)

Also this day Matt Oliver reports that the chief executive and chairman of Boeing will both stand down this year in the wake of a major safety failure that saw a door plug blow out in midair from one of the aerospace giant's planes. David Calhoun is to depart the company at the end of 2024, the company said in a statement, while chairman Larry Kellner will quit following the annual general meeting in May. On Monday Boeing also confirmed Stan Deal, the boss of Boeing Commercial Airplanes, was leaving "effective immediately". Boeing's shares rose following the announcement.

The management clear-out underlines the continuing seriousness of the safety crisis for Boeing following an incident involving a Boeing 737 Max 9 plane in January. At 16,000ft, about nine minutes into an Alaska Airlines flight that took off from Portland, Oregon, pilots were forced to turn around and make an emergency landing after a door plug blew out – depressurising the cabin and leaving a hole in the side of the aircraft. It later emerged that a 15-year-old boy and his mother had been sitting next to where the blowout occurred and that the boy's shirt, as well as his seat's headrest, had been sucked out of the hole while she clung on to him.

In the wake of the incident – thought to have been caused by missing bolts in the door panel – Boeing has been scrambling to reassure customers, regulators and air travellers over its safety record. Several customers have been publicly critical of the company, with the boss of Alaska Airlines saying he was "angry" and the chief executive of United Airlines describing the blowout as "the straw that broke the camel's back for us".

Mr Calhoun has previously admitted that the incident left company bosses "shaken to the bone" and has vowed to put a renewed focus on safety in the aftermath. On Monday, Boeing's statement to shareholders gave no reason for his departure but said Mr Calhoun had taken the decision himself. It added that Mr Calhoun would stay until the end of the year to "complete the critical work underway to stabilise and position the company for the future". Read on at: [Boeing shares rise after bosses announce departure \(yahoo.com\)](https://www.yahoo.com/news/boeing-shares-rise-after-bosses-announce-departure-120000789.html)

➤ 28 March 2024

David Axe comments in The Telegraph that the US Air Force's Lockheed Martin F-22 Raptor stealth fighter has gotten (sic) a major upgrade as the iconic warplane nears its third decade of front-line service and retirement. The F-22 is the most powerful and sophisticated fighter in the world, but it has its weaknesses. Keenly aware of the F-22's limitations – especially with regard to range – the Air

Force is hastening the twin-engine, single-seat jet to an early demise. At the same time, the flying branch is spending billions of dollars to ensure that once the Raptor bows out, something even better – a radar-evading jet without the F-22’s main problem – is ready to take its place.

Many observers of American air power bemoan the Raptor’s planned early end, fewer than 30 years after the type deployed on its first front-line operation. It’s not unusual for a modern American fighter – for instance the Lockheed Martin F-16 or Boeing F-15 – to fly for 40 years or longer. With upgrades, of course. That the Air Force is so eager to replace its *best* fighter says a lot about how, and where, USAF leaders anticipate future wars will play out. Specifically, at great distances over the vast western Pacific Ocean during, say, a Chinese attack on Taiwan. The American air arm is betting that the warplane it is designing to supplant the F-22 will be much better-suited for that kind of conflict. And they are probably right.

The \$300-million-a-copy F-22 had a long gestation. It grew out of the Advanced Tactical Fighter initiative in the 1980s, first flew in demonstrator form in 1990, completed development in 2005, first deployed, to Japan, in 2006 and finished production – of just 195 planes – in 2012. The type fired its first shots in anger during the air campaign versus Islamic State in 2014. Today, it routinely deploys to the Pacific region to deter China, and to Europe to deter Russia.

Despite its futuristic, hard-to-detect shape and blistering performance – unusually, it can “supercruise” at twice the speed of sound without igniting its fuel-thirsty afterburners – in its bones the F-22 is a Cold War jet. Lockheed designed it to battle the Soviet Union from bases in Europe, meaning poor endurance wasn’t really an issue. An F-22 can range just 600 miles or so on internal fuel: plenty far enough to fight over Germany and Poland. Read on at: [World’s best fighter jet gets an upgrade for war against China \(yahoo.com\)](#)

➤ **March 2024**

In the March edition of the RAeS journal, AERO SPACE, Jack Richardson reports from MBDA’s missile facilities in Germany as well as from the Complex Weapons Innovation and Technology Partnership conference in Edinburgh on ‘Innovating next-gen missile technology’.

➤ **April 2024**

And not surprisingly in their April edition, with Boeing’s high-profile problems dominating the aviation industry’s news, Scott Hamilton in an article entitled ‘Boeing at the cross-roads’ looks back at how the global company reached this point and what it can do to get back on track.

In addition, Tim Robinson and Stephen Bridgewater report on the most exciting news and highlights from the 2024 Singapore Airshow in an article named ‘Enter the Dragon’.

Also, Charlotte Bailey visits Saab’s Linköping factory to find out what sets Gripen E apart from its earlier iterations.

And finally, with the prototype COMAC C919 performing during the Singapore Airshow, Alan Dron asks “What chance does China have of challenging the West’s commercial airliner duopoly for the next generation of passenger jets?”

COMMERCIAL AVIATION OPERATION



Source: CAA

CAA Aviation House

The Civil Aviation Authority (CAA) is the statutory corporation which oversees and regulates all aspects of civil aviation in the United Kingdom. Its areas of responsibility include:

- ❖ Supervising the issuing of pilots and aircraft engineers licences, testing of equipment, calibrating of nav aids, and many other inspections (Civil Aviation Flying Unit).
- ❖ Managing the regulation of security standards, including vetting of all personnel in the aviation industry (Directorate of Aviation Security).
- ❖ Overseeing the national protection scheme for customers abroad in the event of a travel company failure (Air Travel Organisers' Licensing – ATOL).

The CAA is a public corporation of the Department for Transport, liaising with the Government via the Standards Group of the Cabinet Office.

The CAA directly or indirectly regulates all aspects of aviation in the UK. In some aspects of aviation it is the primary regulator.

The UK government requires that the CAA's costs are met entirely from its charges on those whom it regulates. Unlike many other countries, there is no direct government funding of the CAA's work. It is classed as a public corporation, established by statute, in the public sector. The connection it has with the Government is via the machinery of government and the Standards Group of the Cabinet Office.

The CAA regulates (approximately):

- ❖ Active professional and private pilots (50,000)
- ❖ Licensed aircraft engineers (12,400)
- ❖ Air traffic controllers (2,350)
- ❖ Airlines (206)
- ❖ Licensed aerodromes (241)
- ❖ Organisations involved in the design, production and maintenance of aircraft (950)
- ❖ ATOL holders (2,400)
- ❖ Aircraft registered in the UK (19,000)
- ❖ Alternative Dispute Resolution providers

The CAA also oversees the Air Travel Organisers' Licensing (ATOL). By law, every UK travel company which sells air holidays and flights is required to hold an ATOL, which stands for Air Travel Organiser's Licence. If a travel company with an ATOL ceases trading, the ATOL scheme protects customers who had booked holidays with the firm. It ensures they do not get stranded abroad or lose money. The scheme is designed to reassure customers that their money is safe, and will provide assistance in the event of a travel company failure.

The CAA was established in 1972, under the terms of the Civil Aviation Act 1971, following the recommendations of a government committee chaired by Sir Ronald Edwards. The CAA has been a public corporation of the Department for Transport since then. The Air Registration Board became the Airworthiness Division of the Authority.

The Civil Aviation Act 1982 was an act of Parliament to address evolving conditions, and currently governs air flight in the UK. Responsibility for air traffic control in the UK passed to NATS in the run-up to the establishment of its public-private partnership in 2001.

From 1 April 2014, the CAA took over a number of aviation security functions from the Department for Transport. The new Directorate of Aviation Security within the CAA now manages rule-making and compliance to deliver proportionate and focussed regulation for UK aviation to ensure the highest standards of security across the civil aviation sector. Air Safety Support International, a subsidiary of the CAA, is responsible for air safety in the British Overseas Territories. The CAA also manages all national security vetting for the aviation industry.

The United Kingdom was a member of the Joint Aviation Authorities, which became the European Aviation Safety Agency. Following Brexit and a transition period, the United Kingdom left EASA on 31 December 2020. The transport secretary Grant Shapps said "As you would expect from an independent nation, we can't be subject to the rules and laws made by somebody else, so we can't accept rules from the EU commission and we can't accept rulings in terms of court cases from the European court of justice or anybody else, any more than the US would".

Sir Stephen Hillier is the current Chair. The present Chief Executive is Rob Rishton.

The CAA head office is located in Aviation House on the grounds of Gatwick Airport in Crawley, Sussex. The Authority relocated from its previous London head office in early 2019, moving its head office functions to its existing office at Aviation House, as well as opening a new London branch office at Westferry Circus, Canary Wharf by that July.

For those readers interested in a career with the CAA please see: [Careers at Civil Aviation Authority \(caa.co.uk\)](https://caa.co.uk)

We continue with two very significant reports, the first concerning the future of Heathrow Airport.

Ben Marlow and Luke Barr – with additional reporting by Matt Oliver and Lucy Burton - explain on 10 March “How the UK’s biggest airport seeks to wave goodbye to turbulent times”. They go on to write that the arrival of VIR100 at JFK from Heathrow in late November was billed as an aviation milestone. Decked out in the familiar red and white livery of Virgin Atlantic, and carrying a certain bearded billionaire, it was the first commercial flight fuelled by a “sustainable” blend of cooking oil and animal fats.

Among the passengers that partied with Sir Richard Branson that evening at Virgin’s Manhattan hotel in the shadow of the Empire State Building, was Thomas Woldbye, the new boss of Heathrow Airport. The 59-year-old, fresh from 12 years in charge of Copenhagen Airport, happily mingled with aircrew and a gaggle of backbenchers who came along for the ride, but he would have been forgiven for being distracted by events unfolding 3,500 miles away back home.

As the canapes piled up, news reached the Dane that Heathrow’s biggest shareholder, Spanish construction giant Ferrovial, had sold its 25pc stake to an arm of the Saudi state and a French private equity house. Woldbye sought to play down any suggestion that the £2.4bn deal was a distraction. “As a management team, we focus on providing the best airport for our shareholders. All the negotiations that are going on are for our shareholders,” he said in an interview with The Telegraph.

Yet its significance to Heathrow’s future can hardly be overstated. Ferrovial’s planned exit has provided an opportunity for other shareholders such as Canadian pension fund CDPQ and GIC, Singapore’s sovereign wealth fund, to make their escape, too. Their “tag-along” rights allow them to find a buyer for their pieces of Heathrow at the same price. With as much as 60pc of Heathrow likely to change hands, the gateway to Britain is on track to wave goodbye to its most turbulent times as it bids farewell to one set of owners and welcomes another. A delayed revolution is finally coming in to land, many hope.

Critics accuse successive governments of wrongly allowing this country’s biggest airport to become a cash cow to be milked by overseas shareholders at the expense of much-needed investment. They helped themselves to £4bn of dividends before the pandemic, and even a £106m payment during the downturn. Starved of capital and laden with billions of pounds of debt that has helped to finance generous payouts to its owners, for some passengers and airlines Heathrow has become a tired, overcrowded airport more synonymous with delays and queues than world-class travel. Plans for a third runway at Heathrow that would dramatically boost capacity have become a withered symbol of the malaise.

The weight of Heathrow’s borrowings was laid out in its latest financial results as it swung to a pre-tax profit of £38m in 2023 from a £684m loss the previous year. The airport forked out £1.5bn in interest payments as its debt pile climbed from £15.8bn to £16.8bn.

As it has lurched from one major crisis to another, the former London Airport has tumbled down the global rankings from the second busiest hub at the turn of the century behind Atlanta's Hartsfield-Jackson to eighth place, behind Dubai, Paris, and Istanbul.

Some have questioned whether Heathrow's demise is emblematic of inexorable national decline. More hopeful players believe the arrival of new shareholders led by Saudi Arabia's ambitious ruler Crown Prince Mohammed bin Salman, together with the appointment of Woldbye, could herald a renaissance that restores some of Heathrow's – and so the UK's – prestige.

“Do we want to let Heathrow's competitiveness slip away or are we going to find a way to hold on to it?” aviation consultant John Strickland asks. It is a question that Sir Keir Starmer will find himself grappling with if he gets the keys to Number 10. In the coming weeks, hundreds of workers at Heathrow are due to walk out, causing serious disruption to getaways and business trips. More than 600 Border Force officers are threatening to hit the picket line over the school holidays, potentially scuppering the Easter holiday plans of tens of thousands of families. Officers have been balloted in a dispute over shift patterns and working conditions.

Meanwhile, a separate dispute over a proposal to outsource the airport's security to third-party contractors could lead to yet further damaging strikes that hit the summer schedule. The cost-cutting plans form part of Woldbye's bid to identify £400m of savings. Union chiefs at Unite, who are spearheading the revolt, have criticised the airport for “choosing to attack workers out of sheer greed”. “The only ones to benefit will be Heathrow's already immensely wealthy owners”, Unite told The Telegraph last month.

Woldbye insists that there is a pressing need to plug a funding gap caused by a reduction in the charges it can impose on the airlines that fly in and out of Heathrow multiple times a day. Management can ill afford yet another bout of bad publicity if they are to restore Heathrow's reputation.

In 2008, Terminal 5 opened. Some 20 years in the planning, costing £4.3bn and designed to handle 35m passengers a year, the shiny building was supposed to herald a bold new era, but it descended into chaos on its opening day after the baggage system collapsed. “Heathrow Hassle” was born.

The airport returned to front pages after the pandemic, when holidaymakers were repeatedly met with chaotic scenes. The post-Covid rebound in international travel should have been a moment to savour as millions of consumers responded to the lifting of restrictions by blowing their lockdown savings on holidays. Yet without plans in place to cope, airports quickly buckled. Travellers were greeted by staff shortages, delays, cancellations, and queues snaking out of the departure hall. At Heathrow, luggage problems reached farcical levels. Some were asked to drop bags off the day before a flight. At one stage, a meltdown in Heathrow's handling system left luggage piled up around the airport. Pilots were seen helping to load and unload suitcases.

Airlines' frustration with Heathrow boiled over when it announced a cap on passengers and asked them to stop selling tickets. Emirates blasted the airport's “incompetence”, accusing it of choosing “not to act, not to plan, not to invest”, and refusing to cut passenger numbers. Ex-British Airways boss, and now head of the International Air Transport Association (Iata) Willie Walsh, claimed Heathrow was trying to “maximise the profitability that they get from the airport at the expense of airlines”.

The airport's then-boss John Holland-Kaye dismissed the backlash as "bizarre", arguing that much of the disruption was due to a dearth of ground-handling staff, which the airlines were responsible for providing.

An attempt by Heathrow to ramp up charges infuriated the airline industry even further, triggering a bitter war of words and shining a fresh spotlight on its owners. Luis Gallego, chief executive at BA parent International Airlines Group, claimed that Heathrow already charged three times more per passenger than other major airports in Europe including Gatwick and Madrid, and five times more than Dublin, and accused it of prioritising investor payouts over service. "High charges, designed to reward shareholders at the expense of customers, risk undermining its competitiveness," Gallego said. After a long battle, the Civil Aviation Authority last year ordered Heathrow to cut its charges by 20pc to £25.43 per passenger. The airport had pushed for an increase to £40.

The contrast with rival hub airports couldn't be more stark. Dubai has been nicknamed "a great airport and airline with a city attached" – and with good reason. Dubai's location at the crossroads of Europe, Asia, and Africa has benefitted it hugely, enabling the rulers of the United Arab Emirates to bill it as a gateway for global trade and a magnet for airlines. But without the spectacular success of national flag carrier Emirates, and the construction of an airport that can cope with 90m passengers a year, the transformation of Dubai from a small fishing village to a bustling desert metropolis would have been impossible.

As the likes of Dubai airport have flourished, Heathrow has waned – something the former heads of the Airport Commission, Sir Howard Davies and Sir John Armitt, warned would happen in 2018 when the pair wrote to MPs urging them to vote in favour of a proposal to expand Heathrow. Its "strong links to established and emerging markets across the world... and the position it allows the UK to occupy at the heart of the global transport network are extremely valuable: supporting trade in goods and services, connecting friends and families, and enabling British companies, universities and other institutions to develop and maintain strong global networks", they said. However, "the continuation of this success cannot be taken for granted, and the rise of Dubai is only one indicator of the risks that the UK faces", Davies and Armitt said.

"The problem for Heathrow is that you need to be able to keep growing. And if you can't keep growing then you can't change and evolve very easily. So what has been happening is that transit traffic has been diminishing, going to other airports that have more capacity – increasingly in the Middle East," Alex Paterson, analyst at the City broker Peel Hunt, says.

Heathrow's saviour may lie over Dubai's western border in Saudi Arabia. Mohammed bin Salman hopes to emulate the success of his UAE neighbour, as well as that of the region's other major players Abu Dhabi's Etihad, and Qatar Airways, with plans for its own truly international airline, Riyadh Air. Aviation has been designated a key plank of the kingdom's "Vision 2030", a scheme of vast scale and ambition to make its economy less reliant on oil by turning Saudi Arabia into a magnet for tourism.

It has placed an order for 78 Boeing 787 Dreamliners – valued by the White House at \$37bn – that will become the fleet for Riyadh Air. Even larger sums are likely to be spent building a new airport in the capital that will accommodate 120m passengers by 2030. "I would have thought that the Saudis, given there are such close links with the UK, will see Heathrow as another prime gateway to the West. It's another bit of Saudi prestige in terms of their influence around the world," Strickland says.

“Heathrow will inevitably be part of the plan, they [Saudi Arabia] will clearly be involved in the strategic direction of the group, and they will want to own slots at Heathrow in order to grow connectivity from the UK to Saudi Arabia,” Paterson says.

Others remain convinced that the answer to Heathrow’s struggles still lies with a third runway.



What Heathrow Airport could look like in 2050 with a third runway and new terminals - Heathrow Airport/AFP/Getty Images© Provided by The Telegraph

At the turn of the millennium, the Department for Transport published some jaw-dropping figures: the number of airline passengers coming to Britain would jump from 160m a year to more than 400m by 2020. With the majority of these new passengers projected to pass through airports in the Southeast of England, the prediction triggered a national debate about the best way to increase capacity.

By 2003, then-transport secretary Alistair Darling had published plans for a third runway and a sixth terminal at Heathrow, along with permission for new runways at Stansted, Birmingham and Edinburgh. “It’s essential that we plan ahead to meet the pressures we know we’ll face as a result of a growing economy,” Darling told MPs.

After a decade of flip-flopping and fierce rows under Labour and then the Coalition, George Osborne established an independent Airports Commission in 2012 to try and build cross-party support for the controversial move. Chaired by Sir Howard Davies and reporting to the Department for Transport, it unanimously voted in favour of a new northwest runway at Heathrow in 2015. The move was finally given the green light in 2018, with MPs voting 415 to 119 in favour.

Almost six years later and not a single grain of earth has been cleared to make way for the 3.5km runway and accompanying taxiways that form the centrepiece of a £14bn plan the airport laid out shortly after it was approved.

Though opposition from locals and environmental campaigners remains fierce, the airport and its shareholders must decide whether to press ahead. Tory MP and former aviation minister Sir Robert Goodwill describes it as “a no-brainer”. “The issue at Heathrow is that there’s no spare capacity. They are chocker. I think it’s vitally important for UK plc that we increase capacity. As aviation becomes more sustainable, there’s no reason why it can’t expand.”

Business figures from across industries want to see Heathrow flourish. “It’s hard to overstate the importance of Heathrow, in practical and reputational terms, especially to business users. Heathrow, Dover and the internet are the main international gateways for business,” former GlaxoSmithKline and Sainsbury’s chairman Sir Philip Hampton says. “If our economy is to grow then we must export more. Businesses from Cornish tea growers to Scottish biscuit makers use it as a hub to access markets across the world,” Shevaun Haviland, director general of the British Chambers of Commerce, says.

Sir Howard believes the case for a third runway is still strong. “I remain of the view that if you want to expand long-haul airport capacity in the London region then Heathrow remains the best answer. An enormous amount of high value goods go out of Heathrow, and the infrastructure – the industrial parks and logistics centres – around it is absolutely massive. “Reconstructing that somewhere else is just unimaginable in my view. That’s easy to overlook but it’s very significant.”

Unfavourable comparisons with other countries are unavoidable for the business elite. Advertising chief Sir Martin Sorrell travels through Heathrow roughly once a week. Airports in Singapore and Dubai feel much slicker, he says. While those in more modern cities stand as a symbol of their rise and growing influence, Heathrow is in danger of being seen as emblematic of Britain’s diminishing global status. When Holland-Kaye said he envisaged Heathrow “kickstarting” Brexit Britain after Covid restrictions had been removed, IAG’s Gallego quipped that the airport was more likely to “thwart” it.

Heathrow could also be seen as a microcosm of so much that is wrong with the country today. Sir Martin, who runs digital advertising agency S4 Capital, returned from a trip to Milan struck by the airport’s advanced security screening machines that mean passengers aren’t required to take anything out of their hand luggage. Heathrow has been slow to invest in the same sort of technology, he points out. “It represents the image we have of the UK – insufficient investment and productivity,” he adds.

Others just want to see decisive action. “Air travel is key to bolstering connectivity, which is so vital for our economy. Future plans – whether they be expanding the number of runways or finding new ways to use existing airport assets – need to be ambitious and demonstrate the UK is open for business,” Martin McTague, National Chair at the Federation of Small Businesses, says.

Virgin Atlantic boss Shai Weiss has said Heathrow needs “massive renovation and new thinking around its business model”. Tired of operating out of Terminal 3, which is 70 years old, he has floated the idea of buying into Terminal 2 – the 10-year-old “Queen’s Terminal” – with other airlines as a way to foster competition. But Heathrow finance director Javier Echave is not a fan. The model has been tried in the US and has been “a complete failure – it’s becoming more expensive and the customer service is worse,” he says.

Frustration that Heathrow is limiting growth extends beyond individual airlines and into the broader economy. Ultimately, as a regulated monopoly, Heathrow’s future direction also depends on the Government. Rupert Soames, chairman of the CBI, says: “With the UK in a global race for investment,

enhancing the UK's connectivity capacity can play a key role in seizing those opportunities. Ultimately, whoever wins the upcoming general election will have to make boosting the UK's infrastructure a key focus for putting the economy on a pathway to sustainable growth."

As campaigners gathered outside the Royal Courts of Justice to hear an appeal ruling on Heathrow's expansion four years ago, there was one voice journalists clamoured to hear. Dressed in a black overcoat with his hands clasped in front of him, Sadiq Khan reflected on his bid to halt the project on grounds that ministers had failed to consider whether it was compatible with Britain's net zero targets. "I'm delighted," the Mayor of London told them. "We brought this case because we thought a new runway at Heathrow had serious consequences on climate change, on air quality, on noise pollution, on the road and rail network, and on the quality of life for Londoners. At the time, Khan was keen to make political hay at the expense of his Conservative predecessor, Boris Johnson.

The ruling was eventually overturned by the Supreme Court, yet the views of Labour's most senior elected politician may soon create a headache for Sir Keir, should the polls prove correct and the party romps to victory at the next general election. Within Sir Keir's inner circle, another voice likely to counsel against expansion is shadow energy secretary and climate warrior Ed Miliband. Ahead of a parliamentary vote in 2018, Mr Miliband argued the scheme was inconsistent with the UK's climate obligations and would lead to unacceptable air pollution.

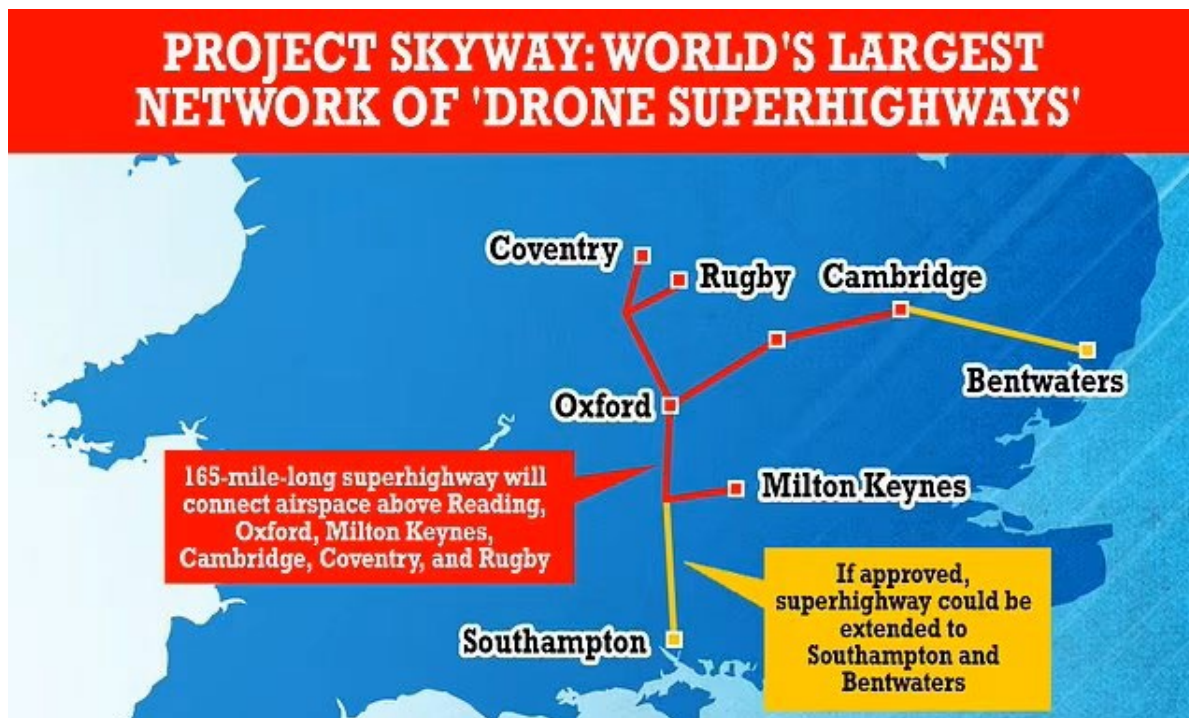
Yet Sir Keir will face equal pressure from Labour's union backers in the other direction, with the GMB strongly supportive of expansion. The union has argued the project will create "many thousands of good, unionised jobs at Heathrow and in the wider supply chain" and is vital to supporting the wider aviation industry post-Covid.

At the moment, Labour has no official position on Heathrow expansion other than four vague "tests" dating back to the Corbyn era. These say the scheme must meet air quality, noise and climate change requirements, as well as having a strong economic case. At the same time, Sir Keir and Rachel Reeves, the shadow chancellor, have also set out plans to help speed up the planning process for major construction projects.

Realistically, it is unlikely Heathrow's expansion will meet Labour's four tests, according to Ruth Cadbury, a Labour MP whose constituency borders Heathrow. "Planes are already coming in at peak times every 60 seconds," she says. "But the cheap and easy thing for them to do is to have more scheduled flights. When I talk about expansion, that's what concerns me. "We're not fighting the third runway, we're fighting the increase of that cap – which means more noise. It is the residents in the areas around Heathrow who will pay the price for that."

Yet the whole of Britain has been paying the price of Heathrow's shortcomings, which the airport acknowledges. A Heathrow spokesman said: "The UK has a direct connection to 95pc of the world's economy because of Heathrow's hub airport status. We are looking at how to unlock more short-term growth by making the current infrastructure as efficient as possible, but we're getting close to our current capacity limits, which will in turn limit the country's economic potential. That's why we are actively reviewing our plans for longer-term growth as well, so Heathrow can continue to deliver for the UK economy, improve journeys for customers and meet our sustainability goals."

The second report concerns the world's first drone superhighway that will open in the UK between June and July 2024.



Source: Daily Mail

Taking advantage again of Microsoft's Copilot we report that: The world's first drone superhighway is a groundbreaking initiative being developed in the United Kingdom. This ambitious project aims to create an extensive network of airspace corridors specifically designed for drone operations. Here are the key details:

Length and Connectivity

The UK's drone superhighway will span an impressive 265 kilometres (approximately 165 miles). It will connect several towns and cities in southern and central England, including Coventry, Rugby, Cambridge, Oxford, Reading, and Milton Keynes.

Purpose and Functionality

The drone superhighway will serve as an air corridor for unmanned aerial vehicles (UAVs), commonly known as drones. Strict regulations will be in place to ensure safety and prevent collisions with conventional manned aircraft. Drone operators will need to sign up to use this superhighway, which will operate at an altitude below regular flight corridors. Ground-based sensors will detect other forms of aviation, allowing light aircraft and helicopters to pass through safely. If drones come too close to other aircraft, they may receive instructions to alter their flight path or even land.

Potential Uses

The drone superhighway opens up exciting possibilities for various applications. For example: logistics - businesses can use it for efficient delivery services; emergency services - medical deliveries (such as vaccines and blood samples) can be expedited; aerial photography - drones can capture stunning images from above; monitoring and surveillance - forest fire monitoring and other surveillance tasks can benefit from this airspace.

Economic Impact

Research suggests that integrating drones further into the UK economy could contribute over \$50 billion of growth and create more than 650,000 jobs. The UK government is investing in aerospace innovations, including the drone superhighway, as part of a \$325 million plan to boost the industry. Other proposed schemes include using drones for safer motorway monitoring and delivering mail and medicines to remote areas, potentially creating up to 8,800 additional jobs.

Summary

The UK's drone superhighway represents a significant leap forward in UAV technology, safety, and economic development. It paves the way for a future where drones seamlessly navigate our skies, benefiting various sectors and communities.

➤ 18 March 2024

Gareth Corfield, Traffic Correspondent for The Telegraph, reports that Britain's first electric flying taxis are set to take to the air in test flights in 2026 according to the government's new plan for aviation. The Future of Flight Action Plan published on Monday paves the way for flying taxis to go into widespread use in 2030. While the initial tests will use pilots, the electric aircraft will eventually be pilotless. The plan is intended to speed up the adoption of aviation technology "once confined to the realm of sci-fi", according to the Department for Transport. Small airfields and urban landing pads will also see a surge in activity from drones and electric air taxi-style aircraft. So-called "vertiports" will be set up for electric aircraft that take off vertically, similarly to the Harrier jump-jet.

Other countries including China and the US have already tested similar all-electric aircraft designed for passenger flights but so far none have progressed beyond the prototype stage. The government's proposals also include increasing use of drones by the police and to make critical medical deliveries by the end of the decade. Under the proposals, the current requirement that a user must be able to see a drone at all times while it is in the air would be dropped. It is hoped that the move to flying drones Beyond Visual Line of Sight will allow the aviation new technology sector to grow.

Aviation and technology minister Anthony Browne said: "Cutting-edge battery technology will revolutionise transport as we know it. This plan will make sure we have the infrastructure and regulation in place to make it a reality. From flying taxis to emergency service drones, we're making sure the UK is at the forefront of this dramatic shift in transportation, improving people's lives and boosting the economy." On Monday, Mr Browne will visit the Bristol headquarters of Vertical Aerospace, a flying taxi company backed by the founder of Ovo Energy, Stephen Fitzpatrick.

➤ March 2024

In this month's edition of AERO SPACE Cirium's VP of Research, Alexis Brooker, explores the challenges that come with harnessing AI's potential in one of humanity's most complex industries where safety comes first, and both accurate and timely data is critical.

And Irene Ruiz-Gabernet, Head of Safety and Compliance at Airbus Military, shares her thoughts about the sector's exciting future in an article entitled 'Generative AI takes flight'.

SPACE



Source: MIT Technology Review

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

It is also a programme very closely followed by the ACP, indeed during academic year 2023/24 we both open and close our schools' presentations with it, and we will certainly continue to refer to it during those presentations as the coming years unfold, especially as we have now joined NASA's global STEM programme – NASA Engages. Consequently, with the Artemis programme's global significance and impact in mind we open this edition with an explanation, But first, why is the programme named Artemis?

The programme to land the first human on the Moon was named Apollo, in Greek Mythology the son of Zeus, the father of gods and men, and the twin brother of Artemis, the goddess of the hunt, so it was apposite to name the return to the Moon - and now beyond – after Artemis.

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

The Space Launch System, Orion spacecraft and the Human Landing System form the main spaceflight infrastructure for Artemis, and the Lunar Gateway plays a supporting role in human habitation. Supporting infrastructures for Artemis include the Commercial Lunar Payload

Services, VIPER rover, development of ground infrastructures, Artemis Base Camp on the Moon, Moon rovers and spacesuits. Some aspects of the program have been criticized, such as the use of near-rectilinear halo orbit and the sustainability of the space program.

Orion's first launch on the Space Launch System was originally set in 2016, but was rescheduled and launched on 16 November 2022 as the Artemis 1 mission, with robots and mannequins aboard. According to plan, the crewed Artemis 2 launch will take place in late 2025, the Artemis 3 crewed lunar landing in 2026, the Artemis 4 docking with the Lunar Gateway in 2028, and future yearly landings on the Moon thereafter.

The Artemis program is organized around a series of Space Launch System (SLS) missions. These space missions will increase in complexity and are scheduled to occur at intervals of a year or more. NASA and its partners have planned Artemis 1 through Artemis 5 missions; later Artemis missions have also been proposed. Each SLS mission centres on the launch of an SLS launch vehicle carrying an Orion spacecraft. Missions after Artemis 2 will depend on support missions launched by other organizations and spacecraft for support functions.

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

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

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

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

Artemis 5 (2029) is planned to be the third crewed lunar landing, which will deliver four astronauts to the Gateway Space Station. The mission will deliver the European Space Agency's ESPRIT refuelling and communications module and Canadarm3, a Canadian-built robotic arm system for the Gateway.

Also delivered will be NASA's Lunar Terrain Vehicle. Launch is scheduled for no earlier than September 2029. The mission will also be the first to use Blue Origin's Blue Moon lander to bring astronauts down to the Moon's surface.

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

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

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

We return now to 2024, and our chronological news reporting:

➤ **15 February 2024**

The Telegraph reports that the United States took a major step towards returning to the Moon on Thursday when the first private lunar lander took off from Florida. SpaceX, the American company founded by Elon Musk, successfully launched its Falcon 9 rocket carrying the lander, nicknamed Odysseus, from Cape Canaveral. If all goes to plan, the spacecraft will land on the Moon next week, the first time the US has made a soft landing on the lunar surface since the final Apollo mission in 1972. Odysseus, which is a Nova-C spacecraft designed by Texas-based Intuitive Machines, successfully separated from the Falcon 9 rocket that carried it into near-Earth orbit shortly after take-off. It is now on course for the Moon.



Source: NASA

Odysseus: Intuitive Machines' Moon Lander

If successful, the mission will also mark the first time a private company has landed on the Moon, following several failed attempts over the past year. Odysseus will operate for roughly two weeks. It is carrying payloads for NASA to help the agency prepare for humans returning to the Moon in 2025. It will land in Malapert A crater, about 185 miles from the lunar South Pole, which is one of the candidate sites for the Artemis base camp where human missions would land.

“We’re getting even closer to the South Pole [of the Moon],” said Susan Lederer, NASA project scientist for the mission. “That’s really good, for understanding the science and what the Moon is like at the South Pole because, of course, the Artemis base camp is planned to be at the South Pole. “So it helps us to really start to understand the geology of where the astronauts are going to end up landing on the surface of the Moon.”

Landing on the Moon is notoriously tricky, with only the US, Russia, India, China and Japan having achieved the feat. All attempts by private companies have failed so far. Last month, Astrobotic’s Peregrine Lunar lander was forced to abandon its mission after springing a fuel leak just a few hours after launch. In April last year, the Hakuto-R lander, built by the Japanese company ispace, lost contact with mission controllers and crashed onto the lunar surface.

➤ **13 March 2024**

NASA reports that since November 2023, Voyager 1 has been sending a steady radio signal to Earth, but the signal does not contain usable data. The source of the issue appears to be with one of three onboard computers - the flight data subsystem (FDS) which is responsible for packaging the science and engineering data before it’s sent to Earth by the telemetry modulation unit.

On March 3, the Voyager mission team saw activity from one section of the FDS that differed from the rest of the computer's unreadable data stream. The new signal was still not in the format used by Voyager 1 when the FDS is working properly, so the team wasn't initially sure what to make of it. But an engineer with the agency's Deep Space Network, which operates the radio antennas that communicate with both Voyagers and other spacecraft traveling to the Moon and beyond, was able to decode the new signal and found that it contains a readout of the entire FDS memory.

The FDS memory includes its code, or instructions for what to do, as well as variables, or values used in the code that can change based on commands or the spacecraft's status. It also contains science or engineering data for downlink. The team will compare this readout to the one that came down before the issue arose and look for discrepancies in the code and the variables to potentially find the source of the ongoing issue. This new signal resulted from a command sent to Voyager 1 on March 1. Called a "poke" by the team, the command is meant to gently prompt the FDS to try different sequences in its software package in case the issue could be resolved by going around a corrupted section.

Because Voyager 1 is more than 15 billion miles (24 billion kilometres) from Earth, it takes 22.5 hours for a radio signal to reach the spacecraft and another 22.5 hours for the probe's response to reach antennas on the ground. So the team received the results of the command on March 3. On March 7, engineers began working to decode the data, and on March 10, they determined that it contains a memory readout. The team is analyzing the readout. Using that information to devise a potential solution and attempt to put it into action will take time.

[ACP comment: It is important to realize that Voyager 1 was launched in 1977 when its total computing power was less than that in a current day car key fob. Its intended mission – to explore Jupiter, Saturn and the latter's moons – was completed most successfully in 1988, and then it was sent out to the farthest reaches of our solar system. In 2012 it passed through the heliopause and entered interstellar space and until this problem arose it continued to send back to Earth highly valuable data.]

➤ **14 March 2024**

The RAeS' AERO SPACE reports that on this day SpaceX conducted the third test flight of its Starship/Super Heavy rocket. Achieving hot-staging and entering orbit before re-entry and breaking up over the Indian Ocean, the 4000 ton Starship is now the largest single object to be launched into space, beating the previous record held by NASA's Skylab.

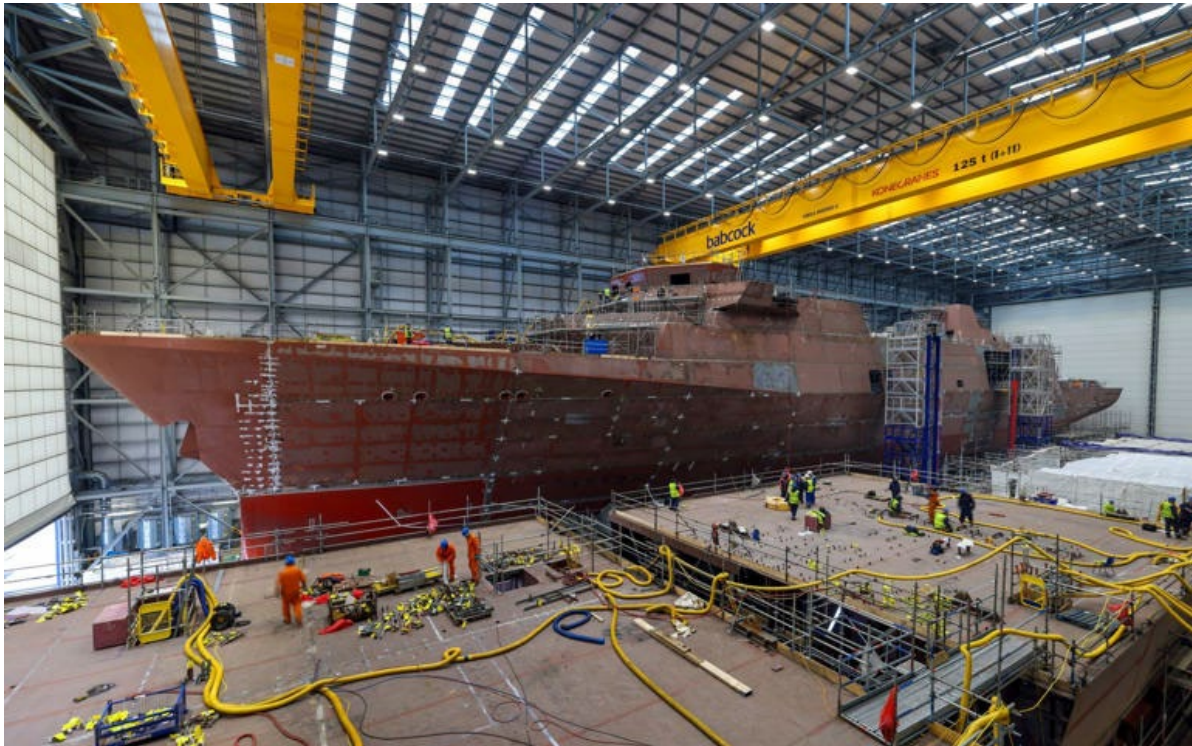
➤ **March 2024**

In an article entitled 'Avoiding orbital mayhem' Tereza Pultarova reports in the March edition of the RAeS's AERO SPACE on the current discussion about managing the increasing amount of orbital traffic around the Earth.

➤ **April 2024**

And in the same publication in April Ms Pultarova writes on 'The state of the UK space race' with SaxaVord Spaceport currently being the clear front runner ahead of Spaceport Cornwall and Space Hub Sunderland. The first two are supporters of the ACP.

UK DEFENCE



Workers at Babcock's Rosyth dockyard in Scotland are busy building the Royal Navy's Type 31 frigates - Barry Wheeler/Royal Navy© Provided by The Telegraph

We set the background to this edition with an extract from an article by Matt Oliver in The Telegraph involving comments by David Lockwood – Chief Executive of Babcock, a strong supporter of the ACP - concerning the defence of freedom, an extremely pertinent topic today as we look around us at the increasingly tense geopolitical situation. As he implies at its conclusion: “we cannot take freedom for granted”. He writes:

Young people must realise Britain needs to spend more on defence to protect their freedoms, the boss of Babcock has said. David Lockwood, chief executive of the British defence company, said Britain must make the case for higher defence spending to younger generations born since the Cold War as the world enters a more dangerous period. Mr Lockwood said the West could no longer take democracy and liberty for granted as authoritarian and totalitarian states such as China and Russia become more aggressive.

Grant Shapps, the defence secretary, has urged the Government and defence companies to become more vocal about the need for a strong military posture to protect democracies as the world enters a “pre-war” era.

Mr Lockwood backed the call, saying: “Grant [Shapps] is right – we do need to get out there and make the case that people’s right to protest is something we’re defending.”

He pointed to a wave of high-profile protests over climate change, arguing that the defence industry helped to guarantee the freedoms of Western demonstrators such as Greta Thunberg. In an interview with The Telegraph, Mr Lockwood said: “If you take someone like Greta, don’t just think about where

she's allowed to protest – think about the countries where she's not allowed to protest. Do we really want to become like them? We want people like Greta to have the right to protest and to be able to do so safely. I have enjoyed speaking to protesters because I think they have a right to protest and I have a right to explain to them why I believe the only reason they can protest is because we're protecting their rights. That's constructive and positive. But we need to get out there and argue that much more, and with much more confidence."

The comments come against a backdrop of apathy among young people towards defence spending. Just 6pc of 18 to 24-year-olds believe the Government should spend more on defence, according to YouGov polling, compared to 41pc of over-65s. Only 14pc of 25 to 49-year-olds back higher spending. Mr Lockwood, 62, said younger generations needed to realise that their freedoms were under threat and increased spending was necessary to safeguard them.

A political debate is currently raging about the UK's defence spending, with Rishi Sunak facing public calls from former cabinet ministers and ex-senior civil servants to raise the level to at least 3pc of GDP from around 2.2pc currently. In a time of stretched public finances, doing so would put pressure on Jeremy Hunt, the Chancellor, to make potentially controversial cuts to other public services.

Mr Lockwood said: "I certainly think that if the threat is growing, [if] you thought you were spending enough against a smaller threat, then either you're going to have to spend more wisely or you're going to need to spend more – probably a bit of both." Speaking at a Ministry of Defence site in Corsham, Wiltshire, where Babcock has just taken over management of the Skynet military satellite system, he also said more positive arguments for defence were crucial in addressing the industry's huge demand for skilled workers.

Babcock recently joined with other businesses to launch "Destination Nuclear", a scheme that aims to become a one-stop shop for careers information and job advertisements across both civil and military nuclear programmes. Through its various businesses, Babcock is involved in both the upkeep of the Royal Navy's nuclear-powered submarines as well as the operation and construction of nuclear power plants. Destination Nuclear's website aims to tempt talented young workers to join from other industries or retrain, stressing nuclear power's carbon-free energy credentials and the role Britain's nuclear deterrent plays in guaranteeing "global peace and security". Mr Lockwood said: "That really matters, because you want to attract people."

The FTSE 250 chief recently took over as president of ADS, the main trade body for the UK's aerospace, defence, security and space sectors, and is now in his fourth year as Babcock's chief executive. He was previously boss of British aerospace pioneer Cobham, which was sold to private equity, from 2016 to 2020.

So far, the chartered accountant has spent most of his tenure at Babcock in turnaround mode having taken over after a disastrous period where the company was forced to issue multiple profit warnings and came under sustained attack from short-sellers. Babcock's share price has more than doubled since Mr Lockwood took charge, with the company today worth £2.5bn. Mr Lockwood has spent time simplifying the business, which he says was previously too federated and suffered from duplication. He has slashed more than 1,000 jobs and vowed to fix its "cultural issues".

The defence engineering giant is one of the Ministry of Defence's most important contractors, with Mr Lockwood describing the relationship between the two as something of a "marriage". Its important

duties include maintaining warships and submarines at the Royal Navy dockyard in Devonport, Plymouth, which is currently being overhauled and modernised to support future generations of boats and even drones. Babcock's Rosyth shipyard is also where Britain's two new Queen Elizabeth-class aircraft carriers were partly built and assembled, in partnership with other defence companies. Workers there are currently engaged in building the Navy's new Type 31 frigates. Elsewhere, the company is responsible for storing and maintaining around 30,000 vehicles on behalf of the Army, including Jackal armoured vehicles and main battle tanks.

More recently, Babcock this month successfully took over the management of the Skynet satellite network from former contractor Airbus following a bidding process that concluded last year. Since then, the Corsham facility has been refurbished and all Airbus livery replaced with Babcock's own branding. Mr Lockwood visited in person on Monday to hoist his company's flag over the buildings. The £400m deal is seen as a new and important foray into space for Babcock's defence businesses, which could lead to similar work for other UK-allied countries.

Through Skynet, the company is now managing the global communications network underpinning all of the British Armed Forces as well as the intelligence services. Satellite communications are vital not only for military operations but also for the more prosaic – but nonetheless important – purposes of ensuring forces personnel can access entertainment services such as Netflix while on tours of duty. As a result, the facility at Corsham must be kept highly secure with operations centres contained within bunker-like buildings that use airlock seals and other protections.

Mr Lockwood is evangelical about the structure of the Skynet deal which he says is based on a “collaborative” rather than “transactional” model. It will mean the company works hand-in-hand with the MoD to continuously upgrade services throughout the six-year contract's lifetime, rather than simply delivering a static product to specification. This is ever-more important during a time of rapid change as developments in Ukraine and elsewhere reshape the battlefield.



Source: BBC News.

Challenger 3, the new British Main Battle Tank

'Tanks are back' as drones eclipse helicopters, Babcock's chief believes. He added: "If you go back 20 years, Western governments were running down their fleets of heavy armour because it was vulnerable to attack helicopters. "Now, helicopters are seen as incredibly vulnerable to drones... but drones can't take out a tank because they can't carry a big enough payload, so tanks are back. "You just have this constant churn, where obsolescence is no longer necessarily permanent."

He hopes the Government – whether it is a Conservative one or Labour after the next election – continues down this more collaborative path in other areas of defence. The Ministry of Defence has vowed to work more closely with industry in various policy papers, with the accelerated deployment of Dragonfire lasers this week championed as a prime example of the benefits this can bring. Such collaboration is of ever-increasing importance as the international threat level rises.

Mr Lockwood said: "I do also think this is the first time in my lifetime when we're not taking Western freedoms for granted. "Because even in the Cold War, frankly, we were either going to be free or blown to smithereens – we weren't under threat in the way we are now."

More detailed current comment on UK defence can be found at:

[Wasteful Britain needs to buy a new arsenal for war with Russia \(msn.com\)](#)

[Guns or butter: hard choices await a mollycoddled West \(telegraph.co.uk\)](#)

[UK has failed to prepare itself for war, warn former defence ministers \(msn.com\)](#)

[Defence readiness must be a national priority \(telegraph.co.uk\)](#)

Finally, before turning to our chronological news items, and with finance in mind, we include an article by Roger Bootle, the senior independent adviser to Capital Economics, who asks the question: "How can we project power while spending so little?" He goes on to write:

Rishi Sunak has an "aspiration" to increase defence spending from 2pc of GDP to 2.5pc. But I doubt whether President Putin places much store by aspirations. The next government, whether Conservative or Labour, will have to conduct a defence review pretty soon and, in contrast to recent efforts, this is going to have to involve major increases in our defence spending.

History helps to put matters in perspective. Spending 2pc to 2.5pc of GDP on defence is not unprecedented. Indeed, that was the level of our defence spending throughout the later part of the 19th century. Mind you, in those days we were the global hegemon, there was less expensive, high-tech equipment to spend money on and, of course, there was no RAF.

Defence spending rose in the run-up to the First World War and exceeded 50pc of GDP in 1916 and 1917. After the war, it fell back to 2.5pc of GDP but in 1936 defence spending rose to 3.5pc, followed by 4.6pc, 6.5pc and 9.2pc in 1939, again rising to over 50pc during the Second World War, before falling back sharply afterwards.

Strikingly, our defence spending was running at 4pc of GDP or over throughout the 1970s and most of the 1980s, falling to 3.8pc only in 1987. It was 4.5pc of GDP in 1982, the year of the Falklands War. And, despite cashing in the so-called peace dividend, we were still spending 3pc of GDP on defence in the early 1990s.

Bearing in mind this history and the nature of the threats facing us, we should probably now be aiming to spend something like 4pc of GDP, implying a doubling of expenditure. That implies finding something like an extra £50bn a year. Where is the money to come from? The comfortable answer is to believe that economic growth will throw off extra tax revenues that can be spent on defence. Let's hope so. But the benefits of such growth as we are able to achieve are already spoken for many times over.

There are only three ways of funding such an increase in defence spending – higher borrowing, higher taxes or reduced government spending. The huge increases in defence expenditure that we have sustained during the Napoleonic, First and Second World Wars were financed by enormous amounts of government borrowing. Given the current debt numbers, higher borrowing to fund increased defence spending is not an attractive option. Meanwhile, with taxes running at a 70-year high, surely it wouldn't be sensible to be thinking about such a huge increase in taxes. This leaves us with the uncomfortable conclusion that any large increase in defence spending will have to be funded by making savings on other parts of government expenditure.

In principle, savings could come from any or all types of government spending. But there is one area which stands out. Total spending on what is euphemistically called “social protection” has risen from £164bn (12.2pc of GDP) in 2004/5 to £319bn (12.6pc of GDP) in 2022/3. Within this total, spending on “family benefits, income support, Universal Credit and tax credits” has risen from £11.7bn to £56bn, while sickness and disability has risen from £31bn to £65bn. So you could say that what we need is a switch of spending from welfare to warfare.

Fortunately, it would not be sensible to increase defence spending very rapidly. That often leads to waste. Instead, spending has to be increased speedily but gradually in the context of a multi-year strategy, thereby allowing procurement to be planned and recruitment to be boosted. As well as strengthening our security, increased defence spending would bring some economic benefits. The armed forces have traditionally contributed a lot to the life education of large numbers of people, providing skills, discipline, community and a sense of self-worth.

On a broader canvas, a strengthened defence posture would greatly improve our relations with a number of friends and allies around the world and that may well bring economic benefit too in the form of trade agreements. This applies not only to the United States, which is clearly getting anxious about the weakened defence capability of its closest ally, but also to countries in the Pacific and to members of the European Union. Remarkably, pending their admission to Nato, we recently gave a security guarantee to EU members Finland and Sweden.

Admittedly, effective defence is not just about how much money you spend. As with everything else, money can be spent well or badly. And there is plenty of evidence that our defence procurement has been badly managed. We should be getting much better value for money. Yet careful husbandry is one thing and extreme parsimony is another. It can bring false savings. What is the point of having two expensive aircraft carriers if we cannot provide the requisite planes, supply ships and escorts, as well as the people to fly and sail them? Recent recruitment difficulties are partly due to inadequate pay but they also reflect the perception that with defence spending being squeezed, the Armed Forces do not offer attractive career prospects. That needs to change.

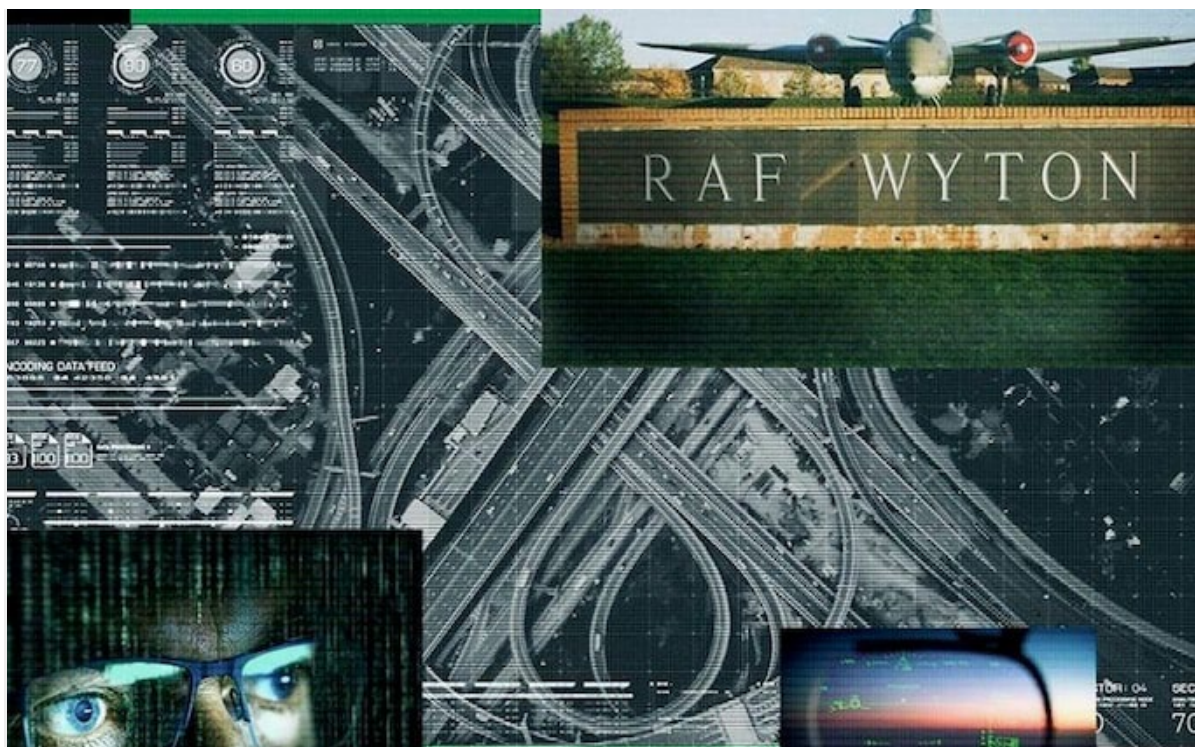
It is pathetic for us to pretend that we can project power while spending so little. For some time, Britain has been trying to do defence on the cheap. We are currently deploying forces in the Middle East and

we have had a presence in the Pacific and Indian oceans. This is not inevitable. We could decide to be like most other European countries and hardly pretend to be able to defend ourselves, never mind playing a role on the global stage. But if we are serious about being able to defend ourselves and being a key contributor to the defence of Europe, while continuing with our global role, then we surely have to devote sufficient resources to the task. This must be a priority for the prime minister. Defence is too important to be left to the bean counters.

And now our chronological news items:

➤ 8 February 2024

Dominic Nicholls writes about the Pathfinder Building at RAF Wyton which has been described as “the jewel in the crown of British Defence Intelligence”.



Source: *The Telegraph*

In 1941, prime minister Winston Churchill visited the Government Code and Cypher School, the secret code-breaking centre at Bletchley Park in Buckinghamshire. He gave an impromptu speech to some of the staff who would soon crack the German Enigma code and who he called “the geese who laid the golden egg and never cackled”. “You all look very innocent,” he told them. “One would not think you are involved in anything secret.”

Similar sentiments could be expressed today by any politician visiting the Pathfinder building in RAF Wyton, Cambridgeshire, described as “the jewel in the crown of British Defence Intelligence”. In fact, this large unassuming building, with a sloped roof covered in muddy turf (to help the environment, not hide from Russian satellites (“they probably had the plans to this place before we started building it,” one staff member tuts) plays a critical role in the work of the 5-Eyes intelligence alliance of the UK, US, Australia, Canada and New Zealand.

Inside the huge open-plan building, with the ever-present soft hiss of “pink noise” to dampen sound and prevent a cacophony of voices, British military personnel from all three services plus civil servants mix – and, crucially, share intelligence – with foreign colleagues from across the alliance. In the rather clunky view of one UK defence official, Pathfinder is “the largest Top Secret, 5-Eyes by design, military intelligence fusion and assessment facility in the world”.

Sharing secrets with friends, especially when trying to combat spies from Russia, China, Iran and elsewhere, may sound obvious. But be under no illusion. When Pathfinder opened it was an unprecedented vote of trust in the alliance and the hundreds of people working behind the secret screens. There is an urgent and growing need for such trust. “This is the most dangerous time in my 40-year career,” one UK defence official says. Read on at: [RAF Wyton: inside the ‘jewel in the crown of British Defence Intelligence’](https://www.telegraph.co.uk/ukdefence/2019/01/22/raf-wyton-inside-the-jewel-in-the-crown-of-british-defence-intelligence/) ([telegraph.co.uk](https://www.telegraph.co.uk))

➤ February 2024

Bella Richards reports in this month’s AERO SPACE edition on the key issues discussed during the recent MoD Defence Space Conference in an article entitled ‘What’s next for the UK National Space Strategy?’

And in an article entitled ‘New Horizons’ Dr David Sloggett explores the design and development challenges of the next generation of air defence systems involving space-based elements.

➤ March 2024

Professor Keith Hayward looks at Skynet’s influence on British Military space strategy, past, present and future, in an AERO SPACE article ‘Skynet – connecting UK defence.

➤ 7 March 2024



Flying the Mach Loop. The aircraft was pictured leaving 'fluffy' condensation trails in the sky CREDIT: Scott Hopkins/Caters News

Rachel Slater reports that military aircraft, including supersonic fighter jets, have been spotted taking to the skies over the Welsh countryside as they took part in training exercises. The aircraft left condensation trails - better known as “contrails” formed by water droplets around a jet’s wing tips suddenly dropping in temperature along with cold and wet conditions - in their wake as they flew through the Mach Loop in Snowdonia.

Some were seen flying as low as 500ft on Thursday with personnel perched on the edge of the open cargo door of a C-130 Hercules as they admired the view from the back of the plane.



CREDIT: Scott Hopkins/Caters News

The Machynlleth, from which Mach Loop gets its name, is a series of valleys in west-central Wales used as a low-level training area for fast aircraft. It is well-known for providing opportunities to photograph the zooming jets from above. Scott Hopkins, 53, who took pictures of the aircraft, regularly visits the site to see the pilots’ display. The Ministry of Defence publishes a timetable of when the training ground will be used.

➤ **15 March 2024**

Nick Gutteridge reports that the jet which had its GPS jammed by Russia while carrying Grant Shapps home from Poland was not fitted with protective systems after ministers baulked at the cost. Military experts said the plane was effectively “defenceless” because it did not have kit such as anti-missile jammers, jam-proof communications or military-standard aircraft electronics.

The Dassault Falcon 900LX was passing Kaliningrad, a Russian exclave between Poland and Lithuania, on Wednesday morning when the pilots lost access to the GPS. Mr Shapps, the Defence Secretary, was on board as he returned to Britain from a visit to Poland, where he watched British troops taking part in a Nato exercise.

Now it has emerged that ministers chose not to pay for state-of-the-art defensive systems to be fitted to the plane – one of a pair – when they ordered the in 2021. The Times reported that Ben Wallace, then defence secretary, made the decision to order the basic model so that money could be prioritised elsewhere in the RAF.

➤ **26 March 2024**

Matt Oliver writes about the battle to replace Britain’s aging nuclear deterrent.



The recent misfiring of a Trident missile from a Vanguard-class nuclear deterrent submarine underlined the need for new investment - Jane Barlow© Provided by The Telegraph

It was meant to demonstrate Britain’s undisputed role as one of the world’s nuclear powers. But as Grant Shapps, the Defence Secretary, came aboard HMS Vanguard to watch the refitted submarine test-fire a dummy Trident missile, the unthinkable happened: it failed. Instead of surging into the sky, the missile was ejected from the launch bay before crashing into the ocean after its boosters failed to fire.

The flop, which followed a separate Trident mishap in 2016, triggered questions about the system’s effectiveness, forcing Shapps to publicly insist it was “effective, dependable, and formidable”. Now, to ensure that remains the case, ministers are ploughing tens of billions of pounds into the biggest overhaul of Britain’s nuclear deterrent in a generation. That will involve massive submarine-building programmes, including the delivery of Dreadnought-class boats in the early 2030s, as well as major upgrades to infrastructure.

Projects already underway include a £750m overhaul of Babcock’s submarine maintenance facility at HMNB Devonport in Portsmouth, a £1bn expansion of BAE Systems’ shipyard at Barrow-in-Furness and a doubling of capacity at Rolls-Royce’s submarine reactor facility in Derby. But on Monday, ministers also announced a “national endeavour” to expand the nuclear workforce underpinning these programmes, backed by nearly £1bn of public-private investment.

The money includes £200m for schemes at Barrow and £763m to support industry recruitment, including the creation of some 5,000 apprenticeships. It comes after an official task force found roughly 80,000 people in the civil and defence nuclear sectors today – a figure that must rise to at least 125,000 by 2030 to meet the Government’s military and energy ambitions. These include programmes to deliver the Dreadnought-class nuclear deterrent submarines and the next generation of nuclear-propelled SSN-Aukus attack submarines, not to mention a fleet of new power stations to keep the lights on at home.

At stake, says David Lockwood, chief executive of defence and civil nuclear contractor Babcock, is Britain's ability to keep itself safe. "In a very fragile world, national sovereignty is at stake if we can't put submarines to sea," he says. "And nuclear power is a key part of the Government's net zero targets. "So without this recruitment, we'll have to choose between net zero and national security – which is not a good choice to be faced with."

Yet growing the nuclear industry quickly enough will require a recruitment drive on a scale never attempted before. It means hiring thousands of extra scientists, software developers and engineers, as well as tradesmen such as welders, electricians, and fitters, not to mention project managers, lawyers and other back-office personnel such as procurement experts. A huge number of these people will be apprentices, who can be trained up through the ranks. But to begin with, many will also have to be poached from other industries with “transferable skills”.

As part of these efforts, a new government-backed campaign and website – Destination Nuclear – has been created to bring together opportunities across the entire industry for the first time. This push is also aimed at transforming nuclear’s somewhat clunky image. There are no pictures of grey cooling towers on Destination Nuclear’s website – instead, it features images of submarines, sailors examining radar screens, and a man teaching people how to write software.

The nuclear industry is a way workers can help provide “low-carbon electricity to millions” and ensure “peace and stability for the nation” by contributing to the nuclear deterrent, it explains. These points were echoed by Shapps in a paper published on Monday. In it, the Defence Secretary argues Britain must be “more vocal” about why its nuclear capabilities are so essential, as well as the exciting opportunities available to those who work on them. “What other programme can combine the ingenuity of the Apollo missions with the science of the Manhattan Project?”, he says.

Read on at: [Inside the battle to replace Britain's ageing nuclear deterrent \(msn.com\)](https://www.msn.com/en-gb/news/science/inside-the-battle-to-replace-britains-ageing-nuclear-deterrent/story-AMZGK1ZG); and visit the careers portal of The future's in your power ([destinationnuclear.com](https://www.destinationnuclear.com))

➤ **11 April 2024**

Matt Oliver reports that robot welders are being used to build Royal Navy submarine-hunting frigates as a shortage of steel workers threatens to delay a crucial delivery. BAE Systems has deployed the machines to a naval shipyard in Glasgow to weld metal panels for Type 26 warships, bolstering the workforce as they race to deliver the next-generation vessels. The robot welders will double the number of panels the company can produce at its Scottish facilities, bosses said.

It emerged as BAE confirmed it was likely to deliver the third of four initial Type 26s for the Royal Navy slightly later than hoped because of setbacks from the pandemic and a subsequent shortage of steel workers. The delay underlines the skill shortages affecting the defence industry as Western

governments push to ramp up production in the wake of the Ukraine war. It comes amid a broader worklessness crisis across Britain that has left companies struggling to hire. An increase in sickness claims has contributed to a jump in the number of people classed as economically inactive since the onset of the pandemic. Glasgow has a higher than average rate of people neither in work nor looking for a job. Some 103,000 Glaswegians were economically inactive in the year to September 2023.

Sir Simon Lister, managing director of BAE's naval ships business, said the welding robots would help to compensate for a national shortage of metalworkers, rather than replacing any of the existing 900 welders – some of whom are being retrained to operate the new machines. The robots are made by Finnish company Pemamek. BAE is also bringing in staff from abroad and has outsourced some steel work to other companies as part of efforts to keep the £8bn Type 26 programme to schedule.

The company stressed that the overall programme to build eight Type 26 frigates by 2035 remained on track. Sir Simon said: "We're still targeting the recovery of the Ship 3 programme. But increasingly, we recognise that we won't quite meet the original targeted date. "Working through the impact of Covid and then steel worker resource in the UK has been a challenge for us, which is partly answered by the outsourcing and partly answered by the robotic panelling. "But we're definitely on track for finishing the [overall] programme on time, if not early."



Type 26 frigates are expected to be the most advanced and stealthy warships in the world - BAE Systems© Provided by The Telegraph

Ministers have said the Type 26s will help to protect Britain's aircraft carriers and form "the backbone of the future Royal Navy surface fleet". When fully outfitted, the Type 26 frigates will be equipped with a medium-calibre gun, Sea Ceptor missiles, a towed sonar array and a helipad capable of accommodating heavy-lift Chinook helicopters. They are designed for stealth, sharing some components with submarines, and will also boast Thunderbird Two-style "mission bays" capable of

transporting boats, drones, special forces equipment, disaster relief supplies or up to eight container-sized “pods”.

BAE is in the process of building a £200m ship hall at the Govan facility, which will be able to house two under-construction Type 26 frigates alongside each other. The 46-metre tall structure will allow work to be carried out under cover in future, making the build process faster and cheaper. The warships are assembled gradually from smaller structural units that fit together “like Lego” into “three or four chunks” that are then welded together, Sir Simon said.

A Ministry of Defence spokesman said: “The Type 26 programme remains on track to deliver eight cutting-edge warships, bolstering our anti-submarine warfare capabilities into the 2060s. “We are investing in the capabilities we need to meet current and future operational requirements and we currently have 16 surface ships in build or on order.”

12 April 2024

Joe Pinkstone writes that an Ocean’s Eleven-style EMP that uses radio waves to disrupt electronics and fry circuit boards is to be tested by British troops for the first time. The electromagnetic pulse technology is a staple of action heist films and has been in development by military scientists since the 1980s, but is now one step closer to the battlefield. The RF DEW (Radio Frequency Directed Energy Weapon) is to be given to the 7th Air Defence Group this summer for testing as part of plans to improve the targeting of drones.

The weapon is mounted to a MAN Support Vehicle and works by emitting high-powered radio waves to disrupt electrics. Matt Cork, the programme manager at the Defence Science and Technology Laboratory (DSTL) at Porton Down, said: “The idea is it generates a pulse, an electromagnetic pulse (EMP), which couples with electronic circuits, overloads them and switches things off. It causes electrical circuits to stop working. We can use this in a non-lethal way.”

The programme, codenamed Project Ealing, will be the first time the Ministry of Defence has conducted “user experimentation” of electromagnetic pulse technology. “We are looking at it for multiple different activities,” Mr Cork said. “For example, could it protect an area, could it protect a moving convoy from drones with explosives on, which are a real threat? We are looking at what is coming out of current conflicts and trying to understand if this would have utility there.”

The range of the weapon and the wavelengths it operates at are classified but it has been made from commercially available technology which was created by a US company called Teledyne E2V to kill the outboard motors on boats. “I can be very precise if I choose to be, or I can cycle through a whole host of frequencies depending on what I want to do,” said Mr Cork. “We have designed this to have a mode with a narrow beam for single targets and I can then open that beam up to target a swarm. Because of the advent of drone threats we are exploring RF’s utility.”

The technology has the potential to kill all electronics in a small area, like in the fictitious Las Vegas scenario of Ocean’s Eleven, but in reality the technology will probably be used as a tool to take down incoming attacks or to hit specific targets. 7th Air Defence will get the EMP technology in the summer, and will also receive the DragonFire laser in September. The experts in this group will assess the capabilities of the two different technologies separately, and provide feedback on flaws and possible

improvements. Read further at: [British troops to test Ocean's Eleven-style electromagnetic weapon for first time \(msn.com\)](#)

And talking of DragonFire, also this day Joe Pinkstone and Genevieve Holl-Allen report that a laser capable of shooting down enemy drones and missiles will be on Royal Navy warships by 2027 amid the growing threat of conflicts in Ukraine and Gaza. The £10 a shot DragonFire weapon could be used even sooner in Ukraine, as the military fast-tracks the “cutting-edge” technology.

The laser has been sped up by the Ministry of Defence (MoD) in response to the rising threat of drone attacks in relation to “two big conflicts”, the Government has announced. Scientists at the UK’s Porton Down defence laboratory (DSTL) have worked with industry experts in recent months to transform the laser weapon from a lab experiment to almost battlefield-ready.

Grant Shapps, the Defence Secretary, said on Thursday on a trip to the DragonFire lab that the weapon, which can hit a £1 coin from a kilometre away, “could have huge ramifications”. He said that delays to the rollout of emerging weapons technologies is the “biggest waste of money in defence”. “Every time there’s a delay, there’s a cost attached,” he said. “What I want to do is speed up what would usually be a very lengthy process, possibly up to 10 years, down to a much shorter timeframe and get it deployed, potentially on ships and potentially on land.”

Mr Shapps said the UK is planning to add DragonFire to its arsenal by 2027, but is working to see if it can send prototypes to Ukraine sooner – even if they are not 100 per cent refined. “I’m absolutely certain that what we’ve got going on here is very special, and a level that other countries are unlikely to be replicating because it’s so cutting-edge,” he said. “The product itself is genuinely years ahead.” The weapon works by focusing 37 channels of 1.5kW laser beams, arranged in a hexagonal array, and combining them with mirrors to merge and amplify the power, a physics phenomenon known as constructive interference.

Matt Cork, a project manager at DSTL, told reporters that DragonFire may be handed over for “user experimentation” to a number of army personnel in September with the 7th Air Defence Group putting the technology through its paces. Read on at: [Laser beam that shoots down drones fitted to Royal Navy ships ‘within five years’ \(msn.com\)](#)

➤ **15 April 2024**



Source: UK MOD

ASD News reports that Britain's heavy lift capability will be bolstered with the purchase of 14 extended-range Chinooks (CH47-ER), which will pump an estimated £151 million into the UK economy. The new Chinooks significantly enhance the UK's strategic mobility with its ability to operate in challenging environments. From the desert to the arctic, the helicopter has double the range of a standard Chinook and is capable of air-to-air refuelling, with the ability to carry up to 55 personnel or 10,000 kg of cargo. With a top speed of 300 kilometres per hour, the new helicopters will have a range of new capabilities, including an advanced digital cockpit and a modernised airframe to increase stability and survivability.

Through successful negotiations between MOD's procurement arm - Defence Equipment & Support - and the US Government, the UK has reduced costs for elements of the programme by more than £300 million, ensuring value for money whilst providing our armed forces with a cutting-edge heavy lift capability. Defence Secretary Grant Shapps said: "Procuring these Chinook helicopters will mark a significant milestone in our efforts to modernise and enhance the agility of the UK Armed Forces, cementing our ability to respond at pace to situations and threats across the globe. The Chinook is one of our most iconic aircraft, having been operated in every major conflict since the Falklands War. Delivering on this deal not only enhances our capability, but will boost UK industry and skills." Read further at: [Capability Boost for UK's Global Military Operations As Cont \(asdnews.com\)](https://www.asdnews.com/2024/04/21/capability-boost-for-uk-global-military-operations/)

➤ 21 April 2024

Camilla Turner and Will Taylor report that Penny Mordaunt has broken ranks to call for an Israeli-style "Iron Dome" missile defence system for Britain. In a highly unusual intervention, the Leader of the House of Commons has publicly urged Rishi Sunak to increase spending on defence, calling it a "duty to our citizens". It comes as former defence secretaries, the former chief of the general staff, a former First Sea Lord and a former Air Marshall all call on the Prime Minister to bolster the UK's air defences, warning that Britain would not be able to protect its citizens from a drone and missile attack of the type launched by Iran against Israel.

The Sunday Telegraph can also reveal that Number 10 and the Treasury previously rebuffed a request from the Ministry of Defence (MoD) for funds to build a British "Iron Dome". Iran launched more than 300 drones and missiles at Israel last week but almost all of them were intercepted largely due to Israel's formidable air defences, which include the short-range "Iron Dome" system. In a move that will be interpreted by some in the Tory party as a leadership bid, Ms Mordaunt, a former defence secretary, strayed from her brief to urge the Prime Minister to boost military spending.

She told The Sunday Telegraph: "To those that say about our defence ambitions 'we can't do, shouldn't do or can't afford to do', I say 'look to Israel' – a nation a fraction of our size, that has staved off an attack from a nation 10 times its size. "It has made a choice. It has made it work. We may not have its daily reminders of the threats we face, but we have the same duty to our citizens. "Israel's defence is our defence, and we must be ready to defend our allies the same way that we would defend ourselves, as we did last weekend."

➤ 22 April 2024



Agamemnon - BAE Systems / SWNS© Provided by The Telegraph

The Royal Navy's latest Astute-class submarine has been officially named at BAE Systems' submarines site in Barrow-in-Furness, Cumbria. Agamemnon – named after the mythical Greek king – is the sixth of seven Astute submarines being built by the company. The vessel is set to be launched later this year, ahead of being commissioned into the Royal Navy.

At 97 metres long and weighing 7,400 tons, the Astute-class submarines are fitted with advanced nuclear technology meaning they never need to be refuelled. They can manufacture their own oxygen and fresh water from the ocean and are able to circumnavigate the globe without surfacing. Equipped with world-leading sensors, the Astute-class carry both Tomahawk Land Attack Cruise Missiles and Spearfish heavyweight torpedoes.

➤ 23 April 2024

Daniel Martin advises that Rishi Sunak has pledged to increase Britain's defence budget to £87 billion a year by the end of the decade, taking it to 2.5pc of national wealth. The Prime Minister unveiled the biggest uplift to military spending in a generation which will add £23 billion to the military budget over the next six years.

Speaking during a trip to Poland he challenged European countries to follow suit, warning that the continent's future security is at risk from Russia. Mr Sunak said £10 billion would go on growing the domestic defence industry and boosting Britain's stockpiles of weapons including air defences. He will nearly double annual spending on arms production with a focus on hypersonic missiles, lasers, anti-tank rockets and artillery shells. A new Defence Innovation Agency will be set up to develop weapons, modelled on the US Defense Advanced Research Projects Agency (Darpa). Under the plan,

Mr Sunak said: “In a world that is the most dangerous it has been since the end of the Cold War, we cannot be complacent. As our adversaries align, we must do more to defend our country, our interests, and our values. That is why today I am announcing the biggest strengthening of our national defence for a generation. by 2030 – a plan that delivers an additional £75 billion for defence by the end of the decade and secures our place as by far the largest defence power in Europe. Today is a turning point for European security and a landmark moment in the defence of the United Kingdom. It is a generational investment in British security and British prosperity, which makes us safer at home and stronger abroad.”

This year the UK is set to spend £64.6 billion on the military budget, which is just over 2.3 per cent of Gross Domestic Product. That figure will rise to £67.5 billion next year and £71 billion in 2026-27, before climbing more rapidly to a total of £81.7 billion in 2030-31. Downing Street said the announcement set “a new standard” for other European countries. If all Nato countries increased their spending to 2.5pc then the alliance’s collective budget would increase by more than £140 billion a year. Read further at: <https://www.msn.com/en-gb/money/other/britain-will-boost-defence-spending-to-2-5pc-sunak-to-announce/ar-AA1nvAS1>

We conclude this section with a description of Steadfast Defender 2024 which involves 20,000 UK service personnel.

Steadfast Defender 2024 is NATO’s largest military exercise since the Cold War. It involves over 90,000 troops from all 32 NATO Allies. These forces will conduct exercises in the Atlantic, Arctic, and European regions from January to May 2024. Here are some key details about this significant exercise:

- ❖ *Objective:* Steadfast Defender 2024 aims to demonstrate NATO’s ability to defend every inch of its territory and the commitment by NATO Allies to protect each other from any threat.
- ❖ *Participants:* Over 90,000 troops from all 32 NATO Allies.
- ❖ *Exercise Phases:* the first part focuses on securing the Atlantic up to the Arctic; the second part involves moving troops across Europe, from the High North to Central and Eastern Europe.
- ❖ *Significance:* Steadfast Defender 2024 showcases NATO’s unity, strength, and determination to protect each other, our values, and the rules-based international order.
- ❖ *Historical Context:* NATO has a rich history of military exercises, dating back to its founding in 1949. Steadfast Defender 24 is the first large-scale NATO exercise to put new defense plans into action since Russia’s illegal annexation of Crimea in 2014.



CYBER



Source: The Telegraph

We start this section with an article written by Matthew Field and Will Bolton in the 20 February 2024 edition of The Telegraph:

A Russia-linked cyber gang responsible for hacking Royal Mail has been locked out of its own website after a cyber raid led by Britain's National Crime Agency (NCA) and the FBI. LockBit's website was taken down late on Monday night and replaced with a notice that said it is now "under the control of law enforcement". Anyone trying to log into LockBit's website is now met with the message: "We may be in touch with you very soon. Have a nice day."

Police investigators claimed to have broken into the gang's IT systems, frozen 200 cryptocurrency accounts linked to the group and made multiple arrests. The crackdown was a joint operation between the FBI, NCA and Europol to disrupt a hacking group that has targeted major businesses and extorted hundreds of millions of dollars in recent years. It comes more than a year after LockBit, a criminal gang with ties to Russia, hacked Royal Mail and knocked out its international delivery service for weeks.

American prosecutors said "LockBit had extorted a total of \$120m from ransom victims in the US alone. Graeme Biggar, director general of the NCA, said: "As of today, LockBit are locked out. We have damaged the capability and most notably, the credibility, of a group that depended on secrecy and anonymity."

Law enforcement officials from Europol arrested two individuals believed to be members of LockBit in Poland and Ukraine. US authorities have charged five Russians in relation to LockBit. Two of the suspects charged by the US are in custody: Mikhail Vasiliev, who is being held in Canada awaiting

extradition, and Ruslan Magomedovich Astamirov, who is in the US. The remaining three, Artur Sungatov, Ivan Kondratyev and Mikhail Pavlovich Matveev, are at large.

Mr Biggar said that while a large number of the cyber criminals were based in Russia, the agencies had not seen evidence of state sponsored support. However, he said authorities there appeared to be turning a blind eye to the hacking gang. Mr Biggar said: “There’s clearly some tolerance of cyber criminality within Russia. “We have not seen the Russian authorities crack down and arrest the cyber criminals we know operate in their jurisdiction, so we can read into that they tolerate that activity.” Hundreds of people are thought to have been involved in running the group.

The NCA said they had identified a hierarchy within the organisation, but would not comment on the extent to which it had targeted those individuals. James Cleverly, the Home Secretary, said: “The National Crime Agency’s world leading expertise has delivered a major blow to the people behind the most prolific ransomware strain in the world.” The NCA said the infrastructure supporting LockBit’s tool that was used to steal data, known as StealBit, based in three countries has also been seized. US officials said they had seized control of key servers used by LockBit.

On the gang’s former dark web page, a post signed by police said: “This site is now under the control of the National Crime Agency of the UK, working in close cooperation with the FBI and the international law enforcement task force, Operation Cronus.” The new web page carried the logos of the FBI, NCA, Europol and multiple European police agencies, as well as forces from Australia, Japan and Canada. Deputy US attorney general Lisa Monaco said in a statement: “Using all our authorities and working alongside partners in the United Kingdom and around the world, we have now destroyed the online backbone of the LockBit group, one of the world’s most prolific ransomware gangs.” However, an alleged spokesman for the group posted on an encrypted messaging forum that its backup servers remain operational.

LockBit, which emerged in 2020, uses ransomware to scramble a victims’ IT systems and steal data before demanding a payment for its release. It also sells its hacking tools to other gangs. The group attempted to extort £66m in cryptocurrency from Royal Mail during an attack in January 2023. The postal giant refused to pay but the incident ended up costing the business £10m as a result of repairs and upgrades to its IT system.

LockBit leaked files it had stolen from Royal Mail. However, most were innocuous and did not contain any sensitive or customer information. In addition to Royal Mail, LockBit’s ransomware has been used to target Taiwanese semiconductor manufacturing giant TSMC and aerospace company Boeing. The group was also responsible for hacking the Industrial and Commercial Bank of China, which is one of the world’s largest lenders.

Paul Foster, head of the NCA’s national cybercrime unit, said that LockBit’s popularity was partly because it was so easy to use. He said: “LockBit had established itself as the preeminent ransomware strain over the last four years and one of the reasons for this was its intuitive platform and its relative ease of use. “That means just with a few simple clicks even the less technically savvy cybercriminals used LockBit to deploy ransomware. “Another key reason for their past criminal success was the marketing and branding that underpinned LockBit. They had a slick website and they had loyal customers.” The gang behind the software used marketing tactics including paying \$1,000 to customers who had the logo tattooed on themselves and promising to pay anyone who spotted errors in their code.

Turning now to our chronological news items:

➤ **25 February 2024**



Source: The Telegraph

Karl Holmqvist, CEO of Lastwall, suggests that the modern Western world is dependent on undependable technology. From healthcare to banking, communications to infrastructure – electricity grids, water supplies, sewage systems and trains – we rely on complex systems that do what they do, when they're meant to. For this to work, these systems must be secure against attack.

However, as shown by recent ransomware attacks on everything from hospitals to libraries, we often aren't ready for sophisticated attacks on our technology. Our systems were built to be operationally reliable, but were not designed to be resilient to the efforts of determined adversaries who want our information or money. And this situation could get significantly worse. New technology has put a timer on our current security methods.

We are rapidly connecting the critical components of the most important systems that keep our economy running to the internet. The cornerstone of the current security practices that make this safe is cryptography; encoding information so that only the intended recipient can decipher it. Our current cryptographic techniques are highly secure against current technologies. They are totally unready for the quantum age and the new types of attacks our adversaries are aggressively developing.

Last year, the cybersecurity community was stirred by a sensational claim that RSA, the most widely deployed asymmetric encryption algorithm, had been cracked by a new method harnessing properties of quantum mechanics augmented by AI. This story passed without disaster. But at some point, quantum computers capable of breaking our current system will be here. Researchers and institutes

around the world are pouring tens of billions of dollars into quantum computing, and the timelines for working devices are shrinking.

While there are many promising applications in science and medicine for a large quantum computer, one of the first specific and proven applications will be breaking cryptography. This means that RSA's immunity, and the security of all the cryptographic systems powering our Internet connected society, may soon be in doubt. Last year's announcement was a shot across the bows for the Western world. The next breakthrough could be real. Read further at: [The West is totally unprepared for the looming attack on its survival \(telegraph.co.uk\)](https://www.telegraph.co.uk)

➤ **16 March 2024**

Sean Rayment writes that British defence chiefs have faced calls to ban the video-sharing app TikTok amid fears that sensitive data could be useful to Chinese spies. One former defence chief told The Telegraph that TikTok was a key intelligence source for China's vast intelligence network and that its use by the Ministry of Defence (MoD) should end immediately. The move follows the ruling by the US government last week that the app faces a ban unless its Chinese owners sell the platform to an independent company.

TikTok usage is banned across Whitehall but the MoD still uses it to communicate with British troops around the world, despite growing security concerns. Intelligence experts fear that Chinese spies will be able to harvest data from the app which could undermine and threaten Britain's security.

Lord West, the former head of the Royal Navy and Chief of Defence Intelligence, told The Telegraph and National Security News: "It would seem extraordinary if there is sufficient concern for the US to ban TikTok that we don't take action regarding MoD and service personnel use."

Rear Admiral Chris Parry, who fought in the Falklands, added: "Absolutely and without any hesitation, TikTok should be banned by the MoD. It gives away far too much intelligence, such as people making videos in front of their equipment, vehicles and ships. It can provide details of troops' IDs and their locations. TikTok is also a route-one source into the China's People's Liberation Army - there's no question. TikTok's links to the Chinese government make it an agent of influence amongst our population and it should be banned - it seems extraordinary that this hasn't taken place already." Read further at: [MoD urged to ban TikTok over Chinese espionage fears \(telegraph.co.uk\)](https://www.telegraph.co.uk)

➤ **25 March 2024**

The Telegraph reports that the Kremlin has launched a disinformation campaign spreading false claims that MI6 and other Western intelligence agencies were responsible for Friday's terror attack in Moscow. A network of automated bot social media accounts has been sharing links to fake websites, designed to look like well-known news outlets, that blame the West for a massacre in which 137 people died, The Insider reported.

In what was the deadliest attack inside Russia for two decades, four men burst into the Crocus City Hall, spraying people with bullets and letting off explosives before attempting to make a getaway by car. Islamic State has claimed responsibility for the attack, with its claim backed up by US intelligence. But the Russian bot network has sought to discredit these claims, suggesting Ukraine and the West are responsible.

According to a report by Facebook parent company Meta Platforms, the spam attack was carried out by the Russian IT companies National Technologies and Social Design Agency, both of which fall under EU sanctions and have been linked to the Kremlin. The owner of National Technologies is Rostec, Russia's state-owned defence conglomerate, headed by Sergey Chemezov, a former KGB agent and a close associate of Vladimir Putin.

One of the bot network's claims, designed to implicate UK intelligence services, is that British authorities said Ukraine was not involved "almost immediately" after the Crocus City Hall attack. In a separate example, a clone of the German publication Der Spiegel published a piece titled: "Legalised Terrorism. A terrorist attack in Russia raises the question of Ukraine's cooperation with Islamist terrorist groups." Other groups blamed for the attack include the Ukrainian government, the US and the "collective West".

The operation is carried out by two principal methods, with some bots posting false stories on their own Twitter accounts and others sharing it in the comments section of unrelated posts – such as threads on football matches or TV shows – in order to gain traction. Called Doppelganger, the bot network behind the attack has previously been accused of sharing fake news articles on websites masquerading as Der Spiegel and Fox News.

Past stunts include spreading fake quotes from the musician Beyonce, claiming the US destroyed the Nord Stream 2 gas pipeline, and from the footballer Cristiano Ronaldo, accusing Ukraine of behaving like "charlatans". Following Friday's attack, the network has reportedly distributed disinformation in multiple languages for the first time, in a possible sign that the Kremlin's propaganda machine is expanding its reach to a wider range of Western audiences. See more at: [Ukraine-Russia war live: Kremlin bot army blames MI6 for Moscow terror attack \(telegraph.co.uk\)](#)

Also this day, Camilla Turner writes in the same publication that the US and UK have exposed a global Chinese hacking plot that targeted White House staff and the State Department as well as British MPs and the Electoral Commission. Washington and London announced sanctions on two individuals and one company linked to APT31, a China state-affiliated group, in response to cyber-attacks that "endangered national security".

The attack on the commission, the UK electoral watchdog, was identified in October 2022, but the hackers had first been able to access the commission's systems for more than a year since August 2021. It exposed the personal data of 40 million voters as the commission held the name and address of anyone in the UK who was registered to vote between 2014 and 2022, as well as the names of those registered as overseas voters.

It also emerged that a group of MPs and peers with hawkish views on China had been spied on by Beijing. They were among 43 parliamentary email accounts targeted with malicious tracking links. Oliver Dowden, the Deputy Prime Minister, told the Commons that any hostile cyber activity directed towards UK parliamentarians was "completely unacceptable" and said the two attacks demonstrated a "clear and persistent pattern of behaviour that signals hostile intent from China".

But his announcement sparked a backlash among some MPs who felt the sanctions did not go far enough. Sir Iain Duncan Smith, one of the MPs spied on, said his statement was "like an elephant giving birth to a mouse" and called for China to be officially labelled a threat to Britain. Robert Jenrick, a former minister, called the Government's response "feeble", saying: "The Government clearly is not

holding China to account for their attack on our democracy. Taking three years to sanction two individuals and a small company is derisory. This feeble response will only embolden China to continue its aggression towards the UK.” Suella Braverman, a former home secretary, said it was “abundantly clear” that China was a hostile state posing an “unprecedented threat” to national security. She said there was a “compelling case” to add it to the foreign influence registration scheme.

Washington said a “wide range of high-ranking US government officials and their advisers, integral to US national security” had been targeted, including staff at the White House and the Department of State. The list also featured members of Congress, including both Democrat and Republican senators, the United States Naval Academy and the United States Naval War College’s China Maritime Studies Institute.

The Department of Justice charged seven Chinese nationals connected with APT 31, who it said had “spent approximately 14 years targeting US and foreign critics, businesses and political officials in furtherance of the PRC’s economic espionage and foreign intelligence objectives”. Announcing the charges, the department said the case revealed China’s “vast illegal hacking operation”, which targeted sensitive data from American journalists, academics and companies as well as government officials. Washington announced that it had sanctioned the Wuhan Xiaoruzhi Science and Technology Company Limited (Wuhan XRZ), which it said was a “front company” for the Chinese Ministry of State Security and had served as cover for multiple malicious cyber operations. Zhao Guangzong and Ni Gaobin, two Chinese nationals affiliated with Wuhan XRZ, were also designated for their roles in “malicious cyber operations” that were responsible for “directly endangering US national security”.

The Department of Justice said APT31 was part of a “cyber espionage programme run by the Ministry of State security’s Hubei state security department, located in the city of Wuhan”, and that the seven defendants targeted “networks, email accounts, cloud storage accounts and telephone call records, with some surveillance of compromised email accounts lasting many years”.

The group operated by sending more than 10,000 malicious emails to targets, purporting to be from prominent news outlets or journalists. They contained hidden tracking links that, once opened, would reveal the target’s location, IP address and devices to the hackers. Once the targets had opened the emails, the group used “sophisticated hacking techniques” to gain access to personal data, the department said. Foreign Office officials said the majority of MPs and peers who were spied on by Beijing were “prominent in calling out the malign activity of China”. The National Cyber Security Centre (NCSC), part of GCHQ, said Parliament’s security department “identified and successfully mitigated” the cyber-attacks “before any accounts could be compromised”.

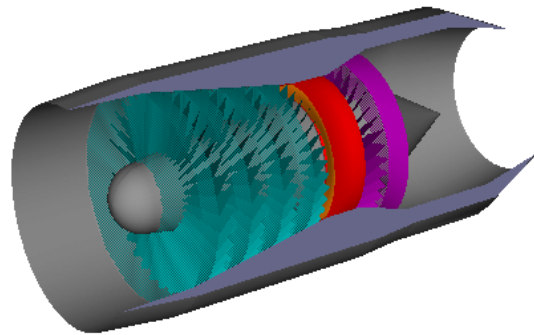
The NCSC will publish new guidance for organisations involved in co-ordinating elections, such as local authorities, which will advise officials on how they can step up the protection of their electoral management systems against cyber hacks. Earlier on Monday, Sir Iain said China critics would not be “bullied into silence” as he compared the West’s approach toward Beijing with 1930s appeasement. Britain has been “too passive” towards China’s overseas influence and has “turned a blind eye” to its malign activities, the former Conservative leader said.



AEROSPACE & THE ENVIRONMENT

We open this section with an extract from NASA's Beginner's Guide to Propulsion. Please note that it has been intentionally organized so as to mirror the unstructured nature of the world wide web. There are many pages here connected to one another through hyperlinks. You can then navigate through the links based on your own interest and inquiry. However, if you prefer a more structured approach, you can also take one of NASA's Guided Tours through the site. Each tour provides a sequence of pages dealing with some aspect of propulsion.

What is propulsion? The word is derived from two Latin words: *pro* meaning before or forwards and *pellere* meaning to drive. Propulsion means to push forward or drive an object forward. A propulsion system is a machine that produces thrust to push an object forward. On airplanes, thrust is usually generated through some application of Newton's third law of action and reaction. A gas, or working fluid, is accelerated by the engine, and the reaction to this acceleration produces a force on the engine.



A general derivation of the thrust equation shows that the amount of thrust generated depends on the mass flow through the engine and the exit velocity of the gas. Different propulsion systems generate thrust in slightly different ways. We will discuss four principal propulsion systems: the propeller, the turbine (or jet) engine, the ramjet, and the rocket.

Why are there different types of engines? If we think about Newton's first law of motion, we realize that an airplane propulsion system must serve two purposes. First, the thrust from the propulsion system must balance the drag of the airplane when the airplane is cruising. And second, the thrust from the propulsion system must exceed the drag of the airplane for the airplane to accelerate. In fact, the greater the difference between the thrust and the drag, called the excess thrust, the faster the airplane will accelerate.

Some aircraft, like airliners and cargo planes, spend most of their life in a cruise condition. For these airplanes, excess thrust is not as important as high engine efficiency and low fuel usage. Since thrust depends on both the amount of gas moved and the velocity, we can generate high thrust by accelerating a large mass of gas by a small amount, or by accelerating a small mass of gas by a large amount. Because of the aerodynamic efficiency of propellers and fans, it is more fuel efficient to accelerate a large mass by a small amount. That is why we find high bypass fans and turboprops on cargo planes and airliners.

Some aircraft, like fighter planes or experimental high speed aircraft, require very high excess thrust to accelerate quickly and to overcome the high drag associated with high speeds. For these

airplanes, engine efficiency is not as important as very high thrust. Modern military aircraft typically employ afterburners on a low bypass turbofan core. Future hypersonic aircraft will employ some type of ramjet or rocket propulsion.

Continuing with the environment in mind and the aviation industry's stated wish to achieve net zero carbon emissions by 2025, courtesy of Microsoft Copilot we list below the many types of current and potential aviation propulsion systems.

Electric Propulsion

Advantages

Reduced Emissions: Electric aircraft produce fewer greenhouse gas emissions compared to traditional combustion engines.

Quieter Operation: Electric motors are quieter, reducing noise pollution.

Efficiency: Electric propulsion systems can be highly efficient.

Challenges

Battery Technology: Developing lightweight, high-capacity batteries remains a challenge.

Range Limitations: Electric planes have shorter ranges due to battery constraints.

Infrastructure: Charging infrastructure needs expansion.

Examples: The Pipistrel Alpha Electro and hybrid airliners are early electric aviation pioneers.

Hydrogen Fuel Cells

Advantages

Zero Emissions: Hydrogen fuel cells produce only water vapor.

Longer Range: Hydrogen-powered planes can potentially achieve longer ranges.

Challenges

Storage and Safety: Storing and handling hydrogen safely is critical.

Infrastructure: Hydrogen refuelling infrastructure is limited.

Examples: ZeroAvia's hydrogen-electric aircraft.

Biofuels

Advantages

Renewable: Biofuels can be produced sustainably.

Compatibility: They can be used in existing engines.

Challenges

Availability: Scaling up biofuel production is essential.

Feedstock: Sourcing feedstock without competing with food production.

Examples: Some airlines already use biofuels in their fleets.

Solar Power

Advantages

Clean Energy: Solar panels convert sunlight directly into electricity.

Endurance: Solar planes can fly indefinitely during daylight.

Challenges

Energy Density: Solar energy density is low, limiting power output.

Weight: Solar panels add weight.

Examples: Solar Impulse 2 circumnavigated the globe using solar power.

Hybrid Systems

Advantages

Combining electric or hydrogen propulsion with traditional engines offers flexibility, extended range, reduced emissions, and gradual transition.

Examples: Hybrid electric planes like the Ampaire EEL.

Nuclear Power

Concept: Nuclear-powered aircraft use nuclear reactors to generate electricity, which then powers electric motors or jet engines.

Advantages

High Energy Density: Nuclear fuel provides immense energy.

Long Endurance: Nuclear planes could fly for extended periods without refuelling.

Challenges

Safety: Ensuring reactor safety during flight is critical.

Regulations: Strict regulations and public perception.

Examples: The Cold War-era Convair NB-36H was a nuclear-powered test aircraft.

Wind Power

Concept: Wind turbines or kites generate electricity during flight.

Advantages

Renewable: Wind energy is abundant.

Lightweight: Wind turbines can be lightweight.

Challenges

Altitude: Wind power is more effective at higher altitudes.

Stability: Maintaining stability during windy conditions.

Examples: Experimental wind-powered drones and gliders.

Bio-Hybrid

Concept: Combining biological and mechanical components.

Advantages

Sustainability: Utilizing organic materials.

Adaptability: Bio-hybrids can adapt to changing conditions.

Challenges

Engineering Complexity: Integrating biological and mechanical systems.

Ethical Considerations: Balancing ecological impact.

Examples: None in commercial aviation yet.

Methane Power

Concept: Methane (natural gas) as a fuel source.

Advantages

Lower Emissions: Methane produces fewer emissions than traditional jet fuel.

Abundant: Natural gas reserves exist globally.

Challenges

Infrastructure: Developing methane refuelling infrastructure.

Energy Density: Methane has lower energy density than aviation fuel.

Examples: Limited adoption in small experimental planes.

Thermal Energy Harvesting

Concept: Capturing waste heat from engines or sunlight to generate electricity.

Advantages

Efficiency: Utilizing otherwise wasted energy.

Sustainability: Reducing reliance on external power sources.

Challenges

Integration: Implementing thermal energy harvesting systems.

Weight: Balancing weight and efficiency.

Examples: Research projects exploring thermo-electric generators.

Staying with Copilot for a little longer we now look in more detail at the (currently) three most promising technologies:

Electric Propulsion

Current Developments: New Zealand's first electric plane, the Pipistrel Alpha Electro, recently flew 80 kilometres across the ocean, using just \$2 worth of electricity. It's 90% efficient compared to 25% efficiency with conventional petrol aircraft engines.

Global Trend: Larger electric commercial planes are being tested in North America, and hundreds of electric air taxis are in development.

Hybrid Airliners: A hybrid airliner has already completed its trial program.

Purely Electric Airliners: However, purely electric airliners are still decades away.

Market Growth: The National Renewable Energy Laboratory (NREL) reports that around 170 hybrid airplane projects were underway in 2022, nearly double the number from 2018. The market for these planes could see strong growth starting in 2028 when 50 to 70-seater electric planes are expected to debut.

Advantages of Electric Aircraft

Environmental Impact: Electric planes significantly reduce carbon emissions compared to traditional combustion engines.

Efficiency: Electric planes are quieter, smoother, and more efficient.

Cost Savings: The cost of electricity for flights is much lower than conventional fuel.

Safety and Sustainability: Electric aircraft offer a safe, affordable, and sustainable way to travel.

Challenges

Battery Technology: Purely electric airliners require advancements in battery technology to become lighter and more powerful.

Regulatory Approval: Electric air taxis and small planes may arrive sooner, subject to regulatory approval.



Source: Pipistrel

Pipistrel Alpha Electro

Biofuel

In particular, Sustainable Aviation Fuel (SAF), also known as alternative aviation fuel, is a type of fuel specifically designed for use in aircraft. It aims to reduce the environmental impact of aviation by minimizing greenhouse gas emissions and promoting sustainability.

Composition. SAF can be produced from various feedstocks, including:

Bio-based Sources: Derived from biological materials such as plant oils, algae, or waste fats.

Waste Materials: Utilizing recycled cooking oil, agricultural residues, or municipal solid waste.

Synthetic Pathways: Creating synthetic fuels through chemical processes.

Properties: SAF has similar properties to conventional jet fuel (such as Jet A-1) and can be used in existing aircraft engines without modification. It is designed to be compatible with existing infrastructure, including storage, distribution, and aircraft fuel systems.

Environmental Benefits: SAF significantly reduces greenhouse gas emissions compared to conventional fossil-based jet fuel. The carbon footprint of SAF is smaller because it is derived from renewable or waste materials. Some SAF pathways even achieve a net-negative greenhouse gas footprint by removing more carbon dioxide from the atmosphere than they emit during production and use.

Industry Adoption: Airlines and aviation companies are increasingly adopting SAF to meet sustainability goals. SAF is considered a long-term solution to decarbonize aviation and achieve net-zero emissions by 2050.



Source: Business Traveller

Hydrogen

Energy Density and Compatibility. Hydrogen boasts an energy-density-per-unit mass three times higher than traditional jet fuel. However, aeronautical engineers must adapt technologies from the automotive and space industries to make them compatible with commercial aircraft operations. One specific challenge is onboard hydrogen storage. While liquid hydrogen storage is promising, storing hydrogen as compressed gas presents challenges due to current aircraft weight and volume requirements.

Safety Considerations. Achieving safety levels equivalent to or better than existing kerosene-powered aircraft is crucial. The aviation industry currently adheres to stringent safety precautions. Future hydrogen-propulsion systems must meet these safety targets before hydrogen-powered aircraft can take flight.

Green Hydrogen and Cost. Hydrogen can be produced via fossil fuels (known as “grey hydrogen”), which emits around 830 million tonnes of CO₂ annually. Alternatively, “green hydrogen” can be generated through water electrolysis powered by renewables. Currently, less than 0.1% of global dedicated hydrogen production is green hydrogen, but this could change with increased adoption.

Liquid Hydrogen Availability and Cost. Liquid hydrogen availability and cost at airports are critical factors. While hydrogen is abundant in oceans, lakes, and the atmosphere, it must be separated from oxygen. Electrolysers, powered by renewable electricity, offer a low-emission alternative for green hydrogen production.

Industry Efforts. Airbus is developing hydrogen-powered aircraft with the aim of commercial service starting from 2035. Rolls-Royce has successfully tested hydrogen-powered jet engines.



Source: ZeroAvia

Zero Avia test-flies a modified 19-seat Dornier 228 twin-engine aircraft with one prototype hydrogen-electric engine retrofitted on its left wing and a regular gas turbine engine, a Honeywell TPE-331, on its right wing.

Feasibility of Net Zero by 2050

Finally, we ask the question: what is the feasibility of achieving net-zero emissions in aviation by 2050? Copilot answers as follows: “It is a complex and debated topic. Let’s delve into the numbers and perspectives”:

Bain & Company Research (2023)

Airlines can potentially eliminate nearly 70% of aviation emissions by 2050. This reduction can be achieved primarily through:

- ❖ Improving fuel efficiency.
- ❖ Wider adoption of sustainable aviation fuels (SAF).
- ❖ Optimization of aircraft operations both in the air and on the ground.

However, sustainable aviation fuel prices in 2050 are projected to remain two to four times higher than the historical average of jet fuel. Furthermore, hydrogen and electric propulsion, while promising, are expected to reduce less than 5% of aviation emissions by 2050 due to technology maturity constraints.

EUROCONTROL Outlook (2050)

Europe's aviation industry can achieve its target of net-zero carbon emissions by 2050. This requires closely aligned industry cooperation, increased use of sustainable aviation fuels (SAF), and focused investment by Member States.

IATA Perspective

Reaching net zero by 2050 is challenging for aviation. The sector's pathways to achieving this goal are narrow and unclear. While all technologies contribute, hydrogen and full-electric propulsion are expected to fall short of expectations by 2050.

In summary, while significant progress can be made, achieving net zero in aviation by 2050 will require substantial efforts, technological advancements, and global collaboration. Realistic solutions lie in a combination of efficiency improvements, SAF adoption, and careful consideration of emerging technologies. However, the industry must also grapple with the economic implications of these changes.

And now some relevant news articles:

➤ **February 2024**

In the February edition of AERO SPACE Robin Evans reports on the 21 November 2023 RAeS Greener by Design conference 'Trial by Contrail – a call for action.'

➤ **March 2024**

In the March edition of the same publication Bella Richards looks at the technological measures to clean up space debris and, more crucially, not add to it in the first place.

And Professor Graham Braithwaite and Jim Angus report - in an article entitled 'Starters for ten' – on the first Global Sustainable Aviation Exchange event established to encourage collaboration on the ten biggest challenges in delivering sustainable aviation.



RECOMMENDED CONTACTS



And finally we recommend readers look at, first:

Careers in Aerospace

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)



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