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CIVIL & DEFENCE/SPACE/SUPPLY CHAIN



AIRCRAFT PROGRAMMES

TAKING A LOAD OFF YOUR MIND Page 10

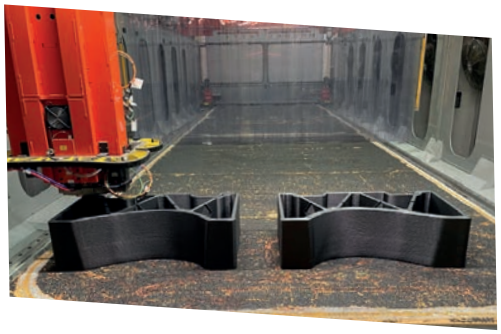
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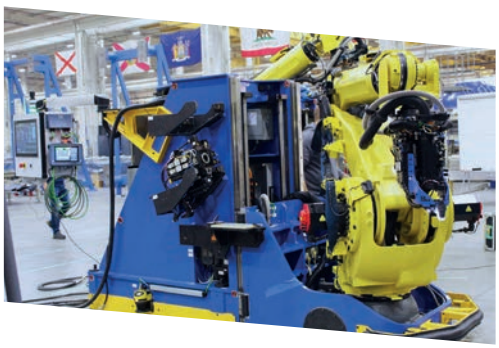
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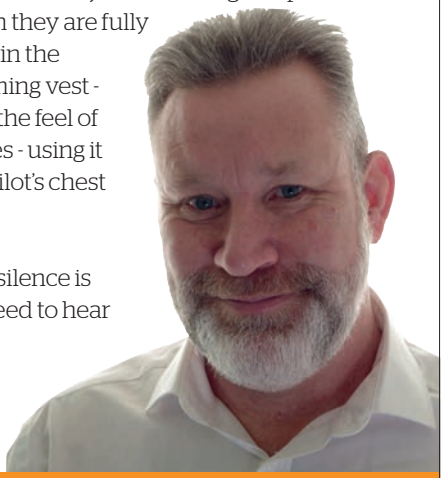
Silence is golden

A press release landed on my news desk recently concerning audio technology specialists, Sonarworks' findings on Gen-Z's content consumption and how it affects their productivity levels at work.

The study found that 93% of respondents reported wearing headphones, with 26% of Gen-Z indicating that they always use them during working hours. Gen Z stands out as the generation consuming the most entertaining content, ranking music as the least preferred type of content to listen to through headphones. Interestingly, the study highlights Gen-Z's acknowledgement that headphones could hinder their productivity.

Reading the report took me back to the dim and distant past when I used to listen keenly to the cutting tool vibrations of my CNC turret lathe when drilling into extremely tough Hastelloy billets. I'd be 'all ears' ready to reduce the machine's feed rate as soon as I heard the drill 'graunch' (is that a word?), or I'd stop the lathe chuck before the drill point fused itself to the workpiece. I would have certainly scrapped the part had I been concentrating on what was on my headphones!

This potentially stressful example of cognitive overload leads me nicely to an article our deputy editor, Ed Hill has written in this issue (*read more on page 10*). Ed hears from BAE Systems, and how the company has been focusing on the best ways to draw a fighter pilot's attention to a particular issue when they are fully engaged with other complex tasks in the cockpit. BAE employs a 'haptic' gaming vest - more commonly used to simulate the feel of action in virtual reality video games - using it to create vibration alerts across a pilot's chest and back.



I don't know about you but for me, silence is golden. To really be productive, I need to hear myself think!

Mike Richardson, editor

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Ford Aerospace makes £1m outlay

Ford Aerospace has announced it is investing over £1 million in advanced manufacturing equipment and strengthening its team with senior skills as the business continues to grow.

The business, which was acquired in April 2023 by SPIROL, has invested in equipment which will allow the team to grow production capabilities, to increase the size of the components that are able to be produced and to enable more accurate inspection of parts.

Recruitment is also underway for a new managing director to lead the business alongside former managing director Chris Ford, great-grandson of founder Robert Ford, and who is staying with the business in a consultancy capacity.

"The business is in a strong position and there is an exceptional management team in place and staff who make me feel comfortable that now is the time to take my career in a different direction," stated Chris Ford. "I am proud of what we have achieved as a family, especially the work to establish our skills academy in the region and I am excited to see the business go from strength to strength under new leadership and as part of the SPIROL group."

www.ford-engineering.com





Airbus opens new Filton wing centre

Airbus is investing further in its UK innovation capabilities, with the opening of a new Wing Technology Development Centre (WTDC) at its Filton site.

The facility, which will be used to build and test demonstrators for a range of programmes and research projects, was opened by Nusrat Ghani, UK Minister of State at the Department for Business and Trade.

The new facility will help Airbus accelerate the design, build and testing of wings for next generation aircraft, by using the latest technology and world-leading demonstrators to further improve the performance of its wings.

"The new Wing Technology Development Centre will help us to ground our research in practicality," stated Airbus head of Filton site and Wing of Tomorrow Programme, Sue Partridge. "A key element of how we deliver technology for next generation aircraft wings is through Wing of Tomorrow (WoT), our largest research and technology programme led by the team in the UK.

"Last week, we achieved a critical milestone in the programme when our second wing demonstrator was completed by the team in Broughton, Wales and delivered to the WTDC. Here it will be prepared for structural testing in our Aerospace Integrated Research and Technology Centre (AIRTeC)."

www.airbus.com

Millions generated for UK economy

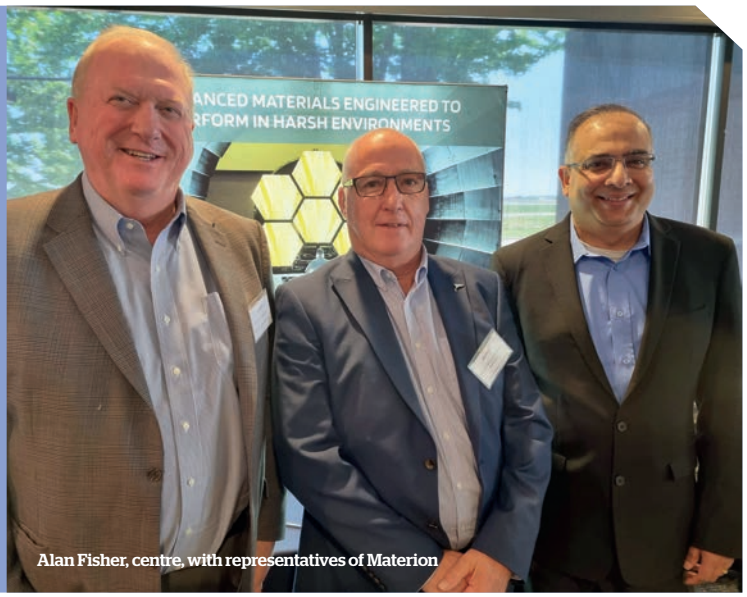
Millions of pounds worth of business have been generated by Farnborough Aerospace Consortium (FAC) at the Ohio Global Aerospace and Supplier Summit.

US businesses will now be setting up in the UK, and British businesses are planning to put down roots in the US, according to Alan Fisher, the FAC's chief executive officer.

Ohio and Farnborough represent the centres of their countries' aerospace industries, and newly forged links will benefit both economies. At the Farnborough Airshow last year FAC and the Ohio Aerospace Institute signed a 'memorandum of understanding'.

This has oiled the route for companies to cross the Atlantic and following the Ohio summit three UK firms have plans to open in the US and three US firms want to set up in the UK or expand their presence.

www.fac.org.uk



Alan Fisher, centre, with representatives of Materion

JEC announced as partner to the ICS show



The International Composites Summit (ICS), has announced it has formed a partnership with JEC with the aim of facilitating international trade, fostering innovation, and strengthening economic ties between the UK and global composites industries.

Bringing together industry leaders, researchers, and innovators from across the composites sector, ICS is scheduled to take place from 6-7 September 2023, at the Marshall Arena, Milton Keynes. ICS promises to be a unique platform for knowledge sharing, networking, and exploring the latest advancements in composite materials internationally, bringing people together to do business.

Through this strategic partnership, ICS will be used as a primary platform to highlight the advantages and potential of trading with the UK composites sector, connecting international companies with the wealth of resources, expertise, and innovations available.

With its extensive global network and industry expertise, ICS will leverage the JEC partnership to provide a platform for European and global companies to explore and seize business opportunities. Through targeted initiatives, intensive promotional activities, and networking events, the partners will facilitate connections and collaborations, fostering mutually beneficial trade relationships.

JEC will support the event through its media channels and provide a digital solution for exhibitors and attendees to connect and meet during the event in September. This solution will connect qualified business partners with an aim of connecting composites industry buyers with ICS exhibitors. Support will be offered prior to the show and will help attendees plan and organise quality meetings.

"We are excited to partner with JEC to spotlight the outstanding trade opportunities that exist within the UK Composites Sector," said Gemma Smith, co-director of ICS. "The International Composites Summit provides the perfect platform for companies wanting to meet and trade with the UK composites sector. We look forward to developing the relationship with JEC and the growth potential it offers to the industry."

Registration for the International Composites Summit 2023 is free and is now open via the official event website below.
www.internationalcompositessummit.com

GKN and Materialise sign AM LOI

GKN Aerospace and Materialise have announced the signing of a Letter of Intent (LOI) aimed at advancing the research, design, and production of polymer additively manufactured (AM) parts for the aviation industry.

The LOI was signed at the Paris Airshow and represents an extension of their existing collaboration. Together, the partners aim to accelerate the certification of the AM process and push the boundaries of additive production of functional and flight-critical aerostructures.

The collaboration ranges from prototyping to the production of functional and flight-critical parts, aligning with the industry's emerging sustainability trends and opportunities. In particular, the partnership will focus on eVTOL aircraft.

"This powerful alliance aims to leverage our combined expertise and the exceptional benefits of 3D printing to push the boundaries of innovation in the aeronautics industry," stated Jurgen Laudus, vice-president of Materialise Manufacturing. "Together, we aim to drive technological advancements, respond more effectively to customer requirements, and shape the future of aerospace manufacturing."
www.materialise.com



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Muirhead strengthens Douglass partnership

Aviation leather manufacturer, Muirhead has signed an exclusive representation agreement with Douglass Interior Products, a leading supplier of aircraft interior furnishings in the US. This partnership will enable Muirhead to supply high performance, sustainable Scottish aviation leather to commercial operators across North America.

Douglass will now carry Muirhead's diverse portfolio of sustainable aviation leather products including LightCore, a lightweight innovation that weighs up to 33% less than standard leather without sacrificing performance, safety, or comfort. Muirhead's CareGuard anti-soil product and its self-disinfecting ActiveHygiene leather will also be available through Douglass.

Myles Hobbs, head of aviation EMEA and the Americas at Muirhead, said: "As we continue to grow our operations in the US, we're confident that the Douglass team's local expertise and trusted reputation will continue to be instrumental in providing a local touch and first-hand expertise for our valued customers."

www.muirhead.co.uk

Dassault UK centre ready for launch

Dassault Systèmes has announced a new partnership with specialist postgraduate institution Cranfield University, which will deliver a new 3DEXPERIENCE Edu Centre of Excellence, opening this September.

The campus facility will provide experiential, initial and lifelong learning with Dassault Systèmes' 3DEXPERIENCE platform to enable the existing and future workforce to accelerate the digital and sustainable transformation of the aerospace industry.

Cranfield University will deliver courses and curricula designed in collaboration with aerospace employers and taught by platform-certified instructors to students and professionals wanting to upskill. It will help learners to boost employability by developing in-demand skills in virtual twin processes, data-driven manufacturing and sustainable design in the context of existing and future job roles.

"We've chosen to partner with Dassault Systèmes because of the ecosystem it already has within the aerospace industry, as well as the cutting-edge technology it has developed through its modelling, simulation and optimisation industry software," explained Professor Dame Helen Atkinson, pro-vice chancellor, School of Aerospace, Transport Systems and Manufacturing at Cranfield University.

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Pictured L-R: Yousif Mahmoud, director general of the Bahrain International Airshow Craig Spyhalski, international air and show trade lead at Lockheed Martin

Airshow cements Lockheed Martin bond

Lockheed Martin has announced its participation and sponsorship of the Bahrain International Airshow (BIAS) 2024. The partnership signifies the global aerospace and defence manufacturer's longstanding ties with the airshow and the wider Gulf region.

The contract was signed during meeting at the Paris Airshow by Yousif Mahmoud, director general of the Bahrain International Airshow and Craig Spyhalski, international air and show trade lead at Lockheed Martin, in the presence of His Excellency Mohamed bin Thamer Al Kaabi, Bahrain's Minister of Transportation and Telecommunication.

BIAS will return to the aerospace calendar 13-15 November 2024 at Sakhir Airbase Bahrain.
www.bahraininternationalairshow.com

Avio purchases Velo3D metal 3D printers

Velo3D has announced that Avio has purchased a Sapphire XC 1MZ printer and an original Sapphire printer to support the development and production of its propulsion systems and accelerate the advancement of the space industry.

Velo3D's solution was selected for its ability to produce quality parts with optimised geometries for the highest performance, and the large build volume of the Sapphire XC 1MZ. Both printers are calibrated to produce parts in nickel-based alloy that delivers strength and corrosion resistance at extreme temperatures.

With one of the largest build volumes for laser powder bed fusion 3D printers, the Sapphire XC 1MZ 3D printer has a print volume that is 600mm in diameter and 1,000mm in height. The original Sapphire has a print volume of 315mm in diameter and 400mm in height. Both printers enable Avio to overcome the constraints of traditional manufacturing methods, including conventional additive manufacturing solutions.

The printers accomplish this by providing a wide breadth of geometric design freedom and a high degree of precision. The solution from Velo3D empowers Avio to optimise its designs and manufacture quality, high-performance components with intricate geometries that were previously unattainable. The result is improved performance, reduced weight, enhanced reliability, and ultimately, a more efficient and accessible space industry.

"Avio is one of the leading space companies in Europe and we are thrilled to partner with them in their pursuit of groundbreaking propulsion systems," said Benny Buller, founder and CEO of Velo3D. "They work with some of the most innovative companies and agencies in Europe and around the world to provide them with the technology they need to reach space. The Sapphire XC 1MZ will help Avio further accelerate the development of its propulsion systems and contribute to the ongoing transformation of the space industry."
www.velo3d.com



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Hosting over 2,800 companies and showing the broadest range of military equipment for land, sea, air, security and joint applications, air vice-marshal (ret'd) **Gary Waterfall**, DSEI senior military adviser – aerospace, reveals what visitors to DSEI 2023 can expect to see at the event.

At this year's Defence & Security Equipment International (DSEI) event held in London ExCeL from 12-15 September, aerospace manufacturing professionals can expect a bustling showfloor with outstanding displays of military capability from around the world. This includes a host of helicopters and aircraft from the highest calibre of exhibitors.

The Global Combat Air Programme (GCAP) will have its own dedicated exhibition stand that will feature truly immersive, digital displays to showcase some of the innovative technologies that are driving this programme. Colleagues from the UK, Japan and Italy will be on hand to talk to visitors about GCAP and the rapid progress that is being made across all areas of the programme.

✈ DSEI 2023 will host over 2,800 military equipment companies at the event (below)

Typically, what kinds of companies and associations does DSEI attract to the event?

From the largest primes to the smaller SMEs, DSEI is open to companies of all sizes throughout the supply chain. There will be representatives from the whole defence ecosystem present, but we have also seen a major influx from companies outside the traditional industrial base, such as Sony, IBM, Oracle and Panasonic.

The ADS pavilion at DSEI will host many different aerospace companies, including Collins Aerospace, GE Aviation and smaller companies such as Standard Aero.



There is a range of valuable opportunities for networking, platforms for business and extensive access to relevant content and live-action demonstrations. The DSEI community can strengthen relationships, share knowledge and allows visitors to view the latest capabilities across the exhibition's Aerospace, Land, Naval, Security and Joint Zones.

How does the aerospace domain at DSEI integrate with other domains for a joined-up approach?

Integration at a national level across the frontline commands is essential and I know that they are all in constant dialogue. 'Multi-domain operations' was the underlying theme of DSEI 2021, and 'achieving an integrated force' is this year's focus. The most effective fighting forces are those who can integrate best across all environments. But it's more than that – it includes integration from supply chain, SMEs and large Primes alongside the UK Government – and all set in an international context. A hackneyed phrase – but together the component parts are much more powerful than the individual sum.

Therefore, the whole aerospace domain will play a prevalent part in DSEI 2023, but it always works best when it's connected with other domains for a joined-up approach. DSEI is a key learning platform and a way to bring together people from different branches of the military to share best practice, discuss ideas and scale capabilities from one domain and apply them to others. This learning from other domains ties in with the overarching



theme for DSEI 2023 of "achieving an integrated force".

What will be the chief highlights of the aerospace domain at DSEI?

There are broadly three key reasons why people should visit the Aerospace Zone at DSEI. Firstly, DSEI will represent a key forum for updates on, and how to sell into, the Global Combat Air Programme (GCAP). GCAP is a trilateral collaboration between the UK, Japan and Italy to develop the next generation of fighter jet. Two months ago, the UK Ministry of Defence (MOD) awarded a major contract to BAE Systems on behalf of British defence firms, Leonardo UK, MBDA UK and Rolls-Royce, to progress the design and development of this aircraft. Tempest is the UK name for the aircraft in development under GCAP. Team Tempest has been researching and evaluating a host of future combat air system capabilities since 2018 and is continuing to develop the technologies needed to deliver the next generation combat air capability.

Secondly, there will be extensive Unmanned Aerial Vehicle (UAV) capabilities being exhibited, such as Mitsubishi's counter-UAV laser prototype. Since Russia's illegal invasion of Ukraine in February 2022, UAVs have been in the spotlight both in terms of increased usage in warfare and the development of new UAV capabilities.

Thirdly, sustainable aviation that maintains an operational advantage will feature heavily. The UK Government is committed to net-zero carbon emissions by 2050 and we know that defence is a significant contributor. It will be fascinating to see how the RAF and large aerospace companies approach the challenges of being both sustainable and competitive.

How will the Global Combat Air Programme feature at DSEI?

In addition to the GCAP feature stand there will be two GCAP panel discussions taking place at DSEI. The first will be in the Aerospace Forum and will include the international programme directors from the UK, Japan and Italy. They will be joined by the senior responsible owners from BAE Systems, MHI and Leonardo Italy. This promises to be a fascinating update from the international partners, who will talk about the overall direction of the programme; the capability that it is delivering; interoperability with allies and other domains; people and skills; and programme milestones.

The second panel is titled 'How supply chains are supporting future combat air' and will see UK industry analyse the procurement challenges and opportunities that lie ahead for the Global Combat Air Programme. The panellists will discuss how GCAP is integrating SMEs, leveraging on their knowledge, capability and skills, which in parallel is creating a productive and robust supply chain.

Q) How do you expect the show to grow this year and what are your targets for the 2023 event?

In terms of scale, DSEI is currently on target to surpass pre-pandemic levels of exhibitors and visitors, which is hugely encouraging. This year, there has been an increase in non-traditional defence companies exhibiting solutions, so it's expected that there will be a broader variety of approaches on display than in previous years.

This year's targets also factor in a sustainability dimension. In collaboration with the ExCeL, DSEI organisers are working to deliver a more sustainable trade show as part of a long-term commitment to addressing the carbon footprint of large-scale events. DSEI 23 will act as a basis to facilitate meaningful reduction targets for all Clarion events going forward.

Finally, in summary, what has changed since DSEI 2021 and how will this affect the show?

The major change since DSEI 2021 is unquestionably the war in Ukraine. The brutal and illegal invasion by Russia has focused minds on how to deter, and if necessary, defeat, a peer/near-peer adversary in order to maintain our hard-won freedoms. The conflict represents a significant shift in how allied forces think about warfare.

President Zelenskyy made a plea to allies for fighter jets in February this year and a few months later Prime Minister Rishi Sunak and Dutch leader Mark Rutte agreed to build an 'international coalition' to help procure F-16 fighter jets for Ukraine. Ukraine has been seeking to obtain F-16s for some time to augment its small Soviet-standard air force because they are widely available, with about 3,000 in service in 25 countries. Depending on where this situation is in September at DSEI, conversations about military aid, particularly the gifting of more aircraft, may still be continuing.

DSEI is a global event, but as its based in the UK will have a significant UK MOD presence. The UK can be proud to be one of the largest donors to Ukraine having committed £2.3 billion in military assistance in 2022 and has pledged to match that assistance in 2023.

DSEI always attracts the biggest brands in the defence industry but increasingly has many companies who are coming from outside of the defence enterprise either exhibiting for the first time or returning, bringing novel applications of their technology into the sector.

www.dsei.co.uk



DSEI includes a host of helicopters and aircraft from high calibre exhibitors (top)

Gary Waterfall, DSEI senior military adviser – aerospace (above)

Scan here for more DSEI articles

TAKING A LOAD OFF YOUR Mind

Dr Jacob Greene, senior human factors engineer and Chris Forrest, innovation, and growth engineer at BAE Systems, discuss with **Ed Hill** the development of so called 'haptic' or tactile technology to provide improved prompts for pilots during complex and stressful combat situations and mitigate cognitive overload.

BAE Systems delivers a broad range of solutions and services enabling its customers to successfully carry out missions. The company has a long legacy of providing large-scale systems in engineering, integration, and sustainment services across air, land, sea, space, and cyber domains.

Working alongside academic and industrial leaders it develops emerging and game-changing technologies to ensure it continues to provide the world's most advanced, technology-led defence, aerospace, and security solutions.

What was the thinking behind developing systems that can help with pilot cognitive overload?

Fighter pilots operate in a complex environment; they are exposed to extreme G-forces, engine noises, changing light levels, and visual instruments, all while performing fast jet operational manoeuvres – making cognitive overload a likely outcome. This can have dire consequences, especially when compounded by stressful situations like system failures or combat operations. At BAE Systems we have been measuring cognitive loads on pilots for many years and wanted to explore ways to give pilots more room to think, with the goal of alleviating the physical demands and mental workload of a cockpit environment.

Can you tell us more about the haptic vests that you are developing?

BAE Systems has caried out research into haptic feedback for pilots using its active stick technology (right)

Dr Jacob Greene, senior human factors engineer, BAE Systems (below)

Chris Forrest, innovation and growth engineer, BAE Systems (bottom)







Why are these better than visual interfaces with the aircraft?

We have been focusing on the best ways to draw the pilot's attention to a particular issue when they are fully engaged with other operational tasks. We took a commercial off-the-shelf 'haptic' gaming vest, more commonly used to simulate the feel of action in virtual reality video games, and used it to create vibration alerts across a pilot's chest and back. In airborne trials, the initial feedback has been incredibly positive, as vibration uses an entirely different part of the brain to the audio-visual cortex, which means it can be consciously registered more easily, especially in stressful situations.

We have done multiple tests on pilots, comparing reaction times between visual and haptic vest cues. We have increased their cognitive load by giving pilots tasks to do on a computer tablet, simulating their attention being diverted elsewhere when the cue arrives. These trials showed the pilots were much more responsive to cues from the haptic vest, as they reacted more quickly and intuitively in comparison to other cues. Following positive trials of this technology in

small commercial aircraft, our next step is to progress it with military customers and sophisticated combat aircraft, as well as rolling it out in a training environment.

Tell us more about the automation of aircraft management systems and evading missile attacks, etc.?

Our new aircraft management system helps pilots under attack in the air by automatically tracking missile threats, and giving the pilot a haptic signal to help avoid them, mitigating the risk of cognitive overload. In the event of an inbound missile accelerating towards the aircraft, the haptic signal would move the flight stick just at the right time to take evasive action.

We have been testing the technology at our simulator facility in Rochester to improve pilot performance and aircraft safety through threat warnings. In one scenario, we simulated very difficult flying environments for pilots, including reduced visibility and enemy attacks. We tested the impact of various inputs, including haptic feedback from the active flight stick, as well as 3D audio and visual cues through augmented reality glasses.

Our tests aimed to determine what information we can efficiently deliver to the pilot when they are under a high cognitive load, in order to ensure that they perform to their maximum potential. Like the haptic vest trials, haptic cues via the active stick were the most effective medium in these high-stress environments. In fact, it was able to give more than one cue at a time! The flight stick technology has been adapted for both military aircraft, such as the F-35 and commercial jets such as the Gulfstream G500/600.

Will there be a role for AI in the development of these systems?

AI will undoubtedly play an increasingly significant role in the development of these systems as we create ever more realistic and complete synthetic environments to test and refine the capabilities that bring the most operational benefit. As an example, AI could generate the flight path and behaviour of airborne drone swarms in response to a variety of tactical situations, to test how our systems could assist a pilot interacting and managing those assets.

As AI expert systems become more capable, and most importantly more reliable, we expect to see their staged deployment into these intelligent systems. Such a capability would be able to monitor both aircraft situation and pilot awareness in order to, for example, provide priority information to the pilot. Eventually we will see such systems able to respond to priority threats, be it through launching of defensive countermeasures, or actively controlling the aircraft to avoid an immediate threat such as an incoming missile, or collision hazard during low level manoeuvres.



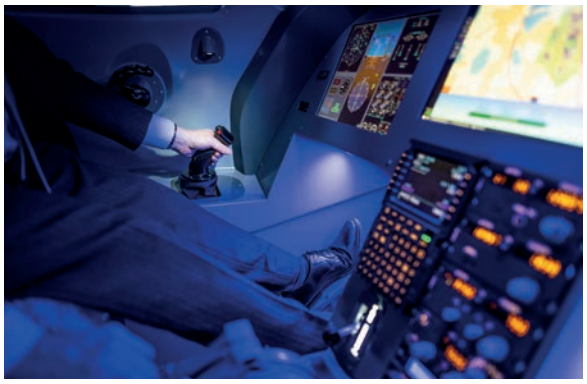
We are already seeing the significant benefit of employing this technology, particularly in terms of driving critical pace and efficiency across our programmes. This is allowing us to break the rising time and cost cycle of our ever more complex work.

In partnership with academic and industrial leaders, for example, we are using data from the complex systems used in fast jets or gathered at our testing facilities to create simulations and prototypes more quickly and effectively than ever before. These can be used to test things like platform aerodynamics, real-time aircraft radar object recognition and stealth capability.

Can this technology be retrofitted to aircraft and how will it develop from concept to being manufactured at scale?

✈ Haptic feedback research is likely to be part of the development of the sixth generation fighter Tempest (above)

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Our systems are constantly being refined in terms of their size, weight, and power footprint, and as such can be retrofitted to a range of aircraft, from lightweight two-seater propeller driven platforms, to future fast jet platforms.

Design for manufacture is always a primary consideration in the development of our systems so they are manufacturable at scale and can be maintained and supported through life. We have a good track record of adapting our new technology to replace and enhance existing legacy capabilities, such as the digital LiteHUD retrofit replacing cathode-ray tube-based head-up displays.

Will this research and technology contribute to the Tempest/FCAS programme?

Absolutely, the capabilities required by Tempest in the future will be fulfilled through research and development projects such as this taking place today.

With so much research going into automating various aspects of flying and deploying weapons, would it not be easier to develop more sophisticated UAVs?

We are very clear that there are significant benefits to unmanned systems, an area we have been working in for many years, but there should always be a human 'in the loop' when it comes to key decisions.

This technology instead brings mission benefits of freeing up the pilot to focus on higher order tasks, such as commanding assets and collaborating with multi-domain forces, while the lower order tasks are handled automatically and safely by the on-board systems.

www.baesystems.com

ONE STEP PROCESS BUILDS BLADE SUCCESS

When one solution for a challenging VTOL blade proposed an expensive multi-stage, autoclaved process, Rockwood Composites suggested a one-step vacuum compression moulding process which can produce the blades to the required quality and quantity.



Rockwood is paving the way for a more efficient and cost-effective future in aerospace manufacturing (left)

Rockwood proposed a one-step process involving vacuum and compression moulding (below)

Many aerospace companies working in composites have a knee-jerk reaction and automatically reach for the autoclave if they are faced with a new or complex problem. This even extends to organisations that specialise in the composites industry more specifically.

However, this is always an expensive solution, even with energy prices coming down - and there are simpler, more elegant ways to address these issues. Other solutions are available and one of the leading capabilities is compression moulding, of which few in the industry understand the full potential.

A good example of this was a particular knotty challenge for propellers used in the emerging vertical take-off and landing (VTOL) aircraft market. However before delving into this particular problem, let us examine the general plusses and minuses of autoclave vs out-of-autoclave (OOA) production.

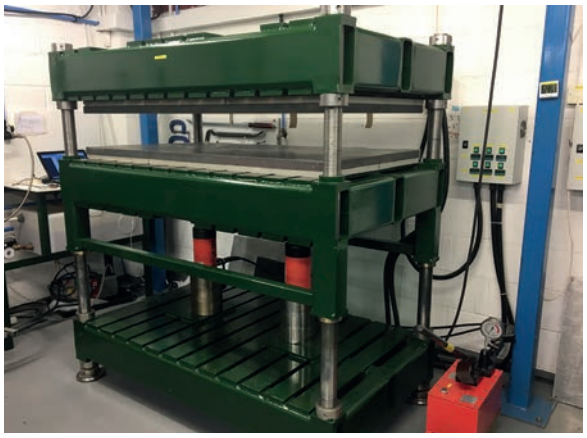
Autoclaved processes are excellent for large surface areas where parts are not required to be net edge moulded, and with only one surface to be controlled. However, autoclaves are expensive to buy, expensive to install and to run and labour-intensive. Also, it is not possible to make adjustments once a process cycle has begun. These cycles are often lengthy which limits production volume.

The OOA process achieves the same quality as an autoclave in most applications while eliminating voids and achieving the required material structures by placing the layup within a closed mould. Vacuum, pressure, and heat can also be applied.

A positive spin

Now let us get back to propellers. The customer set the challenge to several respected composites organisations to manufacture propellers using a multi-stage, autoclaved process, where pre-manufactured structural parts of the blades would be bonded or encapsulated together. Not only is this expensive, but it is also complicated and produces a lot of waste.

First the spar had to be made with



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curing, which was inserted with foam into a mould tool, wrapped in composite and curing again in an autoclave. An alternative process required making two half-propellers, two skins, each to be autoclaved after which they were cold, fine-line bonded. This gave a final structure, though with the obvious potential weakness around the bond.

Compression moulding specialists, Rockwood Composites approached the problem from a different perspective – a single shot compression moulding, where the entire structure is moulded in a single, quick operation, requiring no post manufactured gluing and results in one fully integrated structure; which means no bonds to fail. It is also produced in half the time of its autoclaved alternatives.

"The specified process was clunky and we always try to minimise the number of steps, which minimises cost and waste," explains Rockwood's managing director, Mark Crouchen. "Our development team looked at the problem from every direction – both technical and commercial - and came up with a one-step process involving a vacuum and compression moulding process that met all the stringent aerospace material standards. This was able to produce the blades to the required quality and at the required rate. The process required careful tool and process design to optimise the moulding pressure on all the critical internal structures.

"It also required careful orientation of the blade in the tool in order to allow for compression in both directions, horizontal and vertical. We set the tool at an angle to enable this. This particular process took place at a temperature of 135˚C, which is within our usual range of 120-180˚C depending on the prepreg.

"We can accurately control the consolidation pressure on the prepreg across different core densities in the same moulding. This is a key factor in laminate quality in determining physical properties.

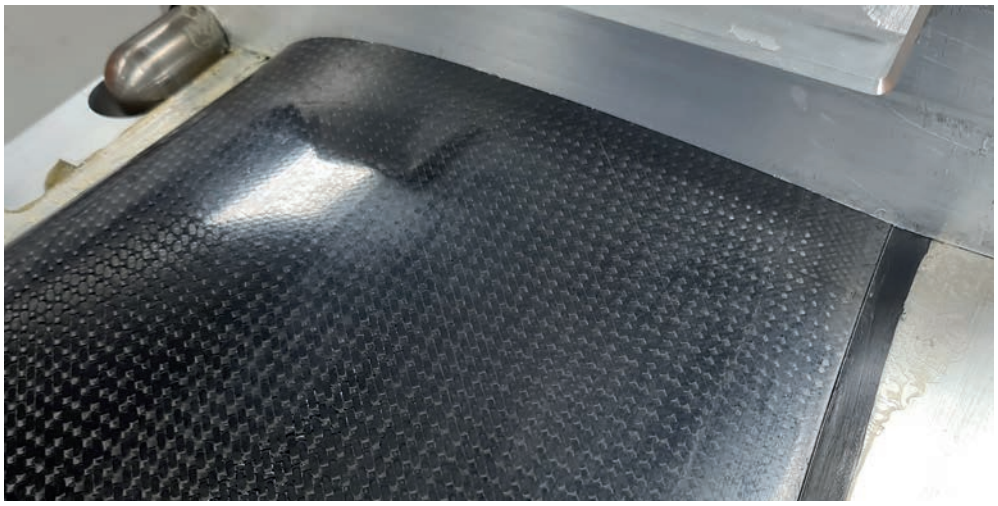
"The consolidation pressure comes from very accurate core machining, and material selection. With this accuracy, we can exert different pressures at different points on the structure. And it is the core that is critical for the pressure.

"By adjusting these cores, we can change the pressures and we can push one component up against another. We need to be very precise in crushing the core and in machining it to regulate the pressure that the crush imparts on the prepreg.

"For example, for a high density core, you might want to limit the pressure whereas for a low density core you might want a higher pressure. You need to adjust all these aspects for an efficient manufacture.

"Material selection is linked to core densities and resin weights because it all has a bearing. If core is specified, we optimise the design to give the right pressure. Where the core is not specified, then the whole manufacturing process will need careful consideration in its entirety. We are super critical over core density and surface accuracy.

"This is not just about making a mould cavity in an aluminium block. It all comes from, firstly, the design of the part within the tool and the second element is the size and shape of the cores, because this is what gives you the pressure."



A question of balance

Post-moulding operation, and as part of the quality control, it is necessary to balance the blades, normalising the centre of gravity of each blade to the heaviest in the set. The mass moment had a tolerance of 500g/mm.

The process was so sensitive that Rockwood found it was affected by engineers simply moving around the room. This problem was fixed by bolting the measuring rig to the floor, which give the required level of stability.

Rockwood designs and manufactures composite components using the out-of-autoclave techniques of compression and bladder moulding of prepreg composite material in metal tooling. The team's pioneering work with compression moulding showcases the immense potential of this technique in addressing the challenges faced by aerospace companies.

By embracing innovative and efficient manufacturing processes, the industry can continue to drive progress, reduce costs, and improve sustainability in the field of composites.

As more companies recognise the advantages of compression moulding and explore its full potential, we can anticipate further advancements and breakthroughs in aerospace composites.

By shifting away from knee-jerk reactions and embracing alternative solutions, Rockwood Composites paves the way for a more efficient and cost-effective future in aerospace manufacturing. Indeed, the company's success story serves as an inspiration and a testament to the transformative power of innovative thinking in the industry. This highly-effective manufacturing technology can produce parts in volumes and accuracy needed by the industry, though it is a highly skilled operation.

As Crouchen concludes: "Compression moulding has all the key attributes for cost-effective, high-volume propeller manufacture, while optimising the properties of the most advanced composite materials."

www.rockwoodcomposites.com



✈ Compression moulding can optimise the properties of composite materials (above)

✈ Rockwood's consolidation pressure comes from accurate core machining (below)

Scan here for more Rockwood articles



A FOUNT OF TOOLING Knowledge

Sandvik Coromant's new UK headquarters and technical centre in Halesowen, West Midlands, will give customers access to the global cutting tool specialist's immense accumulation of engineering expertise as well as the latest industry advances. ***Aerospace Manufacturing*** hears more.

Sandvik's centre is well-equipped to demonstrate its knowledge of metalcutting applications (above)

Magnus Ekbäck vice-president of strategy and business development, Sandvik Coromant (below)



Sandvik Coromant's new state-of-the-art technology centre in Halesowen represents the very latest in cutting tool support, services and research for its UK customers.

Part of a global network of Sandvik Coromant Centres that allow the organisation to share engineering expertise with its customers in a physical environment, the new centre, which historically has also been home to the tooling specialist's UK headquarters, has undergone significant investment and will operate as a national hub for metalcutting expertise.

The facility contains two education stations with two machine tools equipped for tooling demonstrations, application training and engineering projects: a 5-axis DMG Mori DMU 80 eVo milling machine, and a Mazak Integrex i-200S AG lathe. These versatile CNC machines have been chosen to ensure the facility can demonstrate any turning or rotating metalcutting application. Within the education stations, Sandvik Coromant's engineers – easily recognised by their yellow jackets – are on-hand to deliver training and demonstrate trials and tests of cutting tools for customers and partners.

Digital developments

Machine demonstrations at the education stations include CoroTurn Prime for all-directional turning, which can be programmed with Sandvik Coromant's specialist PrimeTurning methodology and in combination with its CoroPlus Tool Path software. The centre is also well-equipped to demonstrate Sandvik Coromant's expanded digital offer and its knowledge of metalcutting applications. CAD/CAM, simulation software as well as tool presetting and measuring equipment is all utilised at the centre for optimum machining.

"Digitalisation is speeding up development of metalcutting processes and it is a new and very important ingredient in the engineering solution mix," comments Magnus Ekbäck Sandvik Coromant's vice-president of strategy and business development. However, it presents a challenge for our customers to keep pace and get the full benefits of it.

"Because we operate in the industry that we serve, it puts us in a great position to help our customers solve their challenges. Digitalisation underpins many activities for our customers and will be essential for the sector as it progresses into Industry 4.0. Many of our customers are already in the design stages of using digital twins and automation in their metalcutting processes. Collaborating and supporting customers at our centres places us at the centre of this innovation."

Sandvik Coromant has well-established links to the UK aerospace industry. It was one of the first Tier 1 members of the Advanced Manufacturing Research Centre (AMRC) in Sheffield where much metalcutting research is carried out by companies involved in the sector.



It has developed cutting tools and coatings such as its S205 grade insert to tackle the challenges of machining materials being used in the sector, such as HRSA and the CoroMill MH20, a high-feed milling tool optimised for pocketing applications in ISO S, M and P materials. This insert's cutting edge geometry delivers a gradual and light cutting action to help support vibration-free production in aerospace component manufacturing. It also has a range of cutting tools for composite materials found in aerospace to tackle issues such as delamination and fibre breakout or metal matrix composites that include both materials.

Sandvik Coromant has a longstanding relationship with the site in Halesowen, being the location of its UK arm since 1958.

"In addition to hosting customers physically at our centres, we can also provide digital live machining (DLM) sessions," explains Michael Eneberg, vice-president of global sales at Sandvik Coromant. "These virtual sessions use technology to give customers an interactive experience of the centre, including multiple cameras inside the machine tools that provide live two-way dialogue between customers and our global specialists."

DLM sessions were demonstrated at the centre's opening providing a close-up look at the metal cutting process on the machines. Sandvik Coromant says the sessions will also be used for educational purposes.

Examples of advanced metalcutting using Sandvik Coromant tools on its inauguration included a large aerospace-style turned part with additional machined features on the Mazak Integrex lathe to demonstrate what could be achieved. Other equipment at the centre includes a CoroPlus Tool Supply automated tool vending machine with software that enhances shopfloor inventory control for improved profitability, productivity, and sustainability.

"Our ambition is that customers, both present and future, can immerse themselves in the Sandvik Coromant experience here and will receive a world-leading level of support," adds David Harborn, Sandvik Coromant managing director for the UK and Ireland. "Our vision is to create a true innovation hub for metalcutting in the UK."

Commenting on the centre and industry trends Ekbäck concludes: "Today, just supplying tools and cutting tool data isn't enough for our customers. They want total solutions and we need partners to provide them, so together our solutions can interface with each other and give the customer a more holistic and comprehensive solution. I believe this new building will be the site of a lot of collaboration and innovation with our customer's and our partner's projects."

www.sandvik.coromant.com

✈ Sandvik Coromant's new UK headquarters and technical centre (above)

✈ The centre includes the latest machine tool technology (below)

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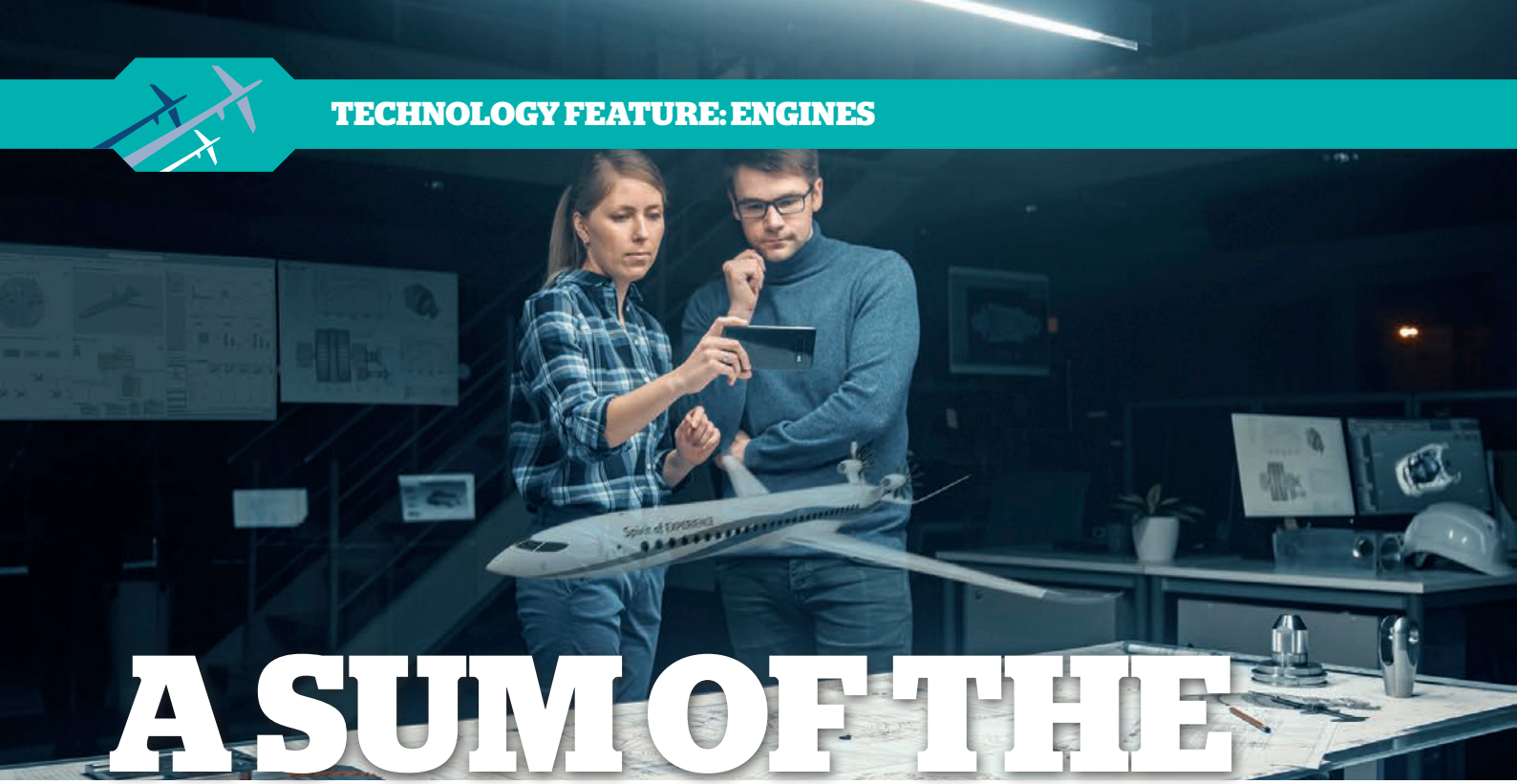
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A SUM OF THE PARTS

According to **Lee Evans**, client director transport, mobility and aerospace, EuroNorth, Dassault Systèmes, hydrogen is only one of the solutions to future aerospace sustainability.

With the 3DEXPERIENCE platform, companies can create and produce fuel in the most cost-effective and sustainable manner (above)

Lee Evans, client director transport, mobility and aerospace, EuroNorth, Dassault Systèmes (below)



As the race to Net Zero is well and truly underway, businesses in every sector across the globe are facing mounting pressure to use energy responsibly and use renewable energy sources where possible. As a result, it's no surprise that the International Renewable Energy Agency has predicted that hydrogen will cover 12% of all global energy demands by 2050 and cut carbon emissions by 10% in a Net Zero scenario.

This is equally applicable to both aviation and aerospace sectors. In 2021 aviation accounted for over 2% of global energy-related CO_2 emissions, having grown faster in recent decades than road, rail or shipping. Although new aircraft are up to 20% more efficient than previous models, this has not been enough to keep up with the growing demand and activity, in-short, fuel efficiency improvements are far below what they need to be in order to achieve the Net Zero goal by 2050.

The sobering facts and the slow pace towards efficiency have caused the aerospace sector to look towards renewable energy to help fuel the future, particularly hydrogen. Hydrogen is crucial in finding a solution that can alleviate climate change due to its exceptional energy density and ability to eradicate CO_2 emissions. With hydrogen still in its development stages, the industry has the scope to mould and develop this fuel type to fit its agenda, making it an exciting opportunity for the sector to capitalise on.

Sustainability in the aerospace sector will occur as emission concerns steer R&D towards newer technologies. These advances will help develop the aircraft of the future – which may not be powered by today's fuels.

One of these sustainability regulations can be seen in practice in France, with the nation banning short-haul domestic flights between cities, linked by a train journey of less than two and a half hours. Approved by the European Commission, it comes as the country starts implementing its 2021 Climate Law to reduce its carbon emissions.

A rapidly changing global energy landscape has resulted in disruptive technologies emerging in the sector. Such disruptive innovation in the energy domain has sparked a revolution in technological capabilities, digital transformation, cost reduction, and the business environment itself. This is mirrored with hydrogen battling CO_2 emissions in our industry.

Hydrogen is often seen as a one fits all solution for the aerospace sector, but that is not necessarily the case. Aviation fuel will not change completely in the near future however; hydrogen will offer an opportunity to become a part of the solution. In the coming years, the aircraft that fit differing range markets will see a variation in fuel sources being used which is not common today. Long haul flights will be more committed to conventional fuels for far longer, with short-range missions undertaken with Urban Air Mobility and electrification options. Hydrogen will find its niche in short to medium-range space, with the transition aided by emergent legislation,

thus forcing change.

As mentioned, hydrogen is currently a disruptor in the aerospace sector. Yet, for this disruption to become more mainstream, there are several key challenges to be overcome, not least the supply meeting the expected demand.

Hydrogen advancements

In the case of hydrogen applications, there is a significant focus on low-Technology Readiness Level (TRL) endeavours, such as researching hydrogen tanks and fuel cell design. To address these challenges, the Aerospace Technology Institute launched FlyZero, which identified technical challenges in aircraft liquid hydrogen storage as an illustrative example. By conducting thorough TRL assessments, we can confidently tackle these challenges and pave the way for a brighter future of aviation technology.

Another challenge that should be prioritised is the storage of hydrogen. Liquid hydrogen's low density and cryogenic characteristics make it challenging to fit into an aircraft, resulting in bulky tank shapes.

The transition towards hydrogen-powered systems will necessitate a substantial revamp of pre-existing infrastructure and logistical systems throughout airports and the hydrogen supply chain. This is a critical undertaking as it encompasses the integration of hydrogen storage systems in aircrafts and the establishment of efficient hydrogen infrastructure at airports to guarantee prompt delivery of the requisite amount of hydrogen for flights.

In addition to infrastructure challenges, improving the transport of hydrogen from producers to airports is another critical development to support widespread adoption. The entire supply chain and value network must evolve to support those new needs.

With the aviation industry expected to double to over eight billion passengers by 2050, it is essential to focus on helping starts-ups that are developing hydrogen technology, such as those looking into how to store and manage the hydrogen infrastructure. Having the ability to design and test in a virtual twin environment allows for a more sustainable development option.

Dassault Systèmes is helping support sustainable innovation around the evolution of aircraft design to incorporate hydrogen as a fuel source. Using the 3DEXPERIENCE platform, we're able to provide the tools for a new generation of engineers and designers to test theories and iterate on designs quickly through simulation to learn how the aircraft and new fuel sources will react - before the costly exercise of real-life testing and manufacturing.

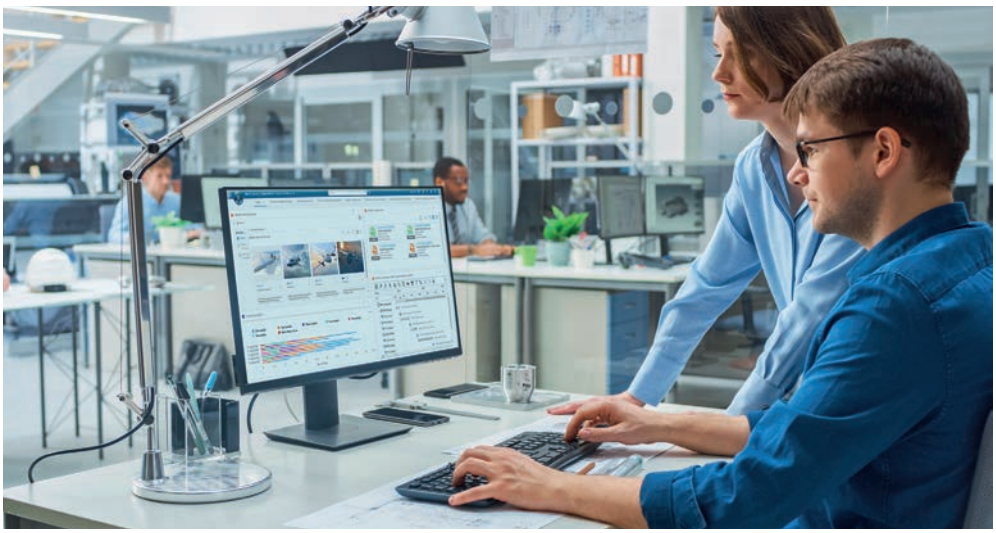
Hydrogen as a sustainable fuel source is much larger in density than traditional jet fuel, and there is still development to be done on the scalability of the fuel cells to the megawatt levels that commercial aircraft require. In the virtual twin, designers and engineers can develop new aircraft designs that can accommodate the more significant levels of storage allocation needed for hydrogen fuel and simulate the next generation of fuel cell technology.

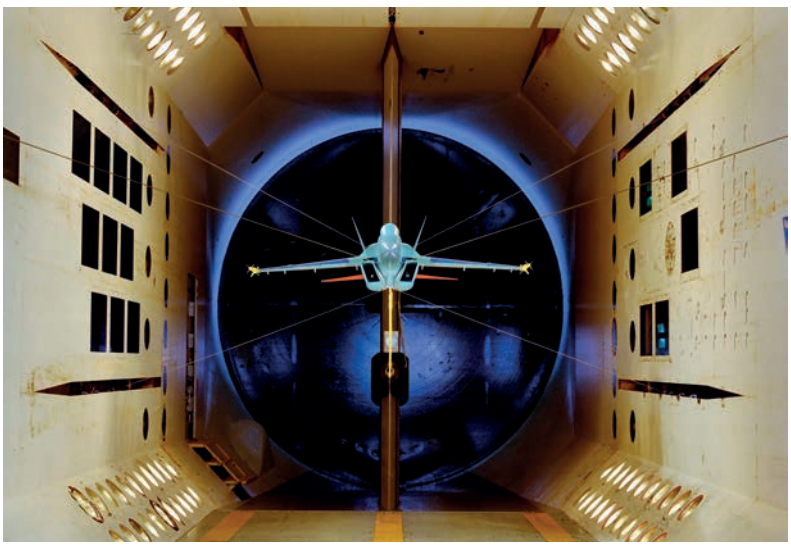
While the complete solution is unclear today, the broad array of areas being worked on across the future supply chain for hydrogen and aerospace demonstrate the future of renewable fuel. In collaboration with these companies, our platforms are helping disparate players in the sector develop their technology and work towards achieving 'Net Zero'.

Long-term thinking about hydrogen involves the same factors as any disruptive technology or design. There must be a commonality. It is important to secure suitable investments to help build and develop the infrastructure to bring the technologies and sustainable fuel sources into the mainstream to help lower the costs. One way to do this is to get backing from governments who have pledged to Net Zero by 2050. Another is by demonstrating results now, today - with the support of tools such as the 3DEXPERIENCE platform, aviation companies can create and produce fuel in the most efficient, cost-effective and sustainable manner to aid the push for NetZero.

The operation for this task is immense but one worth undertaking. The race to 2050 is on and every little aspect of change within the supply chain contributes towards the end goal of Net Zero. As hydrogen provides the aviation sector with the hope it needs for sustainable fuels, it is clear it's not the only solution needed to meet the goals of the sector, but rather part of a sustainable consortium of technologies we hope will fly us to our destination.

www.3ds.com





✈ Dassault Systèmes is helping support sustainable innovation around aircraft design to incorporate hydrogen as a fuel source (above)

✈ The ATI launched FlyZero which identified technical challenges in aircraft liquid hydrogen storage (below)

Scan here for more Dassault Systèmes articles

AIMING SKY HIGH FOR SUCCESS

IPC Mouldings, a leading provider of injection moulded parts and assemblies for aircraft interior applications reveals how it is playing a key role in Northern Ireland's aerospace sector.

Our appetite for air travel shows no signs of slowing down, which is welcomed by everyone working in the aerospace industry as companies work to meet demand and experience exponential growth, quite the turnaround for an industry that two years ago was dependent on government grants and loans for survival.

With the demand comes the requirement for more aircraft and when you begin to think just what is involved in its production, especially in relation to the aircraft interior, it is remarkable to think that every major commercial aircraft programme depends on structures, components, and expert services from Northern Ireland.

Standing just over one sixth in size of the whole of the island of Ireland and with less than 3% of the population of the UK, Northern Ireland is a global leader in aerospace technology. There are more than one hundred aerospace companies in the region within a two-hour radius of each other and it is home to over 50% of the UK's SC21 Aerospace and Defence Supply Chain Excellence Gold Awards.

With a ready-made supply chain, founded on the region's strong engineering heritage, aerospace companies in Northern Ireland are inextricably intertwined, rich in knowledge, skills, and experience.

A 'go to' location

One such company is SC21 Gold award winner, Carrickfergus-based IPC Mouldings, a leading provider of injection moulded parts and assemblies. It provides key aircraft interior products including food trays and latch assemblies, armcaps and IFE bezels.

Operating from its 27,000ft^2 premises, the company offers a wide range of skills and services across the sector, from early input on design for manufacture, tooling solutions, new product introduction, production and assembly using advanced engineering polymers and processing techniques through to quality assurance and product whole life, managing aftermarket requirements.



IPC Mouldings provides aircraft interior products, including food trays, latch assemblies and IFE bezels (left)

Joanne Liddle, managing director at IPC Mouldings (below)

IPC Mouldings' dedicated team of engineers understands the customers' needs and is committed to working in partnership with OEMs, delivering solutions by creating highly cosmetic, lightweight and durable products, which are visible to the end user and certainly play their part to enhance passenger's experience onboard the aircraft.

With a high-quality service and performance at all times, IPC Mouldings has achieved 99.84% average on quality and 99.63% average on delivery from 2017 to 2022 delivering 12 million parts and assemblies to the aerospace sector. The company's key objective is to demonstrate competence, reliability, and the ability to deliver results to its customers through operational excellence within the supply chain.

Joanne Liddle, managing director at IPC Mouldings comments: "The aerospace sector in Northern Ireland is continuing to strengthen and illustrates the region's commitment as the 'go to' for global companies looking for supply chain providers. At IPC Mouldings, we continually invest in our future with new equipment, redefining our approach in this post covid world by optimising our productivity, extending our capability and offering flexible solutions to our customers.

"We are quality driven, and people focused, our culture is continuous improvement, and we place a firm focus on our dedication to quality, precision, perfection and ultimately, best practice. Our goal at IPC Mouldings is to be our customer's best supplier. Our ethos is to evolve and our ambition is to be at the forefront of change, bringing a fresh approach, and encouraging our people, who are the backbone of our success to step up and be part of something great."

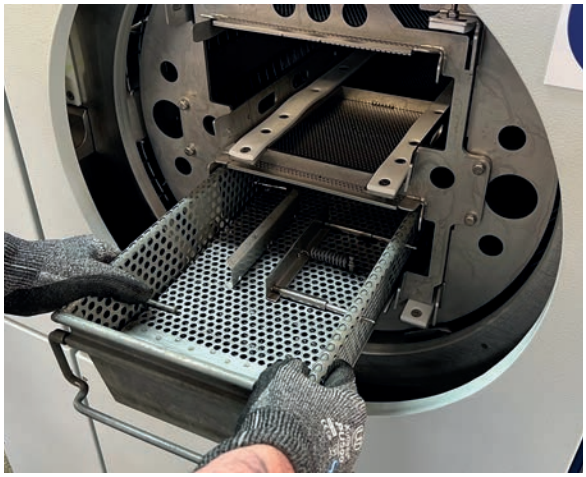
Over the next few years, Northern Ireland will benefit from a package of investment from four City and Growth Deals, with combined funding of £1.3 billion, which will be complemented by private sector and other sources of funding. The aerospace industry is certainly looking sky high for Northern Ireland's economy.

https://ipcmouldings.com



A CLEAN DREAM MACHINE

Precision turned parts specialists, APT Leicester says it is embracing environment-friendly precision engineering in aerospace manufacturing by selecting a cutting-edge industrial aqueous cleaning system from MecWash.



APT's MecWash MWX300 aqueous cleaning system embraces environment-friendly precision engineering (above)

As the aerospace industry continues to prioritise sustainability, APT Leicester says it stands at the forefront of environmental responsibility. With a strong commitment to reducing carbon footprint and implementing eco-friendly practices, the company has recently integrated a cutting-edge industrial aqueous cleaning system into its CNC manufacturing facilities. This significant step marks APT's dedication to green initiatives and sets an example for the aerospace industry.

Recognising the need for sustainable solutions, APT Leicester made the decision to replace its previous solvent-based cleaning system with the state-of-the-art MecWash MWX300 aqueous cleaning machine. This transition represents a major leap forward in the company's commitment to sustainable manufacturing practices. By embracing water-based solutions, it actively reduces air pollution and minimises environmental impact.

Manufactured by MecWash in the UK, the MWX300 is one of only two machines of its kind installed in the country. This advanced industrial turned parts washer aligns perfectly with APT's eco-friendly objectives. With its efficient cleaning performance, combining ultrasonics and high flow washing technologies, the machine ensures precision and quality in every part it cleans. By effectively removing contaminants such as oils, greases, and particles from CNC machined parts, APT Leicester minimises waste generation and maintains the highest standards.

A water-saving approach

In response to the global concern of water scarcity, APT has taken proactive measures to address this issue. It has integrated an Aqua Save wash water recycling unit with the MWX300. This intelligent system captures, filters, and recirculates the cleaning water, significantly reducing water consumption and preserving this invaluable resource. By adopting this water-saving approach, APT Leicester demonstrates a commitment to sustainable manufacturing and responsible resource management.

The adoption of the aqueous cleaning system represents a significant step for APT in its journey towards sustainable CNC manufacturing processes. The MWX300's efficient cleaning cycle and water recycling capabilities directly contribute to the reduction of single-use resources, supporting a circular economy approach.

In addition to its commitment to sustainability, APT Leicester holds AS9100 accreditation which reflects its unwavering dedication to upholding the highest standards of quality and precision. By integrating the MecWash system, APT ensures the consistent delivery of flawless CNC turned components that meet the stringent industry specifications. With a focus on excellence and environmental responsibility, the company is a trusted supplier in the aerospace sector.

APT Leicester's AS9100 accreditation is a testament to its unwavering commitment to upholding the highest standards of quality and precision. The integration of the MecWash system not only satisfies rigorous aerospace requirements, but also ensures the consistent delivery of flawless CNC turned components that meet industry specifications.

Nick Baller, APT Leicester managing director, emphasises the significance of the company's recent adoption, stating: "The integration of the MecWash MWX300 further strengthens our commitment to reducing waste, conserving resources, and minimising our overall environmental impact. We strive to uphold the highest aerospace standards in the production of turned parts for our valued customers."

APT's dedication to sustainable practices goes beyond its machinery choices. The company is proud to champion environmental responsibility in all aspects of its operations. From its flexible and eco-friendly delivery approach to its comprehensive recycling strategy, APT Leicester consistently demonstrates its commitment to reducing waste and minimising its overall environmental footprint.

In conclusion, APT's integration of the MecWash MWX300 aqueous cleaning system showcases its promise to embracing environment-friendly precision engineering in the aerospace manufacturing industry. Through the adoption of sustainable manufacturing practices, the company prioritises reducing waste, conserving resources, and minimising its environmental impact. As a trusted supplier, APT Leicester says it sets a high standard for excellence and environmental responsibility in the production of turned parts for valued customers.

www.aptleicester.co.uk



IT'S ALL ABOUT READINESS

G&P, a leading provider of total quality management services looks at how best to address aerospace sector quality manufacturing standards.

The aerospace industry is still facing significant headwinds in the wake of the Covid-19 pandemic. While there are green shoots in the short-haul aircraft market, the outlook for long-haul specialists is still tough. Clearly that has implications throughout the businesses of both aircraft OEMs and those throughout the supply chain, but now is the time for all organisations to reassess their quality management systems ahead of the predicted recovery.

The issue has been thrown under the spotlight with news that Boeing is bracing for 18 months of supply chain instability as it seeks to increase production. It is a major concern because the company uses a "very large, very fragmented" base of suppliers, according to Boeing chief executive officer, Dave Calhoun. He recognises that Boeing needs to work better with suppliers and help rebuild their workforces up to pre-pandemic levels.

"It's skills, it's talent, it's experience, it's people," states Calhoun. The challenge can be summed up even more succinctly: it's all about readiness.

It is a situation that G&P is very familiar with. Losing expertise from established teams, particularly quality service providers, is hugely problematic: the broad, non-partisan industry view was often lost from those businesses. It makes it hard to tool up universally following those Covid-enforced deep cuts because there will be bits of the puzzle missing. As production begins to ramp up further, manufacturing skills, quality and material planning are substantially reduced, which makes it hard to get the materials and the people to run the machines. But that's just the first challenge.

✈ G&P's solutions comprise inspection, rectification and technical services (above)

Of equal importance is a lack of skilled resources to ensure the necessary inspection and manufacturing quality processes are in place to ensure each product is of the required standard. In turn, that makes it far harder to cope with the rate change as production ramps up.

Managing quality systems

AS9100 has been supplemented by AS13100 to bring in increased emphasis on rate readiness and analysis of process risk, amongst others. This alignment was intended to provide a universal approach. However, many OEMs retain their own 'secret sauce' in their quality systems. There's a certain amount of justifiable pride in each team's own work, but in practice, it adds industry-wide complexity.

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It's far from insurmountable, though. For most OEMs, the bespoke systems which are put in place can be considered merely in a different dialect, rather than a different language altogether.

But it means OEMs and suppliers need to become more consistent and agile in their approaches – and they need to collaborate more closely. Quite simply, OEMs need to be more open to a commercial, off-the-shelf type approach to quality management rather than bespoke processes – particularly if they were involved in devising the AS13100 standards in the first place. Similarly, suppliers need to have the belief that OEMs won't undermine their profitability by asking more of them.

A big part of G&P's work has been, and remains, to ensure businesses are not fazed by the new parts of AS13100. There's a great deal of it that makes absolute sense: can you make the part at the rate required, do you have the necessary flexibility, and what percentage of a supplier's work is your business. It's important to build that into the backend of the process: we'll start with the standards, but seeing the entire picture requires a step back to fully understand how robust suppliers' own planning is, for example.

Key to the success of deepened cooperation is that organisations' quality management systems are robust, widely understood and followed to the letter. The quality of work that both over and under-resourced teams can deliver will be sub-par, leading to increased inefficiencies, escalating costs and time delays.

G&P's flexible approach to quality management teams really helps plug those gaps for short, medium- or long-term projects. Increasingly G&P is seeing talent and organisations moving to its temporary-to-permanent approach, where a team or an individual is employed for a fixed-term contract, and both parties have the option to make the role permanent. It means it is possible for the company to deploy quality management specialists the very next day, affording OEMs and suppliers the option of fulfilling both their immediate and long-term requirements.



Cross-sector fertilisation

While aerospace quality management has exceptionally high standards, it's learning a great deal from other industry verticals, particularly automotive – especially when it comes to volume. The emphasis in aerospace used to be whether you can make the part, and make it repeatably; more capability, less capacity – automotive is concerned equally with both.

One of the things that AS13100 did was to take the AS9100 standard and embellish it with standards around run-at-rate and Production Part Approval Process (PPAP). The Advanced Product Quality Planning (APQP) approach has very much arrived from the automotive industry. G&P has experience in automotive quality management stretching back to 1994, so it is justifiably proud of the way it can bring this to bear in the aerospace market.

Among the services G&P offers the aerospace sector are supplier capability and capacity assessments, document and FAIR technical vetting, inspection, supplier improvement activities, containment services, fault analysis imaging and reverse engineering.

www.gpqm.com

✈ A big part of G&P's work is to ensure businesses are not fazed by AS13100 (above)

✈ Aerospace quality management has exceptionally high standards (below)



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BRIDGING THE SKILLS GAP

Aerospace Manufacturing hears how Hexagon's Manufacturing Intelligence division's new machine training system, HxGN Machine Trainer helps to bridge shopfloor skills gaps.

New training technology now available globally from Hexagon's Manufacturing Intelligence division leverages the power of its digital twins to help manufacturers train machinists and metrology specialists to use valuable shopfloor equipment.

By combining hardware that realistically replicates machines with manufacturing simulation and operator's software tools, it helps trainees gain practical experience without risking damage to expensive business-critical equipment, wasting materials, or tying up valuable production resources.

HxGN Machine Trainer was developed by Hexagon to help companies and educational institutions attract and train the next generation of machine workers – something that is vitally important with the industry facing a skills and labour shortage. In the US, for example, job openings are hovering near all-time highs at 800,000 with 55% of roles unfilled, while almost three in 10 manufacturing firms in Europe reported production constraints in the second quarter of 2022 due to a lack of workers. The skills shortage is compounded by the fact that training people to use CNC machines, and similar tools, is expensive, slow and potentially dangerous. By training machine operators using an accurate and interactive physical simulator, manufacturers can onboard and upskill their staff faster and more cost effectively than ever before.

Hexagon's new hardware simulator bridges the manufacturing skills gap by making it easier to prepare inexperienced staff for the demands of the factory. It is versatile because a digital twin can be created for the specific machine brand, type and configuration they will use. Once trained, workers can easily move from HxGN Machine Trainer to real machines, because the simulator is designed to be as realistic as possible – with hardware that replicates the look and feel of a real machine and a 43-inch screen that displays accurate simulations of a large variety of machine and cutting tools. A light tower, physical CNC hand wheel and CMM joystick completes the experience by enabling trainees to respond to issues and control machine movements exactly as they would on the shopfloor. The agile training system also offers a range of digital twins for coordinate measuring machines (CMMs) to provide practical experience.

Simulate to innovate

Each trainer unit can be equipped with up to three CNC controllers – including those by Fanuc, Heidenhain, and Siemens – on a single training console. The machine trainer utilises the latest version of Hexagon's NCSIMUL CNC simulation software to simulate 3-axis, 5-axis, and mill-turn machine tools; and I++ Simulator software to simulate complete metrology processes.

"Crashing a machine tool because of incorrect setup is a nightmare for both the new machinist and management concerned that a piece of machinery worth millions could be permanently damaged," says Alexander Freund, director of product management at Hexagon. "Crashing a virtual machine tool or CMM is safer for staff and equipment and provides a realistic experience to trainees while ensuring that valuable resources remain up and running."

Staff training to be machine-tool operators, machinists and, ultimately, CNC programmers, can use any of the three controllers to learn how to use its associated conversational programming language.



Accompanying student exercises include instruction sheets that mimic typical manufacturing workflows and job specifications. These instructions list virtual cutting tools to be assigned to jobs and the CNC program to be loaded to the trainer unit. In addition to troubleshooting and learning how to switch between manual and automatic run modes as needed, students learn how to set machine-tool origins and tool parameters, and to determine cutting tool compensation.

HxGN Machine Trainer is available globally now, supporting 3-5 axis CNC machine tools, mill-turn machining and CMM training, with support for up to three CNC controllers on a single unit. It comes with a library of machine digital twins for Hermle, DMG and Fanuc machines. CMMs support includes the Hexagon TIGO SF, with support for other CMMs through the I++ Simulator, paired with either QUINDOS or PC DMIS metrology software. Customers can request a digital twin of any other machine.

www.hexagon.com

HxGN Machine Trainer was developed by Hexagon to attract and train the next generation of machine workers (above)

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KNOWLEDGE IS POWER

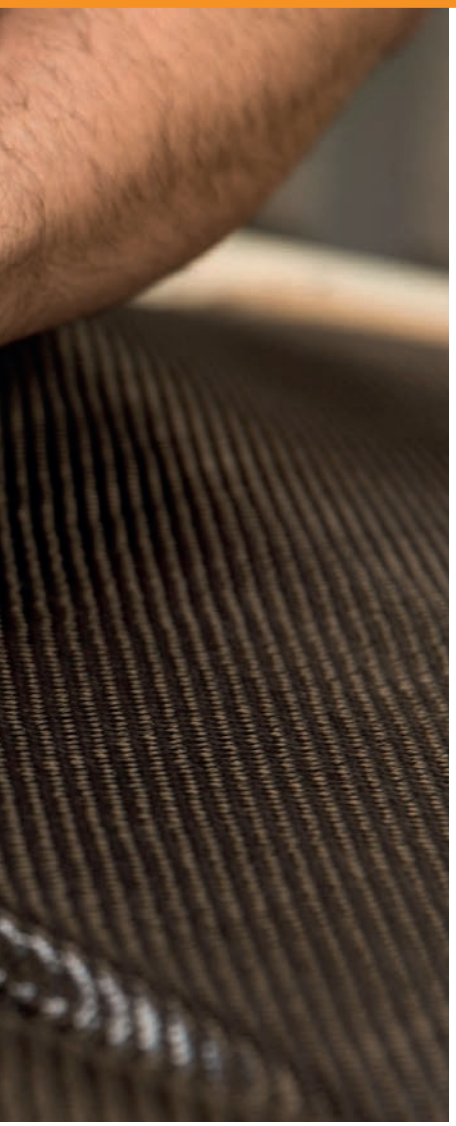
According to JETCAM International's general manager **Martin Bailey**, the biggest issue with change is the threat of change. Here, he looks at how new ideas can get delayed or shelved due to fear of disruption on the shopfloor – and how to avoid it.

✈ CrossTrack is used by many major aerospace OEMs (above)

Composite manufacturers have a unique set of challenges that ERP/MES systems alone often cannot handle. Replacing such company-wide systems just to solve these problems is not viable, so companies might review software systems designed specifically to solve manufacturing issues.

These projects often don't move forward due to concerns over production down-time, integration with existing data systems, changes to workflow and staff resistance. However, with the right planning, projects can be implemented smoothly with minimal impact on production, can deliver a clear return on investment, and can be seen as a positive by users from the start.

For you to have reached the decision that there needs to be change, you will have probably reached a tipping point. Perhaps yet another roll of expensive prepreg went out of date because newer rolls were used instead, or it simply got lost within your facility. Maybe your nesting software is generating inefficient nests, or perhaps even the opposite – dynamic nests can often take much longer to kit at the



machine, offsetting any savings made through material efficiency. If you have multiple cutter brands, then maybe you're having to deal with various CAM/nesting systems, making it difficult to move jobs between machines.

Whatever the reason, many companies will get to this point despite having already invested in expensive ERP and/or MES systems. So why are they not doing the job? The issue is that the composite manufacturing industry has problems that are often not seen elsewhere in general manufacturing. Prepreg material, or more specifically its unique properties, can often be the main culprit. Some ERP systems cannot handle tracking of life as raw materials are moved in and out of the freezer. This becomes infinitely more complex when applied to kits – how do you calculate the kit expiry date when it might comprise of hundreds of plies from multiple rolls; each with their own expiry? Throw in real-world scenarios such as a ply being scrapped in layup and being cut from a scrap by hand, and you start to understand the enormity of the problem.

There may be other smaller but no less inconvenient issues that you may wish to solve. While prepreg will have an overall 'cure by' date, it will also have a shop life, based on time out of the freezer at room temperature. However, the material might not be flexible enough to go through layup within its remaining shop life, so a secondary 'handling life', that deems when a kit needs to clear layup, may also be required. Some companies will often want to create single plies that consist of multiple layers. Again, tracking the consumption of multiple lengths of material - but only seeing the ply as a single entity - can prove challenging for all but the most comprehensive ERP systems.

Size and cost

It's important to quantify the size and cost of the problem to the company. Can you place a monetary value on material loss, scrapped parts, delayed production, etc.? When you start to consider solutions, you will need to be able to justify a return on investment, and you can only do this by understanding the scale and cost of the issues you are trying to solve. Some departments, such as Stores, will be able to put a figure to this, but problems that span multiple departments may be more complicated to calculate. For example, generating traceability data for a kit will span multiple departments, so trying to put a time/cost value on that might be complicated.

Buy-in from the top is critical. Implementing any solution will take time and resources, usually from senior staff members, so it's essential that top-tier management are committed to investing time and money to solve the issues that have been defined.

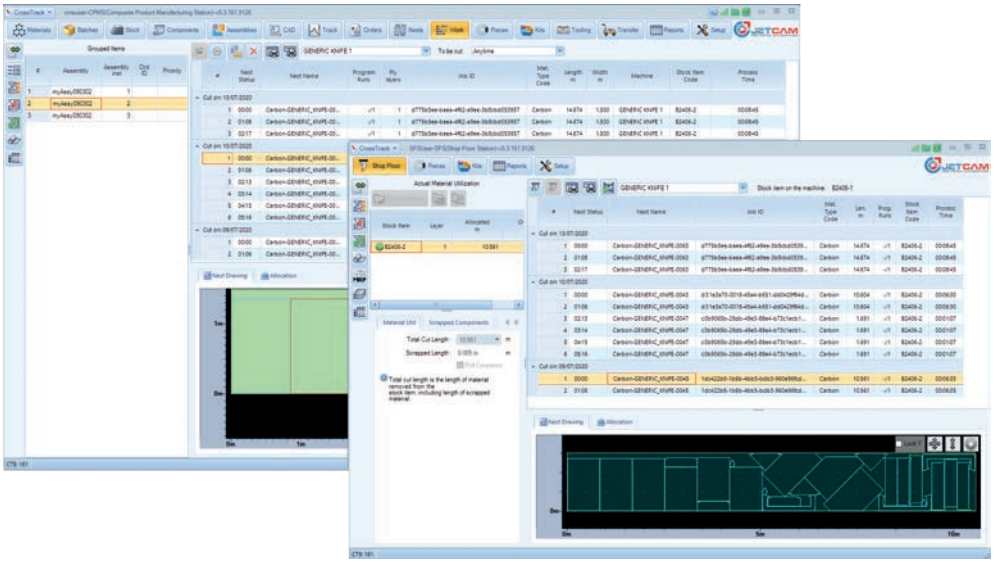
The data touch points

By this point the extent of the issue has been defined, and you can begin to list the existing data systems that need to exchange data with any new solution, such as goods-in, freezer/store locations, CAD, nesting, CNC cutters, layup, autoclave and additional processes, such as painting, quality, etc.

The next question is how you will exchange data between systems. Every data touch point can be looked at uniquely. Some systems such as CAD will output DXF files with associated part programming information, containing information such as material and thickness, which can be imported to create component files that can then be nested. CSV or XML format files are also often used for data exchange, as they can be generated by most systems and are human-readable.

ERP or MES systems will generally allow for more automated data exchange methods. This again might rely on CSV files, with either the ERP or inbound shop floor system monitoring for new files to arrive in a designated folder for processing. For example, the ERP system might generate lists of parts that need to be nested, with the nesting software then able to identify all the associated plies in order to build a list of items to be sent to the nester, perhaps also including previously scrapped plies scheduled for re-nesting.

For some data touch points it might be beneficial to start as a manual process and then move to automating



JETCAM's CrossTrack software help resolve the issue of managing orders, materials, nests, parts/plies and kits (below)

them. This will not only allow you to go live quicker, but also give you time to work out potential issues that might need to be handled. The drawback is that this tactic may allow errors to creep into the data, so be mindful where you use this approach.

Establishing a workflow is also important. You may decide, for example, that goods-in will continue to use ERP for adding stock to the system, but your new system will be used for transferring it on the shopfloor. The reason may be that the interface is cleaner, or the task is performed as part of other functions. Mapping this out as a flowchart is essential in ensuring that each system will receive the right data when it needs to. Additionally, take time to ensure that real-world scenarios are well-catered for, otherwise people will invent ways to buck the system 'just to get the job done'.

Rolling out your solution

Once you've selected a solution, established where, when and how data will be exchanged, and provisionally mapped out your workflows, the next step is to start implementing and testing your system. This is where a test 'development' environment is essential. This should be a replica of your planned live system, allowing you to test workflows or new software releases without impacting production, therefore minimising any disruption.

Start by creating your live system and import your data, such as your material types and stock, along with other data such as plies, assemblies, etc. Next, create your development environment and start testing. Run it in parallel with your current systems, as this will not only highlight any gaps that need plugging, but it will also confirm that the new system should be faster than the methods it plans to replace,



reassuring you that you made the right decision. You can also break the testing down into specific areas. Initially, you might run through all the raw material workflows (e.g., booking items in/out, etc.), then separately or in parallel to this you can test the order/nest creation and scheduling process.

It's likely at the beginning the new processes will take longer, as people won't be used to them and there may be further configuration to do, such as tweaks to the NC code output for your CNCs. But by breaking down the testing into manageable chunks, you'll make the go-live process much easier and smoother. Expect to modify workflows as you identify the rare anomalies that also need to be catered for.

A system of systems

It's not only the managers and stakeholders that need to fully understand the system – all staff that interact with it need to have a good grasp as well. Don't just limit their knowledge to their specific roles or departments – make sure that they understand the method and reason to use the system, and give them visibility of other departments' involvement so they get to see the big picture. This will be effective in preventing users from trying to find ways of bucking a system that they might feel is prohibitive, especially if they do not understand the reasons behind certain workflow processes.

Ensure that people have documentation to fall back on that they can refer to when they need clarification. With software, short 'how-to' videos that show common workflows are quick to create and an ideal way of explaining how to complete a task, also covering additional information around it.

Just because your system has gone live, is passing data between systems, and is providing you with the automation and reporting that you were aiming for, there's no reason to stop there. You may have resolved the big issues, but chances are there could still be some small manual processes tied into your new system – either within the departments already covered or in areas outside of the initial project scope. Every standalone spreadsheet or paper-based system that can be replaced is another step towards simplicity and traceability.

While ERP and MES systems are the lifeblood of manufacturing, their shortcomings can be a limiting factor when it comes to composite manufacturing. Traceability for the aerospace and defence industries is paramount, so having a system that is dedicated to automatically collecting and collating relevant data for composite parts can drastically reduce the staff overhead required, as well as delivering additional savings in material utilisation, machine runtime and manpower.

www.jetcam.net





Martin Bailey, JETCAM's general manager (above)

Multiple cutter brands may mean having to deal with various CAM/nesting systems (left)

Tracking material consumption - but only seeing the ply as a single entity - can prove challenging for some ERP systems (below)

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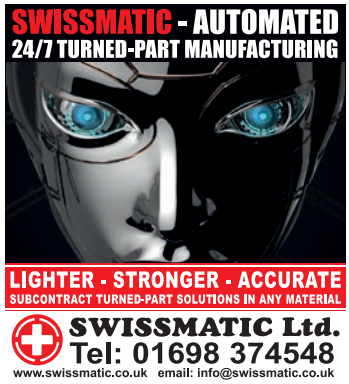
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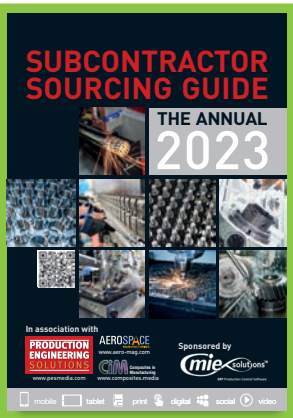


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THE DEMAND FOR CHANGE

It's both a challenging and exciting time for the aerospace sector. With so many factors at play, the demand for change is strong. According to ELE Advanced Technologies' CEO, **Manesh Pandya** the opportunity to grow the industry's size and sustainability is clear, however a substantial shift in the culture may be needed to make these aspirations a reality.

Aerospace has already seen significant change over recent decades. My involvement in aircraft engine manufacture began over 30 years' ago while working at a division of Linread. Since then we've seen the embedding of Lean manufacturing principles and, more recently, the advancement of digital technologies within the aerospace sector. However, I believe an even more seismic change lies ahead.

When considering what the future might look like, let's give some thought to the challenges and opportunities we currently face. Short-term there's the obvious challenge of inflation. At ELE Advanced Technologies our energy costs alone have increased by 200% and it doesn't stop there. The impact ripples across the whole supply chain ramping up all production costs. It's certainly a major hurdle we all face, now.

More longer-term, there's the complexity of the supply chain to consider and the need to have the capability to manage it effectively. Doing so will enable the ability to manage working capital and increase profitability, to invest in developing capabilities to remain globally competitive.

For those firms that can be resilient and progressive, the prospects for the sector are bright. With increased demand for air travel across the globe due to better affordability, accessibility and awareness, the civil sector looks likely to be buoyant for the next 10-15 years. Developing economies are expanding their fleet numbers and developed economies are replacing aging aircraft – with Air India's recent placing of the largest order on record being a perfect example. The defence aircraft sector too remains strong due to increasing threat levels seen worldwide.

But there's one major factor I've not yet mentioned. Sustainability. The drive to improve efficiency and reduce CO_2 emissions to meet Net Zero targets will need to sit alongside the desire to meet increased demand. And it will need to progress at the same speed.

Shifts in sustainability that will come from transitioning to different fuels and technologies will clearly take time. Given the safety critical nature of aerospace the certification of new technologies and capabilities is a robust and lengthy process. The challenges of electric propulsion in terms of the range and weight of batteries will need to be addressed and compensated through reduction in the size of aircraft or fewer passengers. However the speed at which EVs have developed (albeit slower than needed) demonstrates the speed at which technology can evolve.

In aerospace there has already been good progress towards reducing extensive lead-times for the manufacture, assembly and testing of aero engine manufacture. This charge has been led by major OEMs to meet demand. As demand for their products increases further, the lead-times will need to reduce even faster.

It's clear that the need to meet increased demand in the aerospace sector in an environmentally sustainable way will drive the change required for greener technologies. At ELE Advanced Technologies we have always found it comparatively easy to change our processes and culture to meet change in global demand over the past 20-plus years. With one example being development of our technologies and capabilities to deliver a unique turbine blade cooling solution that increases the performance and efficiency of aerospace engines.

The aerospace sector may now need to adapt more aggressively to embrace new technologies and meet increased demand. But for those that do jump on board, the sky's literally the limit.

https://eleat.co.uk



✈ Manesh Pandya, CEO, ELE Advanced Technologies

For those firms that can be resilient and progressive, the prospects for the sector are bright

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