Aircraft interiors INTERNATIONAL

SEPTEMBER 2018

IFE special issue:

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SAVING THE WORLD, A STRAW AT A TIME

Many of you jetsetters may occasionally feel jaded with flying, but I believe it's good for the soul. Gaze up at an airplane soaring overhead and just imagine the joy and anticipation it is delivering: people traveling for family reunions, weddings, holidays, honeymoons – any number of events where loved ones want to come together, and aviation can convert their separation from thousands of miles to just a few hours.

And that's not even counting the joy that might lie in the cargo hold. Take the example of the Emirates A380, which is celebrating a decade of innovation and operation this year (see p144). This airline's superjumbos have transported more than 120 tons of food and vital emergency equipment to needy people around the world since its humanitarian ferry flights began in 2013.

Staying with Emirates' A380s as an example, just this aircraft program alone supports manufacturing jobs across the global aircraft manufacturing supply chain, with Airbus estimating that Emirates' A380 orders support 41,000 direct, indirect and induced jobs in Europe alone – and you can add to that figure the airline's 1,500 flight deck crew and 20,000+ cabin crew specially trained to operate the A380 fleet. Meanwhile, the airline estimates that the Europe-wide impact of its A380 investment contributes US$3.9bn to the GDP of the region. And these figures will just keep growing: in January, Emirates ordered a further 36 A380s worth US$16bn, taking the airline's commitment for the aircraft to 178 units, generating further catalytic benefits for European economies.

And that's just one airline. Collectively the hundreds of aircraft operations around the world generate enormous numbers and huge benefits – but also potential harm to the environment. Substantial reductions have been made in aircraft fuel consumption and emissions, and advances in propulsion technology will help further minimize the negatives of aviation. Where the aircraft interiors community can help, however, is with plastics use.

Cabin plastics are a complex cocktail (now served with a bamboo stirrer), but according to experts interviewed for our cover feature, they can all be recycled or reused. It isn't always easy, as you'll find out, but there are many ways industry can help by planning ahead for the end of life of cabins – and it certainly can be done. Even better, some cabin plastics can be reused without energy-intensive recycling, and with the right partnerships, a defunct cabin can still yield money for its owners – a far better alternative than costly storage or wasteful landfill.

The time to plan is now, and suppliers can design all plastic cabin hardware, from sidewalls to seatbacks to IFE controllers, to be easily recyclable, helping conserve this beautiful planet, garnering positive public feeling – and creating a strong selling point for airlines wanting to show their caring side. Recycling and reuse shouldn't be considered a burden or something that merely ought to be done. Planned correctly, today's plastics can still hold value tomorrow, making the process an absolute must for aviation business.

Flight is a magical part of science and it brings so much value to people's lives, directly and indirectly. Let's work to make sure that while aviation shrinks the world and delivers joy, it also helps protect the planet.

Adam Gavine, editor

WORLDWIDE

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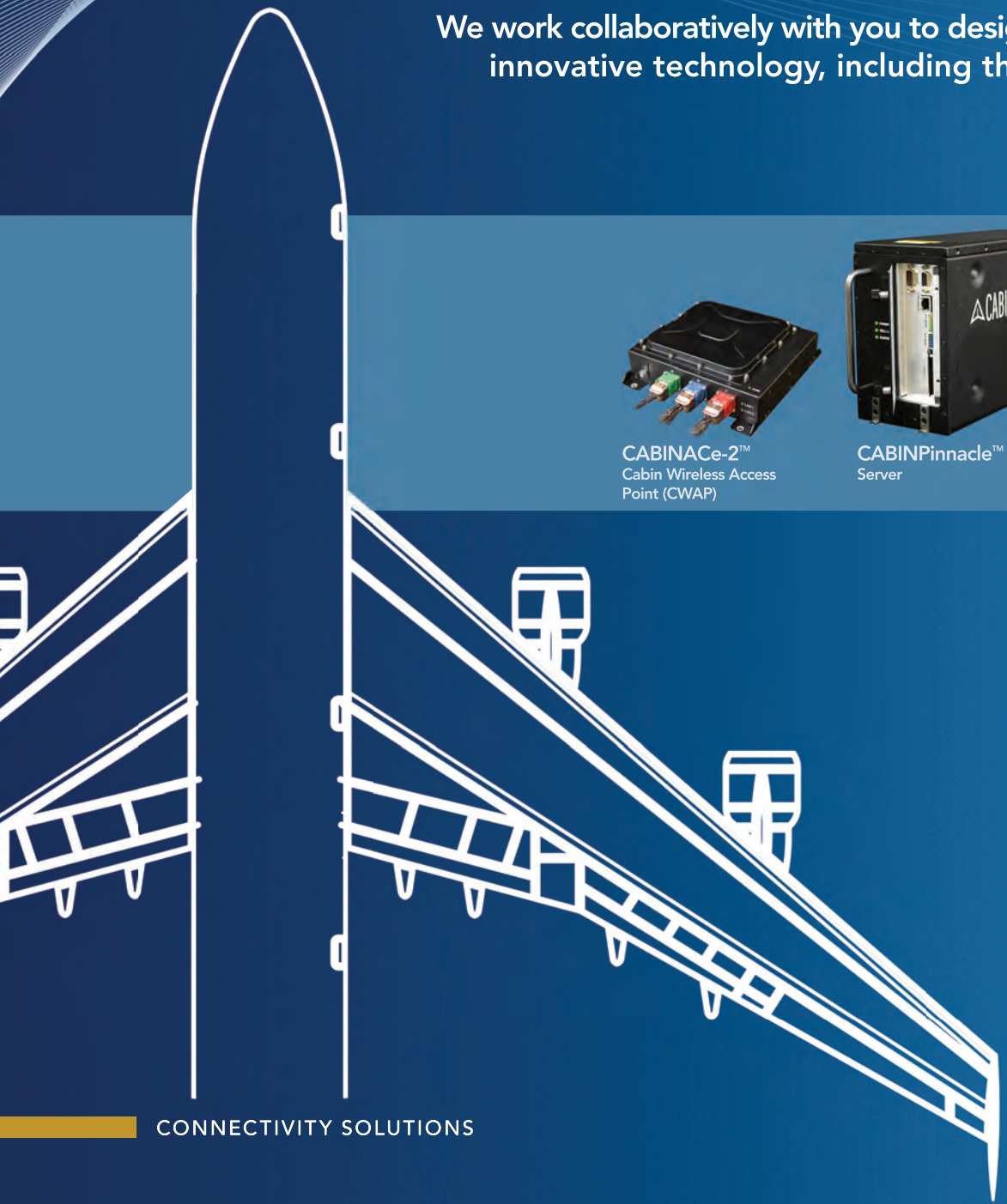

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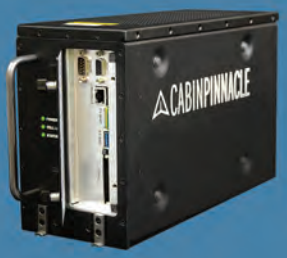

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CONNECTIVITY SOLUTIONS

Up front

A selection of the latest technologies, trends, developments and oddities entering the passenger experience airspace

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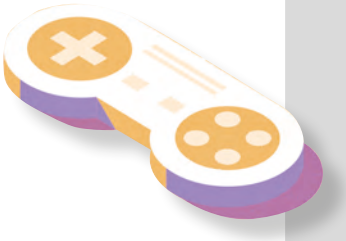

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BREATHING LIFE INTO 3D PRINTING

Air New Zealand is continuing to investigate the use of 3D-printed metal parts for aircraft interiors, and is giving passengers a taste of what's to come

Visit the Videos section of our website to see the aerators being manufactured

Air New Zealand's chief operations officer, Bruce Parton, has stated that the airline is committed to furthering the use of additive manufacturing (AM) processes, with its latest innovation being 3D printing using new materials.

This project is being undertaken with fellow kiwi innovator Zenith Tecnica, an additive manufacturer that specializes in printing titanium parts using an Electron Beam Melting (EBM) process.

Air New Zealand first investigated 3D printing in 2016 with a cocktail table and has since developed the application of the technology to include items such as small components for IFE screens and prototype metal framing for business cabins. The airline is keen to adopt the technology so it can reap cost and time benefits, partly by being able to implement just-in-time production to replace damaged components.

As well as Zenith Tecnica, the airline is working with technology and application partners including ST Engineering Aerospace and Arcam (an EBM machinery company), and it is also exploring new processes with universities and other technology companies. One of the most recent developments has involved using a 3D laser scanner to create part designs, tool designs and interior modeling.

"While we are in the initial stages of working with these companies, so far we have printed prototype metal framing for our business cabin, to quickly test new concepts and ideas, and we have also made wine aerators," said Parton.

These aerators are quite something – 3D printed in the form of aircraft engines. The device is held over a glass, and as the wine is poured through, it draws in and mixes the proper amount of air for the right amount of time, allowing the wine to breathe in less time than a decanting process. The device may look like a mini turbofan, but passengers need not worry about any suck, squeeze, bang, blow effects staining their clothes.

"While the aerators are a bit of fun, we're really excited by the possibility they represent," stated Parton. "Aircraft interiors are made up of tens of thousands of parts, and the ability to 3D print on-demand lightweight parts we only require a small number of, rather than rely on traditional manufacturing methods, is of huge benefit to our business."

FLIPPING INNOVATION

Air New Zealand's journey into additive manufacturing technology began in 2016 when it worked with Auckland University of Technology to 3D print the fold-down cocktail trays in Business Premier. The trays are small, but as a first step, the project was important.

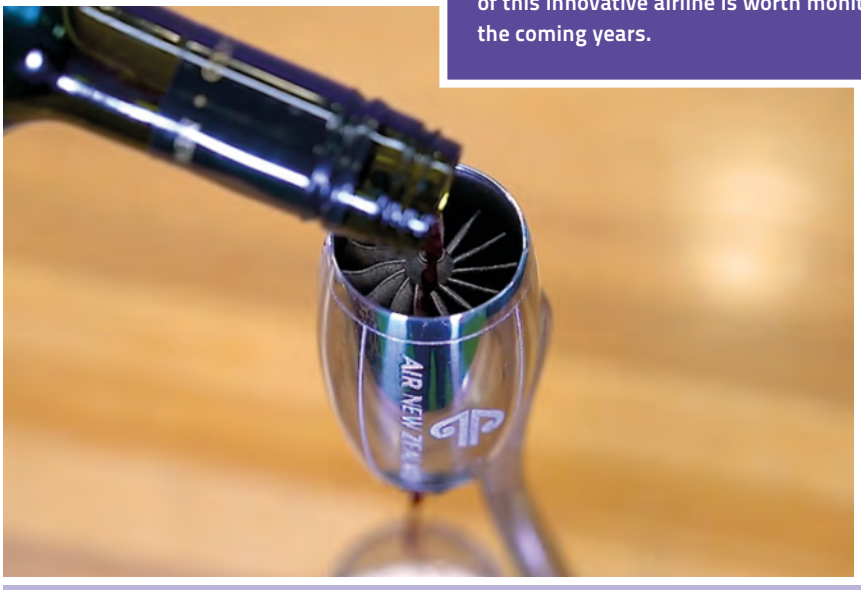
"Aircraft interiors are made up of tens of thousands of parts. Not only can't we hold stock of every replacement part we might need, we often only require a small number of units, which can be really expensive to produce using traditional manufacturing methods and can involve frustrating delays while a replacement part is delivered," explained Bruce Parton.

"A big advantage of 3D printing is that it allows us to make cost-effective lightweight parts ourselves, and to do so quickly without compromising on safety, strength or durability."

Parton stated at the time that the airline is exploring opportunities to introduce further printed components. "It seems the possibilities are limited only by imagination," he said.

The steps since have been small, but the work of this innovative airline is worth monitoring over the coming years.

AS AN UNAUTHORIZED PASSENGER 'SOUVENIR', AIR NEW ZEALAND'S WINE AERATORS COULD BECOME MORE COVETED THAN EVEN VIRGIN ATLANTIC'S WILBUR AND ORVILLE SALT AND PEPPER SHAKERS



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COMMON DENOMINATOR

Our roundup of Q2 2018's statistics shows a positive trend for the aviation industry, in terms of financial growth and indicators of improved comfort and safety

Jumbo birthday

It has been **50 years** since the Boeing 747 was unveiled to the world

Our 2019 Design Showcase issue will celebrate the Jumbo

More than 23,000 commercial aircraft will have inflight connectivity by 2027, up from 7,400 in 2017

Euroconsult

Of 106 aviation professionals surveyed,

95%

are looking to make a connected aircraft purchase over the next five years. 38% would spend at least US$1m per aircraft and 17% would spend more than US$10m

Honeywell survey

ANGER MANAGEMENT!

Russia is raising fines for 'violent behavior' on board passenger aircraft by

1,000%

Great connection

The connected aircraft has the potential to save airlines US$15bn annually in operational efficiencies by 2035, and 21,300,000 metric tons of CO_2 emissions

London School of Economics research in association with Inmarsat

LOW COST, HIGH RETURNS

The global low-cost airlines market is projected to grow from 2016's US$117,726m to

US$207,816m

in 2023

ResearchAndMarkets

The global commercial aircraft market, valued at US$191bn in 2018, will reach US$255bn by 2028 – a total expenditure of US$2.3tn

ResearchAndMarkets

The world's passenger jet fleet will grow by 4.4% per year over the next 20 years, more than doubling in size to

48,000

aircraft

Airbus Global Market Forecast 2018-2037

COMFORTABLE RIDE

Readings from a device that a passenger volunteered to wear on a Qantas flight from Perth to London showed that the passenger stayed in his business class seat for the entire 17-hour journey

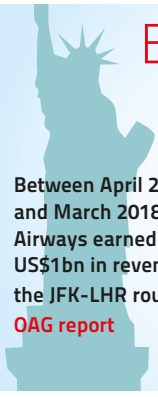
The aircraft cabin interiors market will register 3.2% CAGR through 2026, surpassing

US$14.5bn

in revenues

Future Market Insights

BA BITES THE BIG APPLE



Between April 2017 and March 2018, British Airways earned more than US$1bn in revenue from the JFK-LHR route

OAG report

Juniper Research

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THE FINAL 6%

Airbus is approaching 100% aircraft recyclability. How can cabin design methods help achieve those challenging final few per cent?

Plastics make up a big part of the aircraft cabin, presenting potential environmental issues both during production and at the end of cabin service life. We asked Airbus for an OEM view of what it is doing to tackle this issue, and if the focus on reducing the use of plastics and recycling more of the plastics that are used is putting greater pressure on the aerospace and airline industries.

Axel Becker, Airbus's manager of trends research, stated, "We include sustainability in our visions, so that elements of the cabin can be recycled, and new cabin items manufactured from that material. This is something that needs to be defined in the product structure from the beginning."

Indeed early planning seems to be key, as Becker explained: "It's important to apply environmental rules within the early phases of the R&D and innovation and engineering process. This is something we need to further develop so that we really look at the environmental impacts of a project in the very early stages. We need to discuss this with our suppliers and involve them very early, because 95% of a cabin comes from suppliers."

For more recycling innovation insight, read our special feature on page 30

ABOVE: A SODA CAN COULD HAVE A 'SECOND LIFE' AS PART OF AIRBUS'S ROADMAP FOR REDUCING ITS ENVIRONMENTAL FOOTPRINT

Today, we are close to

94%

overall recycling of an aircraft and we are talking about the last few per cent

Axel Becker

"Today, we are close to 94% overall recycling of an aircraft and we are talking about the last few per cent as we try to get to 100%. It's not an easy task due to certain regulations, and some elements of the aircraft are difficult to recycle. We need to look for new materials and consider how aircraft and cabins are assembled, considering how we can make things easier to dissemble after the end of their life."

Rolling innovation

Sometimes the best ideas are the simplest. Airbus's ReTrolley galley cart design has become quite a success, winning awards and entering production. The idea is simple: as crew pass down the aisles collecting waste, they separate the items into three customizable modules for recyclables and non-recyclables for easy processing, and they can also stack cups, crush cans and collect liquids, all within a standard-sized galley cart. It's a simple design, with a manual compression function that can reduce the waste volume by up to 30%.

ReTrolley is based on a concept first designed by students at the University of São Paulo and later advanced by Airbus Innovations experts. The trolley became part of the Airbus BizLab Accelerator program, during which a demonstrator of the concept was validated with airlines last year. The design won the Greener Cabin, Health, Safety and Environment category of the 2017 Crystal Cabin Awards, and has now been further developed with Iacobucci HF Aerospace, which has refined the design to meet particular market and customer requirements for commercial use.

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GREEN LIGHT

The massive increase in the use of CFRP in aviation is leading scientists to seek ways of recycling and repurposing constituent materials, from 3D-printed power sources to nonwoven fabrics

Carbon-fiber reinforced plastics (CFRP) are strong and lightweight, and they have become popular in aerospace. For example, while a 1970s Airbus may have contained around 1% carbon-based materials, some modern wide-bodies consist of over 50% CFRP – which can amount to more than 65 tons per aircraft. However, when such aircraft come to the end of their operational life, that CFRP is not so attractive: indeed, in some countries such as Germany, the landfilling of CFRP is prohibited, and waste incineration plants can refuse the material.

Looking for options, German research institute Fraunhofer has developed a technology that separates carbon fibers from the plastic matrix and converts the recycled fibers into materials that can be used for batteries and fuel cells. The carbon fibers are electrically conductive and suitable as a substitute for natural graphite, which also consists of carbon. It is a resource-critical raw material for the German economy that currently has to be imported from China at great expense.

Low cost, high tech

Vartega, a Colorado-based technology company specializing in CFRP recycling, has developed a low-cost grade of recycled carbon fiber that it says has mechanical properties similar to the virgin material.

Much of the feedstock for Vartega's process will come from high-grade pre-impregnated scrap material, such as that used in the aerospace industry, which the company says can be readily repurposed for a broad range of applications including nonwoven fabrics, thermoplastic pellets, yarns, and 3D printing filaments for use in aircraft interiors, automotive applications, consumer products and sporting goods.

Cabin interior plastics are another major focus for recycling innovation. See our feature on p30

WORLD FIRST

In what it describes as "an undisputed world first", US-based company Universal Asset Management (UAM) claims to have completely recycled carbon fiber from commercial aircraft, paving the way toward total aircraft recyclability. The company is understandably coy with the full details of the process, but says that CFRP is collected through a proprietary process, filtered for purity and refined into pellets, which can then be used as raw material for 3D printing.

The first demonstration of the process is a 3D-printed engine stand manufactured from CFRP recovered from commercial aircraft. The resulting second-generation carbon-fiber material is a suitable raw resource for industrial use, according to the company, and could become a feasible material for advanced additive manufacturing supply chains in need of cost-competitive carbon fiber.

"UAM is the only company to harvest CFRP from end-of-life aircraft to be re-introduced to manufacturing," said Keri Wright, CEO. "This unique and proprietary process is an industry first in the total recyclability of aircraft. The possibilities of our applications are only limited by one's own imagination."

The theory sounds great, and Fraunhofer is confident. Indeed, together with partners, the institute has found a way to use recovered carbon fibers to produce a prototype of a bipolar plate for a PEM fuel cell on an industrial scale.

"The amounts of CFRP recycling material are tremendous," states Elisa Seiler, a scientist at the Fraunhofer Institute's chemical technology faculty. "Electric drives are now a serious topic in the aviation industry. Manufacturers can directly perform value-preserving recycling by transferring materials from one application to the next."

A key finding by the Fraunhofer team was that recycled CFRP can be used for additive manufacturing processes such as 3D printing. The institute's experts have developed a process that uses microwave radiation to burn the plastic matrix that surrounds the carbon fibers. This process requires temperatures of up to 900°C, so to ensure the process does not burn the fibers, the combustion is performed without oxygen in a process named pyrolytic decomposition. The recovered fibers can then be embedded in thermoplastic material, creating a composite material with similar properties to graphite.

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take 2

Emirates Engineering is busy converting Emirates' Boeing 777-200LR fleet from three-class layouts to two. However, a simpler layout does not make for a simple project...

Visit the Videos section of our site to see a time-lapse of the reconfiguration

Emirates is investing more than US$150m reconfiguring and refurbishing the interiors of its fleet of 10 B777-200LRs to better suit market demand. The main elements of the project are the removal of the eight-suite first class cabins and an upgrade of the business cabins, including going from a 2-3-2 layout to 2-2-2, and adding a new social area. Emirates Engineering has been appointed to carry out the work in its Dubai facility, and the project is proving to be rather intensive.

At the project planning stage, to ensure that the job is completed successfully and on time, detailed work was required, including outlining specifications, reviewing designs and layouts, managing procurement and contracts with suppliers, securing regulatory approvals, maintaining a stock of the required raw materials, and managing workflows, timelines and resources in the run-up to grounding the aircraft.

Eight cabin blueprints were proposed, and once the airline had selected the most suitable design, the engineering team then had to secure approvals from regulatory authorities, including the GCAA and the FAA, in order to modify the aircraft from its original design.

Approvals secured, Emirates Engineering then worked with suppliers – more than 30 of them, including Boeing, Jamco, Panasonic, Rockwell Collins, Zodiac and ATG – to ensure that all 2,700 of the necessary parts and spares required for each aircraft would be available in time for each aircraft being brought in.

With the planning stage complete, it was time to ground the first aircraft, strip out the interiors, and then fit new wiring for the lighting systems, raise the ceiling height in the business cabin, modify the galleys to incorporate the social space, install new seats, and refresh the economy class cabins.

That post-grounding fitment process takes 35 days, followed by a raft of safety tests, including prototype testing whereby the design was validated for regulatory compliance, functional testing of cabin components, electromagnetic interference and airflow testing, a five-hour test flight with various scenarios simulated, and fire and smoke testing.

2,700+

parts managed at one time

Emirates Engineering

ABOVE: STRIPPING THE CABINS. BIG CHANGES IN BUSINESS INCLUDE REMOVING THE CENTER OVERHEAD BINS AND ADDING A SNACK AREA

BELOW: THE 38 BUSINESS SEATS ARE 2IN WIDER AT 22.5IN. PITCH HAS GROWN FROM 60IN TO 72IN

In total, from the time the airline decided to reconfigure the fleet, to the first flight-ready aircraft rolling out of the hangar, took 22 months, including over 16,000 collective man-hours – and that's just for the Emirates engineering team.

However, the process will require incrementally less time for each aircraft as the team develops learnings and efficiency. The first aircraft required 55 days of ground time to reconfigure before it took to the skies in March, but the second aircraft, which was ready for operations in July, was completed in just 35 days. With eight remaining B777-200LRs planned to be progressively reconfigured by mid-2019, perhaps even more time can be shaved off.

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GAINING GROUND

The availability of a new radio frequency range has enabled a project that aims to achieve a data transfer rate of 8Gbps between the aircraft and the ground

Find out more about the potential for 5G in the future passenger experience on p48

A team of researchers at Karlsruhe Institute of Technology (KIT) in Germany has been developing a system to optimize the capacity of data connections between the aircraft and the ground, with a claimed signal transfer rate of 8Gbps between airplane and ground station.

The key to reaching this data rate is the use of the radio frequency range between 71GHz and 76GHz for the air-to-ground radio connection – a range recently released by authorities including the Federal Communications Commission for such purposes, which makes large bandwidths available for achieving multi-gigabit data rates. This range is creating interest among many big technology players including Google and Samsung, with the millimeter wave technology seen as a gateway to new super-fast wireless connections.

In the case of KIT, the team views the potential aviation benefits of the range as enhanced broadband internet and video-on-demand in the cabin, with high-resolution videos and sensor data able to be transferred continuously and uncompressed from an aircraft, an Earth observation satellite, or a drone to the ground.

"The frequencies now available represent a good compromise between the achievable data rate and susceptibility to interference," says Thomas Zwick, head of the Institute of High-Frequency Technology and Electronics at KIT. "The data rate achieved now enables simultaneous transmission of up to 600 different 4K video streams, corresponding to about 16Mbps. Global satellite networks seamlessly integrated in glass fiber and radio networks on the ground by this technology can provide globally available broadband internet and enable an increasing number of data-intensive services on the Internet of Things."

A QUALITY INFLIGHT CONNECTIVITY SERVICE IS BECOMING A PASSENGER EXPECTATION. NEW BANDWIDTHS COULD HELP FUTURE SERVICES

The potential lies not just in the IFEC sphere, with Zwick adding that the technology would also make it possible to swiftly read out the ever-growing volumes of operational data from onboard storage systems as the aircraft approaches or passes by receivers, instead of having to be connected by cable while the airplane is on the airfield. He added that the current physical process, "takes time and, hence, makes the novelty highly interesting for airline companies".

During a test flight, a research aircraft circled around the receiver station at a radius of 5-12km (3 to 7 miles) at a height of 1,000m (3,281ft), with a control system for the parabolic antenna on the ground (developed by KIT) ensuring precise orientation to the aircraft. The team reports that the broadband connection remained stable for three minutes during a complete overflight at a radius of 5km (3 miles), which at a data rate of 8Gbps, corresponded to a data volume of 180GB. This is no fair-weather technology, as KIT also states that the connection is uninterrupted during inclement weather conditions such as cloud, rain and fog.

According to the KIT team, this technology could open up new possibilities, including 5G, which could in turn bring new opportunities for cabin design and the inflight experience.

GROUND SUPPORT

KIT is not working alone, with the experimental flight forming part of the E-Band Link Platform and Test for Satellite Communication (ELIPSe) research project funded by the German Aerospace Center and the Federal Ministry for Economic Affairs and Energy. Other participants include Stuttgart University, Radiometer Physics GmbH, and two Fraunhofer departments: the Institute for Applied Solid State Physics IAF, and the Institute for High Frequency Physics and Radar Techniques FHR.

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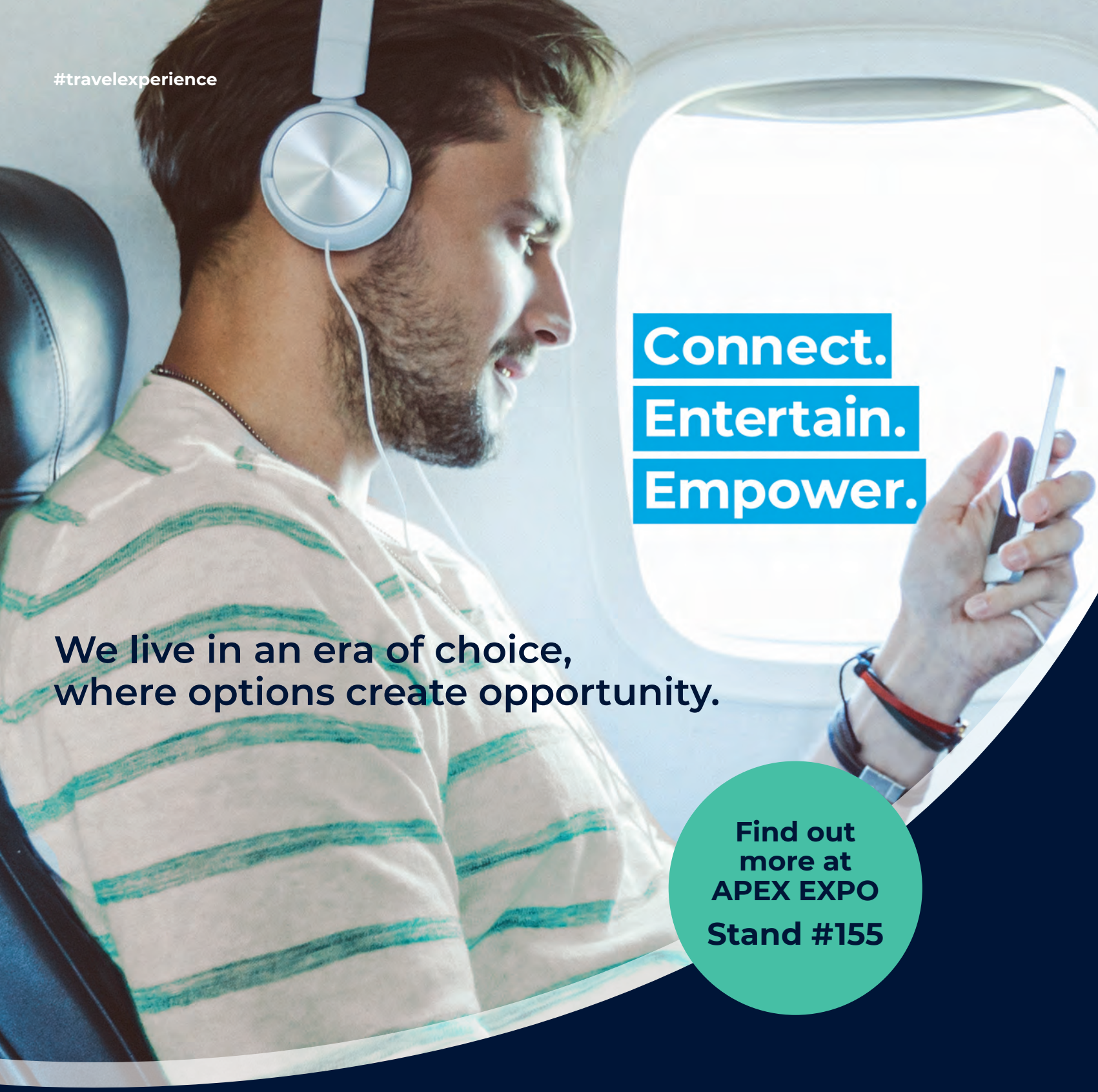

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LAY DOWN THE STRAW

As legislators and the public alike clamor to reduce plastic waste and pollution, the airline industry is reacting with many initiatives

IATA data estimates the global airline industry generated 5.2 million tons of inflight waste in 2016

1 OFFICIAL ACTION

The European Commission has found that single-use plastic products constitute 70% of all marine litter and has proposed a solution: where alternatives are readily available and affordable, single-use plastic products will be banned. For products without straightforward alternatives, the focus is on limiting their use through a reduction in consumption, design and labeling requirements, and waste management/clean-up obligations for producers.

2 FROM THE OCEAN, FOR THE OCEAN

Research collated by amenities company Galileo Watermark suggests that by 2050 there will be more plastic in the ocean than fish, and it views aviation as a major contributor. In response, the company is reclaiming plastics from oceans, seas and rivers and repurposing them to create packaging for its OCN cosmetics range. The next stage is to introduce textile and hard plastic ranges for meal service, showing that ocean plastic is not waste but a resource.

3 SQUASH QUARANTINE

To overcome issues with quarantine, Sky Chefs has teamed up with Air New Zealand and authorities to tackle waste from the airline's international flights arriving in Auckland, with the aim of diverting 150 tons of waste from landfill annually. The scheme, named Project Green, has enabled 40 products such as sealed beverages and snacks previously sent to landfill due to biosecurity controls to be reclassified so they can be reused on future flights. In the first month of the project, 13 tons of waste, including 266,000 plastic cups, 480kg (1,060 lb) of sugar packets and 3.5 tons of bottled water were diverted.

4 A WARM, GREEN FEELING

Emirates has introduced sustainable blankets In long-haul economy class made from 100% recycled plastic bottles. Each ecoThread blanket is made from 28 recycled plastic bottles, which are recycled into plastic chips before being turned into yarn, creating a polar fleece material. The thread is then woven into soft blankets, designed with amenity specialist Buzz. Emirates estimates that, by the end of 2019, the blankets will have rescued 88 million plastic bottles from landfills – equivalent to the weight of 44 A380s.

5 CREATING A STIR

In November, American Airlines will transition from plastic straws/stir sticks to bamboo stir sticks – a move predicted to eliminate more than 71,000 lb of plastic per year. American's green efforts on board go back to 1989, when it started the industry's first onboard recycling program, which is still running.

6 RYANAIR GOES GREEN

2018 is the fifth year of Ryanair's Always Getting Better plan, the latest initiative of which is a plan to eliminate all non-recyclable plastics from its operations over the next five years. As the airline's chief marketing officer, Kenny Jacobs, explained, "For customers on board, this will mean initiatives such as a switch to wooden cutlery, biodegradable coffee cups, and the removal of plastics from our range of inflight products."

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SELF-MADE GENIUS

While some researchers are developing passenger aircraft that fly autonomously, an institute in Germany is working on techniques to help manufacture them autonomously

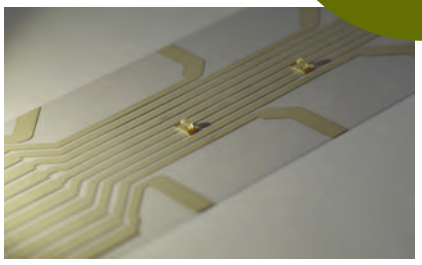
See p16 for more materials innovation from the Fraunhofer Institute

Akin to the nervous system in the human body, wiring carries essential signals throughout the aircraft cabin, the copper cables transmitting electrical signals for everything from temperature-measuring sensors and LED cabin lighting to electronic seat actuators and IFE. However, while these cables are highly engineered, their assembly process is rather less high-tech, with individual cables combined into harnesses by hand in a time-consuming and costly process.

The solution to greater efficiency, according to the Fraunhofer Institute for Electronic Nano Systems (ENAS) in Germany, is to develop manufacturing processes that automatically print electrical conductors directly onto aircraft components, enabling simple and accurate customization, reducing production waste and eliminating cable harness fitting processes – as well as creating savings in terms of cabin space and weight.

"We use electrically conductive silver ink, which we apply by screen or inkjet printing in layers of only a few microns directly onto lightweight aerospace materials, such as high-temperature-resistant plastics," explains Dr Ralf Zichner, head of the printed functionalities department at ENAS.

> "We use electrically conductive ***silver ink***"
> Dr Ralf Zichner



ABOVE: AN ENAS PRINTED CIRCUIT-BOARD SCREEN PRINTED ON A FLEXIBLE PLASTIC FILM. THE TRACKS TRANSMIT ELECTRICAL IMPULSES – TO MAKE LEDs GLOW, FOR EXAMPLE

The technologies can produce printed conductors, but Zichner's team is also working to integrate microcontrollers, diodes, capacitors, resistors and other electronic components directly into aerospace modules, with a key consideration being that the ink and printing processes must be optimally matched to the subject material. According to ENAS, the technology is almost ready for launch and is being optimized in Fraunhofer's 'Go Beyond 4.0' Lighthouse Project, which is working toward individualized mass-production techniques.

THE NEXT STEP IN THERMOPLASTICS PRODUCTION?

Thermoplastics are a key element of aircraft interiors, with advantages including weight, forming and flame resistance. However, another arm of Fraunhofer Institute, the polymer engineering and thermoplastics processing department, has found room for improvement.

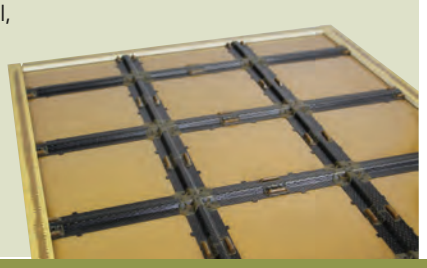
"In aviation, there has previously been a lack of concepts for the cost-effective production of functionally integrated thermoplastic structures," states Tobias Joppich, a project leader at the Fraunhofer Institute for Chemical Technology.

The institute says it has made a big step toward exploiting the potential of thermoplastics in the construction of aircraft, developing a new component and production concept with modular stiffening elements that is adapted to cargo holds. These elements are produced from fiber-reinforced, high-temperature thermoplastics in a hybrid molding process, which is a combination of forming and injection molding processes. The resulting lightweight components are flame retardant, stable, can be automated in large quantities, and are easy to assemble.

"This enables manufacturers to quickly stiffen interior walls of cargo holds according to a flexible design," says Joppich.

The stable grid structure is then attached by laser transmission welding to the inner wall of the cargo hold. The concept can also be applied to other aircraft components, including the bodyshell, clips or internal components, such as seat structures. Hybrid material combinations can also be manufactured.

BELOW: A HYBRID STIFFENING PANEL FOR USE IN THE FREIGHT HOLD



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BABY STEPS

THE BRIEF

We often hear aviation experts and observers suggest new ways to keep toddlers quiet during flights, whether this involves keeping them occupied, well fed or asleep. However, it would be nice to see research that could help keep toddlers safer during flight.

THE SOLUTION

One answer comes courtesy of a team of scientific researchers from the UK's University of Sheffield, which has conducted a study into the bone strength of children, which could prove a valuable resource for improving the safety of toddlers seated in the cabin. Many parents bring children's car seats on board aircraft to improve the comfort and safety of children below three years of age; however, the safety evaluations for car seats, and indeed many aircraft seats, are generally conducted using simulated crash tests, and in these tests the models for child occupants are simply scaled-down versions of the adult models. The problem with this approach is that, anatomically speaking, toddlers are not just small adults: they have a very different bone structure because their bones are not fully formed and are still growing.

However, the Sheffield team has made more accurate models of children's physical characteristics by using computerized tomography (CT) scans of a series of youngsters, a process that involves taking several x-ray measurements of parts of the anatomy from different angles in order to produce cross-sectional images of bones. This data is then used to create a computer model, which can be utilized to investigate the effects on the bones of children of various ages when different amounts of force are applied in various directions. As the technique is non-invasive, the team is free to bend and twist the virtual bones to detect their breaking points.

One of the latest breakthroughs in the research has been the creation of 3D models of the femur (thigh bone) in the newborn to three-year-old child age range. This age range is of particular scientific interest, as it is the range that has received the least research in the past, and is also an age range at which children can't talk or communicate effectively about how any injury occurred, meaning that medical analysis is even more valuable.

Children in this age range also generally experience rapid growth, and the computer models enable the researchers to determine how bones develop during this three-year period and how bone strength changes. The result, according to the team, is accurate simulation, based on accurate models, which can be used to improve the safety of products such as seats for children in this age range.

VERDICT

Toddlers may at times be the noisiest of passengers, but they are the least vocal when it comes to safety, and the most vulnerable. With so little research into the bone strength of young children, this work by the University of Sheffield is very important, and its findings could help car seat manufacturers, and any other companies designing children's products, to create safer products. By using these new bone strength models at the product design, development and testing stages and optimizing the designs to meet the specific anatomical makeup of a toddler, these vulnerable travelers can be made as safe as possible. And who knows, if they can sense the increased safety, perhaps they will be quiet in the cabin...

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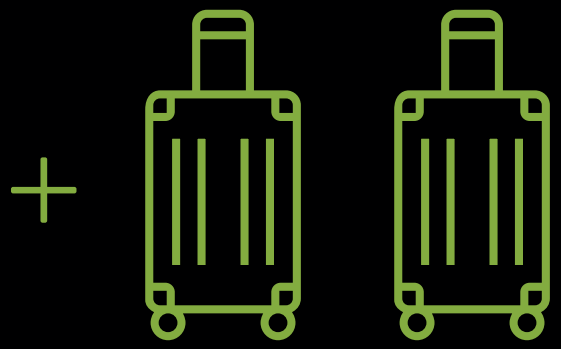

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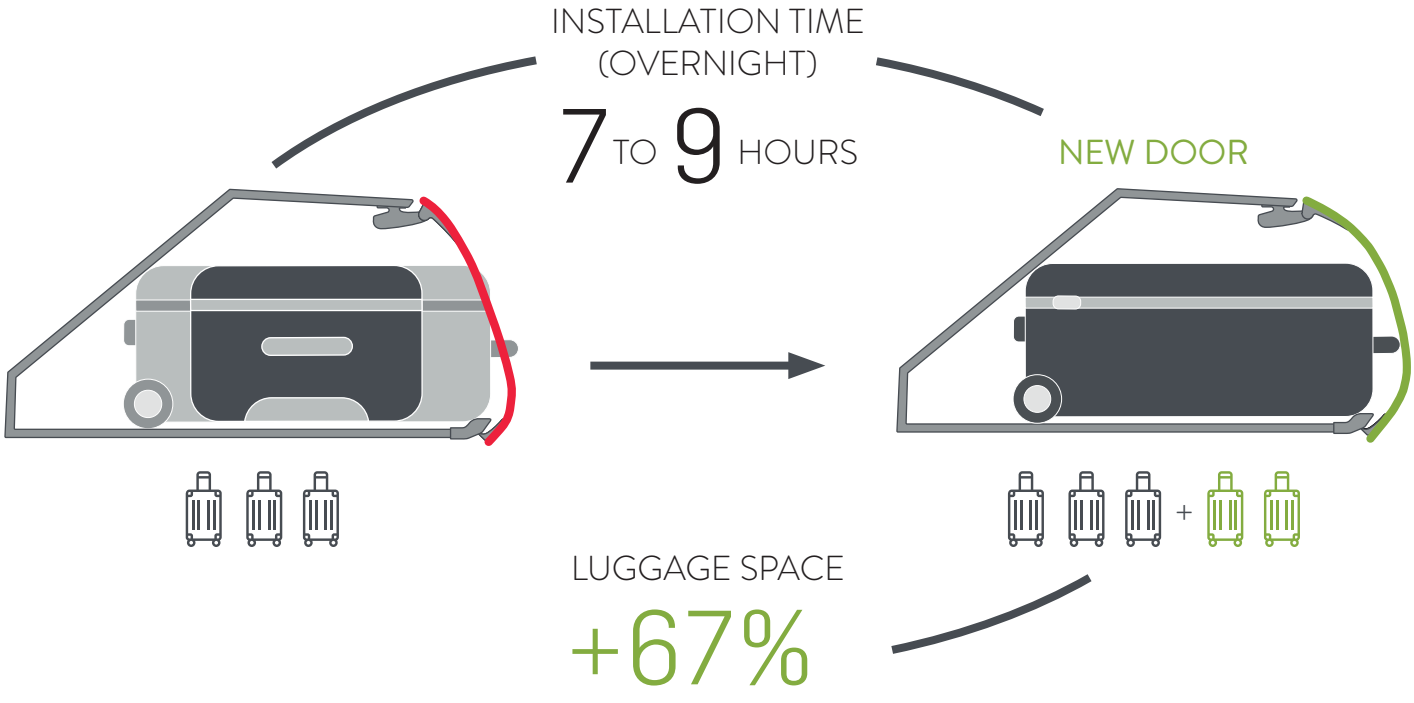

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LIFETIME PLANNING OF INTERIORS TO INCLUDE RECYCLING AND REUSE CAN YIELD BENEFITS FOR THE ENVIRONMENT – AND FOR THE BOTTOM LINE

Words by Marisa Garcia. Illustration by Sean Rodwell

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ACRO

Airlines are looking for green strategies to reduce the impact of their operations on the environment and are devising new ways to reduce waste, especially plastics. Ryanair was the first airline to make a commitment to fly 100% plastic-free by 2023, eliminating all non-recyclable plastics from its cabin service. A number of airlines have made similar announcements, such as American Airlines, which is cutting plastic straws and stirrers from its inflight service, in favor of biodegradable alternatives.

But the cabin interiors themselves could pose a danger to the environment. They may contain a large quantity of plastics, composites and hazardous materials, which should be handled with care at the end of their service life.

For a solution, we spoke to Tony Seville, owner of AIRA (Aircraft Interior Recycling Association), which has set up a recycling facility in the UK that breaks apart interiors components into reusable and recyclable parts. "We separate all of the metal frames from the plastics, seat cushions and seat covers, and wiring if IFE is installed," Seville says. "The seat covers are baled for recycling and can be reused for yarn, which can be used in new carpet tiles or carpet underlay. Seat cushions are also baled for recycling."

One of the challenges in the process is that aviation plastics are difficult to categorize. "There is no code to identify what type of plastic it is," Seville explains. "The majority of them, we have learned to identify in various ways, but there are several types of plastic within the cabin, which, if not properly identified, can cause cross-contamination, so identification and segregation is key."

Seville and his team are able to recycle many plastics that have second-life applications in other industries and have partnered with some industry suppliers to collect plastics from their customers.

"We're working with Boltaron and its UK distributor Amari Plastics to pick up all of their UK manufacturing customers' plastic waste, and we recycle this into reusable plastic. The only thing we're not allowed to do is put it back into the aerospace industry," Seville explains.

Seville has developed a sorting and preparation process and also reached out to Warwick University in the UK for guidance.

"A lot of plastic seat parts from old seats mostly contain double-sided tape – this needs to be removed, otherwise it contaminates the plastic recycling process. It can be done, but it is time-consuming. Some parts have metal, glue or silicon on them and have to be removed if possible, and if not they go straight into the waste bin, to be sent to landfill," Seville says. "Luckily this only adds up to about 1% of the entire recycling process."

Any plastic parts that have been repaired and painted with various fillers to mend cracks must go directly to landfill because those patches can contaminate the good plastic and ruin the recycled end product. Any contaminated product must go to landfill.

"Any plastic product within the aircraft cabin can be recycled if it is clean and free of contamination," Seville says.

EMEA led the global aircraft dismantling market in 2017, with nearly 45% of the market share

Technavio research

NUMBERS NEEDED

"What the interior manufacturers in aviation need to start doing is putting an [identifying] number on the plastic. Most plastics have a code from one to seven, so that you know roughly what type of plastic it is. This labeling may have already started on newer interiors, but on the older interiors that we are recycling, it's not apparent."

Seville says that, working with Warwick University, AIRA is testing plastic materials to identify them for second-life, by determining their properties.

"They are really taken aback with what we are doing; and also that there is no regulatory body that has control over what materials are being used, and that no one has

"Interiors manufacturers need to start putting an identifying number on the plastic"

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IFE issues

IFE components in interiors also require careful sorting and pose unique environmental challenges. "Wiring and plugs are recycled, along with circuit boards, which contain precious metals," Seville says. "LCD screens must be handled with extreme care as they contain CCFLs (cold cathode fluorescent lamps). CCFLs contain a small amount of mercury, which is toxic and is classed as hazardous waste. If not recycled correctly, these screens can cause serious problems, if they fall into the wrong hands. Some 5-10 of screen types contain enough mercury to pollute 30,000 liters of water, beyond the safe drinking level in the UK. So, if you are thinking of sending your old seats to landfill, then think again. You must let authorities know what materials you want to recycle, so that they can charge you accordingly for handling hazardous waste and for the landfill tax."

taken responsibility for recycling of the materials that make up the interiors, like the automotive industry has," he says. "The auto industry has worked on a system where the materials they use in the car can be identified and will be recycled at the end of service life. This is where our industry needs to be," he adds.

COST INCENTIVES

There is a lot to be salvaged from a cabin, and a big cost-incentive to avoid landfilling seats. The typical weight of materials for a shipset of seats from a 180-seat narrow-body aircraft such as an B737 or A320, without IFE and without composite back frames, contains 3,086 lb (1,400kg) of metal, 880 lb (400kg) of seat foam, around 440 lb (200kg) of seat covers and 660 lb (300kg) of plastics – that's a total of 5,070 lb (2,300kg), or 2.3 metric tons.

"It can cost about €4,500 [US$5,000] to send a shipset of seats with IFE and composite back frames with a combined weight of 2,300kg to landfill. The lowest cost would be €2,000 to €2,500 [US$2,300 to US$2,900] for seats without IFE and composite back frames, depending on the landfill site," Seville says. "Not all landfill sites will take hazardous waste or composite materials and will charge a fortune to handle them and dispose of them."

Seville says that some airlines and other suppliers store shipsets indefinitely, considering them assets. But the value of these assets depreciates. Without a plan for repurposing or recycling they become cost burdens, not just in warehousing, but ultimately in disposal to landfill.

RIGHT: 'THE BASE' IN CHINA COULD TURN THE PROBLEM OF THOUSANDS OF AIRCRAFT RETIRING IN CHINA INTO A MONEY-MAKING OPPORTUNITY

CHINA EXPANDS VALUE CHAIN

Aircraft Recycling International (ARI) has begun operations at what it calls 'the Base', Asia's first large-scale aircraft recycling facility. The 300,000m² Base is located near Harbin Taiping Airport in northeast China, and its various facilities and technologies covers seven areas of business operation, including aircraft purchasing, selling, leasing, disassembling, replacing, conversion and maintenance, providing aircraft recycling solutions to airlines, MROs, lessors, as well as manufacturers and distributors of aircraft materials. The site currently has an effective handling capacity of 20 aircraft per year.

Li Yuze, general manager of the disassembly center at the site, said, "The Base will complete the final link in China's aerospace manufacturing value chain. As there are yet no comprehensive aircraft recycling and remanufacturing systems in China, aging aircraft are usually dissembled and disposed of by companies in Europe and the Americas, involving high costs and long waiting times. More and more civil aircraft in China are set to retire soon, offering extended market opportunities to the emerging aircraft recycling and remanufacturing industry. We strive to maximize the value of used aircraft and set up a new growth pillar for the aviation industry chain."

"Lets say, for argument's sake, a company has six shipsets of seats [1,080 pax places] that are already seven years old, stored in a 10,000ft² warehouse for the last five years, and the cost per square foot is €9 [US$10]. Over the five-year period, the seats have cost €448,000 [US$520,000] to hold as a depreciating asset. They were probably worth around €670,000 [US$780,000] when first put into storage. When five years pass, the company wants to move the seats on, but there are no takers because the seats are now 12 years old. What does the company do with them? There are no options, only landfill," Seville says. "Everything has the potential to have a value."

Beyond recycling, interior parts that are in good condition can be segregated for reuse and re-introduced back into the supply chain. Parts can be cleaned and inspected and recertified with full traceability, in order to be sold on to a new clients.

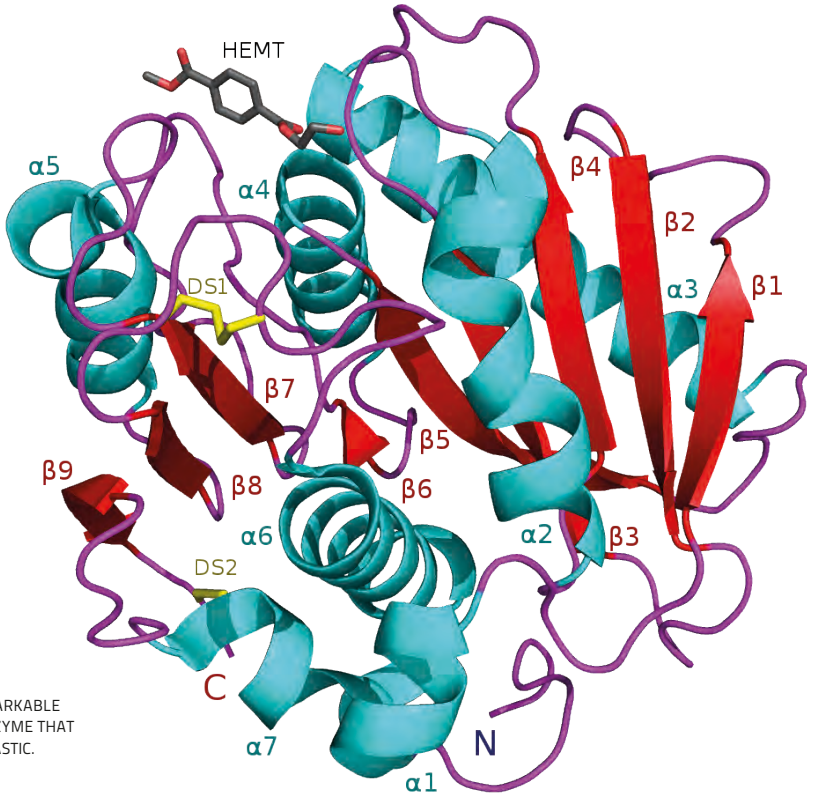
"The one thing you can't get from interiors easily are spare parts. We know that airlines need interior spares on a regular basis. We are trying to build an interior spare parts distribution center in the UK where the parts would be able to be sold onto new clients instead of going to the landfill," Seville says.

AIRA also has a scheme to share 30% revenue from the parts that it sells on to the airline or whatever company owns the interiors.

"There's an incentive there for them to send owned seats and interiors to us – to either recycle or reuse – that would otherwise end up in landfill," Seville says. "We're looking for airlines to recognize that they don't have to hold it and keep parts forever."

Landfill costs, but recycling or reuse is cheaper, and it's recycled correctly.

"Everything has the potential to have a value"



PETase WAS A REMARKABLE DISCOVERY: AN ENZYME THAT ENJOYS EATING PLASTIC. IMAGE: KEMINISTI

GROWING APPETITE

Scientists have engineered an enzyme that can digest some commonly polluting plastics, such as polyethylene terephthalate (PET), which currently exists in millions of tons of plastic bottles, and which can survive for hundreds of years in the environment. The research was led by teams at the UK's University of Portsmouth and the US Department of Energy's National Renewable Energy Laboratory (NREL), and among the many remarkable parts of the project, one thing stands out: the discovery was accidental.

Prof. John McGeehan at the University of Portsmouth and Dr Gregg Beckham at NREL had successfully solved the crystal structure of PETase, a natural enzyme that can digest PET, but when they were examining the structure, they inadvertently engineered an enzyme that is even better at degrading the plastic than the one that evolved in nature.

PETase is thought to have evolved in a waste recycling center in Japan, allowing a bacterium to degrade plastic as a food source. The researchers are now working on improving the enzyme further using protein engineering and evolution tools, to enable it to be used industrially to break down plastics in a fraction of the time.

"Serendipity often plays a significant role in fundamental scientific research," says Prof. McGeehan."Although the improvement is modest, this unanticipated discovery suggests that there is room to further improve these enzymes, moving us closer to a recycling solution for the ever-growing mountain of discarded plastics.

"We can all play a significant part in dealing with the plastic problem, but the scientific community who ultimately created these 'wonder-materials' must now use all the technology at their disposal to develop real solutions," adds McGeehan.

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Seville believes the industry must think of asset value beyond the initial purchase price, to the full service life and second life of the products. This may mean planning ahead, marking the class of plastics on the component, just as the industry marks all parts for full traceability by regulatory standards. Manufacturers and designers can also think ahead to recycling and repurposing by considering where they use laminates or decorative elements that require glue.

"Everything we have has a value. It's how we deal with it, whether we make it economical to recover that value, that is the key for recycling," Seville says. "There is now an opportunity for seat and interior manufacturers to go to the likes of Boeing and Airbus and airlines and say, 'Buy our seats or interiors because they can be recycled at the end of their service life."

GO GREEN EARLY

During the Passenger Experience Conference at Aircraft Interiors Expo this year, industrial designer and circular economy expert Christina Fagin of Grüner Hering, suggested that aviation industry designers and engineers need to be involved in product development earlier on, looking for a business model that supports a green lifecycle and includes plans for second-life applications of components. She suggested that the focus for today's manufacturers should be to retain the value of products both in resources and built parts.

She identified four potential lifecycles or 'loops' that help retain value. Some of these are already in place for aircraft interiors, including refurbishment. "The first loop is to try to keep them in use for longer. That can be done by building high-quality products, selling them once, and adding services like care or consumables – like selling the detergent instead of the washing machine," she said. "The second loop is sharing, ensuring that the product can be used more efficiently throughout the same lifetime. The third loop is the product reuse and the parts reuse. Then, you must collect the products, refurbish them, and put them on the market again and create more revenue through that. I know of a company in the Netherlands that does this with office furniture. They sell it and have a contract with the client that they will buy it back after a seven-year period, refurbish the furniture and sell it again. They do that three times and, in the end, they create 25% more revenue and can offer their products to a broader client range because not everyone can afford the higher-quality first product. The fourth and last loop is the material recycling."

Recycling, she emphasized, requires that manufacturers can identify the specific material components so that they can be properly processed. Repurposing products also requires planning ahead, designing for second life to preserve the maximum value. That may involve designing products that are easier to repair and repurpose, or easier to disassemble to recover second-life parts. It will include marking parts for easier recycling. There are a variety of strategies that make repurposing or recycling easier, but the key to retaining product value is to avoid re-introducing a heavy cost burden to the second-life process.

"The more supply chain stages, the more that you have to go through again to make the product go back to market," she said. "That also means more input. If you have material recycling, you still have to put more energy and labor in before you can sell the product again. The higher value is in the inner loops, where the most attractive business models are. The smaller the loop, the more profitable and resource efficient it is. Don't repair what is not broken, don't remanufacture what can be repaired, and don't recycle what can be remanufactured."

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ECO-COMPASS

A Euro-Chinese project is underway, aiming to develop and assess multifunctional and ecologically improved composites from bio-sourced and recycled materials for application in aircraft secondary structures and interiors. Named Eco-Compass, the 36-month, €1.9bn project has 11 Chinese participants and eight European, including Airbus Group Innovations, AVIC and various research organizations and universities.

The partners acknowledge that the lightweight structures used in modern aircraft have excellent mechanical properties combined with low weight: for example the GFRP used in aircraft interiors and the CFRP used for fuselages and wings, etc. However, they also feel that all these composite materials are man-made and energy-intensive to produce, and that renewable materials such as biofibers and bio-resins could be a greener alternative for composites.

The 50 researchers and engineers on the project are now assessing the use of ecologically improved composite materials for interior and secondary structures, including bio-sourced and recycled fibers, bio-sourced resins and sandwich cores.

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high

THE AIRLANDER 10 CABIN MAY LOOK LIKE A FANTASY, BUT ITS DESIGNER SAYS THAT IT IS NOT ONLY VIABLE, BUT POINTS THE WAY FORWARD FOR COMMERCIAL FIRST CLASS

Words by Adam Gavine

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"Airlander focuses on time rather than distance"

Welcome to the world's largest aircraft, which, if its development goes to plan, will offer possibly the most luxurious and intimate passenger experience in the skies, and could even influence future commercial aircraft interiors.

The Airlander 10 is a hybrid airship designed and built by British manufacturer Hybrid Air Vehicles (HAV), originally as a US Army program, which was canceled in 2013 but revived by HAV as a civilian project in 2016. The aircraft is truly vast, at 92m (302ft) long (20m longer than an A380) with a 38,000m^3 (1,300,000ft^3) envelope.

One application the airship was originally developed for was 'eye in the sky' duties, monitoring conflict zones from a static position. The Airlander's military credentials may have been revoked, but that ability to stay aloft for long periods and to travel very slowly with little noise makes it perfect for creating a mobile environment akin to a boutique hotel with incredible views. Just imagine gliding over the North Pole or the Serengeti in silence, observing the glory of nature from plush, temperature-controlled and predator-free accommodations.

ABOVE: LAS VEGAS CASINOS LOOKING TO TREAT THEIR HIGH ROLLERS COULD ARRANGE INCREDIBLE EXCURSIONS OVER THE GRAND CANYON

BELOW: AIRLANDER WOULD CERTAINLY REMOVE THE DISCOMFORT INVOLVED IN EXPLORING THE NORTH POLE

Airlander 10 can also take off and land from almost any flat surface, whether desert, ice or water, eliminating the need for traditional infrastructures such as a port or airport and opening up opportunities to land and set foot directly in remote places without any bothersome hiking.

So, a flying cruise, if you will? "It is, in that you can do lots of activities on board. But you can go much higher – on a ship you see the horizon and the water within 30ft [9m] of you," says Howard Guy, CEO of the project's design consultancy, Design Q. "With Airlander you can go down to 20ft, you can go up to 2,000ft – you can do whatever you want with it, and that's what makes it different."

The difference is Airlander focuses on time rather than distance, with air cruises of 50-100 miles (80-160km) spanning up to five days predicted to be a big market.

THE PASSENGER ENVELOPE

While it is dwarfed by the inflatable structure, the passenger cabin is pretty spacious, at 20 x 3.2 x 2m

PASSENGER PROFILE

So who will be on board Airlander? "Private individuals who have enjoyed private jets and yachts, but are looking for something different, something that will give them unique access to remote parts of the world, to enjoy 'slow travel' with amazing views of our planet," predicts Howard Guy.

"Similarly, we envisage luxury travel companies will be keen to offer their well-heeled clients this unique experience. We think the modularity of Airlander 10 will offer the flexibility such bespoke travel companies are looking for."


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DESIGNER'S WHIMSY

The Airlander's passenger cabins are gorgeous, but come on, this is a giant blimp with regulations that can allow an aircraft cabin designer to let loose with their imagination. So what ideas is project designer Howard Guy secretly plotting?

"I've been contemplating a glass-bottomed jacuzzi," he says.

Now you're talking, but is it possible? "There's nothing difficult about a glass-bottomed tub – you see them in some hotels and modern buildings," he says.

Another idea is to attach giant inflatable zorbing balls to the tail on bungee cords. Guests could climb inside and be launched into freefall before being winched back in. That may well lead guests in search of a relaxing tea in the lounge afterwards, or something stronger in the bar.

Guy's next idea is a little less adrenaline-fueled: having high-powered binoculars on tripods at every window so guests can see every detail of the amazing surroundings.

(65 x 10.5 x 6.5ft) – especially when you consider it is only intended to carry 18 passengers.

The space is an attractive proposition for a designer, featuring huge floor to ceiling windows throughout, an optional viewing deck, and design possibilities that are far less constrained than commercial jet cabins.

"It does open opportunities of what you can do with the space and allows you to look at first class transportation in a completely new way," says Guy.

So what would the Airlander cabin offer? Design Q has been striving to achieve the feel of a luxury apartment, with flexible zones that can create various activity zones, customized to the journey and passenger profiles. This is rather different to commercial first class, where the focus is often on an enclosed suite.

"It's about moving around, talking, dining, doing whatever you want, like you would at home," says Guy.

The sky doesn't really impose a limit, with the modular design enabling zones such as a bar, lounge, disco – whatever the operator may wish, and entirely flexible. For example, if there are only 15 guests booked, the structures can be reconfigured before the journey to remove an unneeded bedroom suite and expand the lounge with another window and sofa. During a flight, a cocktail lounge could be reconfigured as a breakfast room, briefing room or fitness room throughout the day.

> Airlander 10 is equipped with pneumatic skids, which enable it to land and take off from a variety of terrains, and from water

ABOVE: EVEN THE BEDS ARE ANGLED TOWARD THE WINDOWS

BELOW: THE ALTITUDE BAR – POSSIBLY THE COOLEST PLACE IN THE WORLD TO ENJOY A SUNDOWNER AS THE WORLD SLIPS BY, VERY SLOWLY

Guy describes the modular scheme as a "joy" to work with as it "allows you to think differently".

"You can reconfigure spaces to look different throughout the day, perhaps using curtains to close off any unused spaces," he adds. "It's the same sort of feel and appointments as a yacht. Lying there with a gin and tonic, watching the view outside."

REALITY CHECK

This all sounds marvellous, but is it a realistic proposition for certification or a giant pipe dream? Guy has read up on the regulations, and has found that, "some regulations haven't been written yet, which is cool. This is not like a rigid aircraft, which has to be laid out a certain way".

"And it's not like were inventing the whole airship, just the interior, which is perfectly doable," he adds. "So this

THE EXPERIENCE

So how would Howard Guy explain the passenger experience? "The closest analogy I can think of is, imagine The Orient Express in the sky: that level of opulence and luxury, but with the ability to get absolutely anywhere in the world, from Antarctica to the plains of Africa, to float above the mountains of Patagonia, or the glories of the Amazon. You are not constrained by where the rails take you, or a timetable; it gives you the freedom to go anywhere you desire."

Materials and finishes are seen as key to the experience. "Luxury is about nurturing the senses, providing delight by thoughtful touches down to the tiniest detail. Designed to be relaxing, the real wood flooring and the Tai Ping silk carpets lift the interior to a class of its own," he adds.

"Perhaps the ultimate experience is to sip sundowners in the bar as you float slowly over icebergs and glaciers, or perhaps the Victoria Falls, or even a cityscape like Manhattan. Does it get any better than that?"

"It will inspire airlines to create a new first class zone"

could be ready for operations really quickly – and Airlander is looking for orders quickly."

Indeed the studio is now working to finalize the design with the Airlander engineering team and anticipates sharing 'exciting news' in the next few months.

The relative ease of the regulations, especially compared with the studio's airplane cabin work, also makes those flexible cabin configurations entirely possible, according to Guy.

The FST regulations are expected to be the same as those the studio complies with for commercial aircraft cabins, but the impact requirements are rather different, being 3*g* rather than 16*g*.

"This means we can be a lot more relaxed with furniture structures," says Guy. "We can have the furniture doing things you normally never see happen."

For example, not only can the sofas in the main cabin rotate – they can be reconfigured 1-1-1, four in a row, four looking out or four looking sideways, depending if passengers want to face each other or the windows."

The brief for the seating was that it must not look like aircraft seating; it must look like super-comfortable high-end furniture. Even better, guests can use any seat for TTL under the regulations.

The brief

To create a whole new experience for seasoned and discerning travelers that is at once exhilarating, wondrous, and like nothing else on Earth

ABOVE LEFT: HOWARD GUY IS EMBRACING THE DESIGN FLEXIBILITY THAT THE AIRLANDER ALLOWS

ABOVE RIGHT: GUY IN FRONT OF THE 38,000M³, 92M-LONG AIRLANDER

BELOW: OCTURI'S VISION FOR AN AIRBORNE YACHT IS MORE GEARED TOWARD DAY TRIPPERS

"You can do whatever you want, and because it only has to meet 3*g* , it enables us to do it easily from an engineering point of view – although the seats will be certified 4*g* ," says Guy.

Airlander flights will certainly not be inexpensive, but Guy predicts the experience will trickle down into commercial aviation, albeit in the premium cabins.

"These ideas will dribble into commercial aviation without question," he says. "We are already working out how to make these seats 16*g* because this is what first class passengers really want. They don't want to be put in a sardine can and charged £6,000 (US$7,600) for it – they want this.

"Luxury is space and the freedom of space, allowing free movement and seclusion if required. In contrast with a commercial aircraft, even in business class or first class, the space you get is not commensurate with the expectation or the ticket price. Space is at an absolute premium, unlike Airlander 10."

"First class is starting to get more open, but something like this will really trigger change. People don't know what they want until they see it. But designers never ask people what they want because people don't really know – but when they see it, they know that they want it," concludes Guy. "As soon as people see the Airlander design it will inspire airlines to create a new first class zone. You saw it here first."

a rival idea

The Toulouse-based Octuri design studio has created a sightseeing airship concept that takes off and lands on water. Named the Flying Yacht, it has been devised for Hokan Colting, founder of the Canadian company Flying-Yachts Inc, to enable up to 40 passengers to enjoy a spacious 516m² (5,550ft²) cabin, entered through an airlock. This wide, open space is made possible because the hull's rigidity is created by cabin pressurization, not through structural elements in the cabin. As the craft is all about the views, the cabin walls are made of transparent polycarbonate sheets, giving 360° visibility. Once the craft has landed, following a cruise at an altitude of 100-300ft, guests can go back through the airlock and access the two outside balconies without any loss of cabin pressure.

The 40 seats, positioned at the front of the craft and diagonally at the sides, are occupied during TTL and as desired during flight. For sociable flyers, there is a snacking area with tables and several bench seats between the outer seat rows, and a bar area at the rear.

For those seeking some inflight and on-aqua entertainment, besides the stunning views afforded by the large windows, there are two areas with transparent floors, offering vertical views when in flight, and a glimpse underwater when in floating mode.

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Fifth element

5G CONNECTIVITY IS CLOSE TO BEING DEFINED, AND EARLY INDICATIONS SUGGEST THAT WHEN IT ARRIVES IN THE 2020s IT WILL OFFER BENEFITS FOR CABIN WEIGHT AND DESIGN, PASSENGER EXPERIENCE ENHANCEMENTS AND ANCILLARY REVENUES

Words by John Walton
Illustration by Michal Bednarski

The next generation of mobile connectivity, 5G – whatever it actually happens to be – seems set to revolutionize the world, including the world of aircraft interiors.

As is the case with many emerging and emergent technologies, few people agree on precisely what 5G is, and international standards bodies are only just forming their opinions, with the ITU's (International Telecommunication Union) IMT-2020 standard still at the proposal and consensus-building stage.

"There is no accepted industry standard or definition for 5G yet," airline technology consultant Michael Planey explains. "The ITU has only recently defined the first stage of requirements for 5G. For me, I use 5G with clients to denote the next generation of mobile communications technology that will be defined by the following characteristics: ten- to hundredfold improvements in bandwidth, tenfold improvements in latency, tenfold improvements in reliability/uptime,

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substantial improvement in energy consumption and a newly designed network architecture allowing for 'immersive' signal density for continuous two-way communication between devices. It is also often described as the way for the IoT [Internet of Things] to become more fully realized."

Yann Cabaret, VP of customer programs at integrator SITAOnAir, meanwhile, says, "From a network connection perspective, we expect inflight 5G to be composed of various other networks – 4G, 5G, NB-IOT, LoRa, wi-fi – addressing specific business requirements seamlessly for end users.

"A 5G roll-out is unlikely to be a one-size-fits-all story around the world," Cabaret notes. Operators are all at different roll-out stages and considering different approaches. Current industry indications suggest that most operators will opt to roll-out 5G alongside other connectivity options, which could serve as a bridge to eventual standalone 5G networks."

"5G will be both evolutionary and revolutionary," Planey suggests. "It will begin to be built upon the existing 4G LTE and 802.11 and Bluetooth standards and architecture. Backwards compatibility will be the norm for the first few years as 5G devices establish a market footprint. 802.11 [wi-fi] networks will continue to expand for at least the next five years until a better roadmap to the future of 5G is created. At some point – probably around 2025 – 5G will be the standard upon which all our interactions are based."

IT'S NOT JUST ABOUT THE BENEFITS WE CAN SEE; IT'S THE ONES WE HAVEN'T EVEN THOUGHT OF YET

There are two things many of the people and companies working in the 5G space can agree on: that the benefits we can already identify revolve around a bigger pipe, and that the bigger pipe will enable innovation to deliver a range of benefits that aren't on anybody's radar.

"I often tell clients that the difference in experience between today's 4G LTE or wi-fi and tomorrow's 5G networks is like the difference between running through sprinklers on the lawn and jumping into the pool," says Planey. "Today you're a little bit wet; in the future you'll be soaked.

"It's like the difference between running through lawn sprinklers and jumping into the pool"

WI-FI IS FAST BECOMING A PASSENGER EXPECTATION, BUT 5G WILL BE A REVELATION

"5G is perhaps the best example of 'build it and they will come' for new applications," he continues. "In my opinion, we probably don't know which applications will most greatly benefit from 5G in the aviation sector. In reality, it is likely that the greatest use of it will be for an application that hasn't been invented yet – but that is looking 10 years down the road. If a full 5G network architecture encompassing land, air, sea and space is realized, then the possibilities are nearly limitless."

Of course, the overwater question has not yet been answered: will this revolve around satellites in a variety of orbits, drone ships, or even something like a solar-powered automated flying cell tower? Regardless of how, the promise of new technology is a siren song.

"The headline buzz is the bandwidth performance of the cmW and mmW spectrum, downloading an HD movie in four seconds, but that's just attention-grabbing," suggests Joe Hoffman of SAR Insight and Consulting. "3.5GHz is shaping up as a 5G worldwide roaming frequency, which means lots of mobile devices, and

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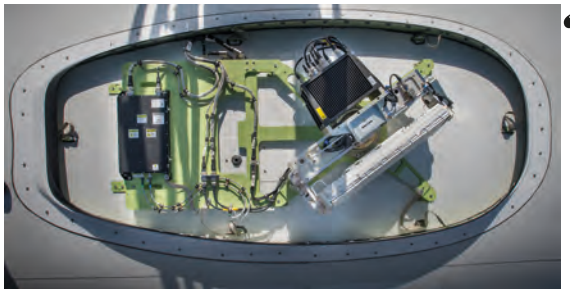


"Taking more hardware out of the IFEC systems should offer substantial weight savings"

this fits well with airline needs. The technology innovations open the door to new business model innovation, which will be made possible by the airlines partnering with mobile operators. However, it will take a while to roll-out 5G, as there have to be enough 5G-equipped flyers, and also attractive business models and services, so it will be chicken-and-egg for some time."

VISIBLE CABIN CHANGES ARE LIKELY TO FOCUS ON REMOVING VISIBLE BITS OF IFEC EQUIPMENT

With faster, higher-capacity and higher-bandwidth wireless connectivity comes, naturally, a reduction in (and eventual absence of) wiring, cables, the boxes needed to manage them, and the in-cabin infrastructure required to serve every seat on the aircraft.

As these boxes, wires and cables shrink, disappear and no longer need to be engineered for, cabin interior designers and seating engineers will be able to stretch the boundaries of what is now personal space. The benefits sound, for example, like an evolution of the current-generation seating work being done to carve out space at the knees, which is already benefiting passengers.

"Taking more hardware out of the IFEC systems should offer substantial improvements in weight savings, reliability, power consumption and system maintenance," says Planey. "The removal of under-seat IFEC boxes will free up desperately needed comfort space and the removal or size reduction of some seatback components will give designers the flexibility to improve the ergonomics and comfort of the seats for passengers."

Furthermore, Cabaret says, "The expectation is that the growth in inflight connectivity will continue to accelerate over the years to come, driven by the demand for new applications such as augmented reality [AR] and virtual reality [VR] and the proliferation of Internet of Things devices."

Cabaret notes that the content loading revolution too will benefit from the new technology. "5G will also play a key role in connecting the aircraft at the airport gate. 5G bandwidth – greater than 1Gbps – will enable high-speed transfer of aircraft data during aircraft rotation."

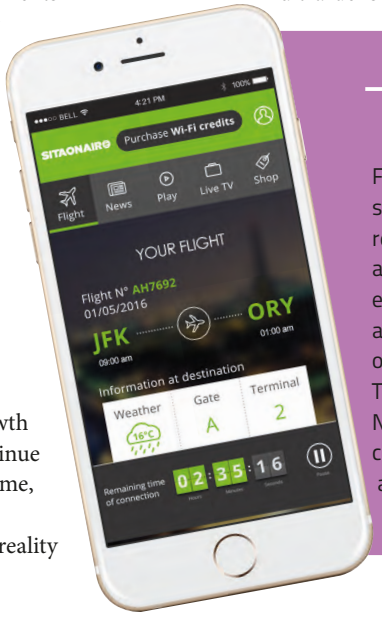
In addition, Cabaret says, "5G data streaming capabilities can play a key role in transferring local content to airline devices – updating IFE devices from the local server, for example. Weight savings can also be delivered with the increase in wireless technology."

CONNECTIVITY WILL SEE A STEP CHANGE IN SPEED AND EASE OF USE

The potential performance of 5G could benefit airports and airline ground operations, and the passenger experience (see *Airport knock-on benefits will improve PaxEx*). However, back in the aircraft cabin, connectivity is almost a no-brainer benefit for 5G.

"5G mmW can deliver fiber-optic-like performance and provide connectivity for a multitude of systems, including IFE, reduce physical connections to just power, and eliminate cables. 5G brings the ultra-reliable and ultra-dense IoT to the aircraft," says Hoffman of SAR

LEFT: HONEYWELL'S JETWAVE SATCOM TERMINALS ENABLE GLOBAL CONSISTENT CONNECTIVITY VIA INMARSAT'S GLOBAL XPRESS (GX) KA-BAND NETWORK



THE EXPERIENCE

From the passenger experience standpoint, many of the benefits revolve around travelers truly being able to have an at-home experience in the air – or, if not at-home, at least an at-the-office or at-a-friend's-house experience. Think watching an episode of a Netflix show via a fast cellular connection over lunchtime, or asking your friend for their wi-fi password to download a movie.

"In terms of the passenger experience, true 5G will mean that everything a passenger does from home or office will be readily available in flight, with a seamless transition between air and ground," says Michael Planey. "It also means that airlines and airports will be in continuous contact with passengers at every step of their journey – providing they opt in, of course."

Airport knock-on benefits will improve PaxEx

The promised performance and reliability of 5G will also mean an increase in the back-end efficiency and reliability of airports and ground operations, which will by extension improve the passenger experience. Notes SITAOnAir's Yann Cabaret, "One of the major innovations will be the introduction of network slicing, which permits business customers to enjoy connectivity and data processing tailored to specific business requirements, and adhering to a service level agreement with the service provider."

"Wi-fi is not going away," agrees Joe Hoffman of SAR Insight and Consulting, "but we will start to see private networks at airports. Because of 5G network slicing, using licensed spectrum, and managed by telecom operators, all airport operations can go wireless and extend their IT networks, bringing the IoT and its advantages to aviation. I can see autonomous freight operations emerging, with high-capacity, low-latency 5G private networks at the airport providing the reliable connectivity to manage both runway and tarmac activity: no more human error."

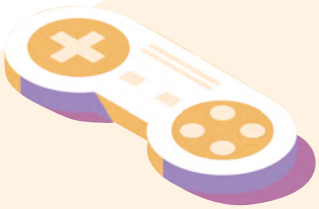
"Air traffic control systems will benefit greatly from increased real-time communications with all aircraft," consultant Michael Planey says, "and airline operations will be able to establish more efficient aircraft utilization rates with improved maintenance reliability. Aircraft systems being able to be in continuous contact with operations centers affords an opportunity for gains in safety, reliability and efficiency."

"Wi-fi is a somewhat disappointing user experience"

Insight and Consulting. "Wi-fi is a somewhat disappointing user experience, and only about 10% of potential users pay for it. With 5G, the onboard server becomes a Mobile Edge server, and I expect airlines will collaborate with operators so that subscribers can roam onto an airline network. No need to worry about GSM, 3G, or all the 4G bands, just the most likely 3.5GHz band.

"Currently," says Hoffman, "inflight broadband is wi-fi-incumbent, which makes sense as wi-fi is widespread and host-neutral, but it is difficult to get people to pay for it, and the process is clumsy. 5G will bring innovation to monetize inflight broadband, and collaborating with 5G operators is a way to tap into the premium 5G subscribers. How many different ways can we bundle value-added services, all while making it seamless and easy for the flyer?"

LEFT: THE OPEN ARCHITECTURE OF GOGO'2 2KU SYSTEM LEVERAGES CURRENT AND FUTURE KU SATELLITES



From SITAOnAir's perspective, Cabaret says, "Today, ATG networks such as EAN [the European Aviation Network] are based on 4G standards with a peak rate of around 75Mbps. The 5G protocol would enable faster connection to the aircraft, greater than 1Gbps."

"The demands of 300+ passengers streaming individual video feeds can only be handled by proposed 5G architecture," says Planey, but he notes that, "It's not clear to me how that will be able to serve passengers over the middle of the Pacific Ocean, so we'll have to wait for more concrete definitions to come forth."

Inflight retail will also see more opportunities, both to embrace new technologies to sell passengers products they really need via the devices and media that they are already using, and to reduce the friction passengers experience when paying today: Do you take Amex? Can I use Apple Pay? Does this terminal have an NFC limit?

Ultimately, says SAR Insight and Consulting's Hoffman, "For aviation, most industry innovations will come from high-bandwidth, low-latency connectivity. That connectivity will ignite the widespread automation/augmentation of physical processes."

But does that mean automation in the passenger world? Perhaps not, Hoffman says, or perhaps not at first. "I think we will see the same thing in aviation as with autonomous vehicles: appearing first in the long-haul trucking industry before passenger cars. For the airlines, we'll see semi-autonomous freight planes handling take-off, landing and tarmac navigation, coordinated and managed by the airport's private 5G network. We'll see FedEx and UPS robo-freighters before BA or AA robo-passenger planes."

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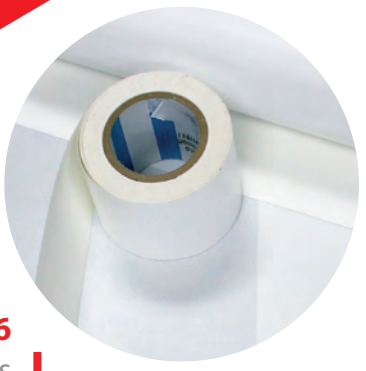

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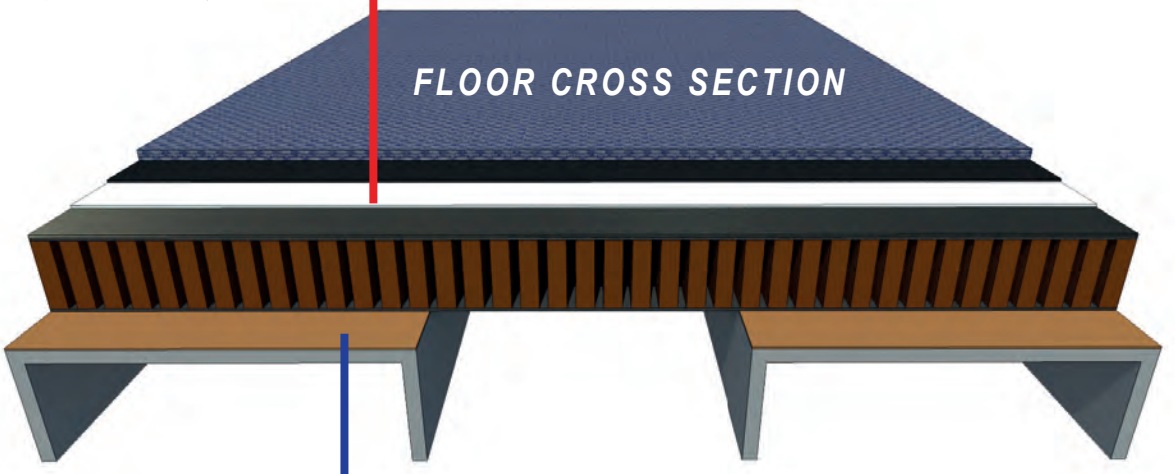

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NINE MAJOR PLAYERS IN CABIN DESIGN ARE COLLABORATING TO CREATE AIRCRAFT CABIN CONCEPTS TAILORED TO THE PROJECTED NEEDS AND DESIRES OF EAST ASIAN PASSENGERS – AND WHICH COULD INDICATE THE WAY FORWARD FOR THE REST OF THE WORLD

Words by Adam Gavine

THE FUCAM TEAM IS EXPLORING IDEAS TO CREATE A LUXURIOUS AREA BELOW DECKS THAT WOULD BE AVAILABLE TO SUPER ECONOMY PASSENGERS FOR AN ADDITIONAL FEE

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People in different parts of the world have a lot in common, but quite a few differences as well; these differences make travel exciting and fascinating, and could make aircraft more interesting too. A universal cabin design is convenient, but not optimal for each market, which is why a project is underway that aims to develop a short-to-medium range aircraft cabin for 2025, tailored to the specific tastes and requirements of East Asian flyers. This three-year EU-Japan collaborative project, named FUCAM (FUture Cabin for the Asian Market) brings together the expertise of research and industrial partners from Europe and Japan. So what could the future Asian passenger experience have in store?

Between them, the nine consortium partners represent the entire value chain for new cabin designs, from upstream research to industrial end product. They have been analyzing the particular user requirements of airlines and passengers in key markets representative of East Asia, especially Japan and China, and what they have found is a desire for a blend of tradition and innovation. To meet this demand, the partners are devising a range of new cabin technologies that would be suitable for optimizing the passenger experience in this market.

To identify those particular needs of the East Asian market that aren't being fully met today, we asked Thomas Krousarlis, project implementation manager at EASN, a FUCAM partner. He explained that the market is important, as the Asia-Pacific region is the fastest-growing air transportation market in terms of aircraft deliveries and seat capacity growth. This market has huge potential, with strong economic and demographic growth. Japan in particular may be influential.

> *"Japanese airline passengers' needs are recognized as anticipating societal trends"*

"Japanese airline passengers' needs and requirements are today recognized as anticipating the societal trends that will affect the world's future passengers," he says.

"Once the design of the future human-centered cabin is able to satisfy the highly demanding expectations of Japanese customers in terms of the most crucial aspects, such as safety, perceived quality, comfort, connectivity, time and space, it will also most likely please customers in Asia and consequently elsewhere in the world.

"These facts will drive researchers to contribute to the advancement of the state-of-the-art in cabin architecture, design and systems development so as to eventually develop the best cabin product, meeting the needs of the Asian market, and becoming the basis for future work. This is a unique opportunity for the EU aeronautics sector to contribute to the development of the future cabin, while also leveraging resources, mitigating risks and establishing a long-term relationship with Japan."

Modern aircraft are generally not lacking in safety, perceived quality, comfort and connectivity, so why does

BELOW: SUPER ECONOMY IS FAIRLY SPARTAN (NOTE THE SEATBACKS), BUT IT IS CERTAINLY LIGHTWEIGHT

KEY AIMS OF FUCAM

- Establishing the steps that should be followed in order to create a viable cabin adjusted to the Asian market's needs;
- Assessing the impact of the benefits and usefulness derived from the concept cabin for the Asian market on people's future daily life;
- Estimating the overall impact of the project on technological excellence and on citizens;
- Creating the opportunity to participate in a fruitful discussion on future collaborative common activities in the framework of the concept cabin;
- Enhancing the added value of international collaboration in the field, along with the technical excellence acquired through the FUCAM project.

ABOVE: BUSINESS CLASS LOOKS VERY MUCH LIKE MANY OF TODAY'S DESIGNS. THE HIGH CENTER PRIVACY DIVIDERS ARE AN INTERESTING FEATURE

"We agreed to dive deeper into the usability of lower deck scenarios and seat design"

the consortium feel that these areas need improvement for the East Asia market? "Factors like these, especially comfort and quality, are and should be under a continuous improvement process in order to develop an environment of trust and loyalty in the market," he states.

The FUCAM project is based around today's short- and medium-range commercial aircraft, such as the A350 family, with an expectation that the size and the dynamic nature of the East Asian market will drive airlines to evolve their current conventional low-cost carrier (LCC) and full-service carrier (FSC) offerings as we know them into more diversified and differentiated value proposals.

Working within that framework, FUCAM concepts and research are divided into several branches, which include creating a higher-density business class, as well as a 'super economy' cabin – with 'super' meaning higher density rather than a more luxurious experience.

However, if super economy passengers find the cabin a little tight for comfort, they may find some respite below decks. The FUCAM researchers have been studying the needs of "a new typology of Asian passenger", and think they have met this future flyer's needs by creating a concept to make the lower deck a passenger zone.

"After holding two workshops at the beginning of the project we agreed to dive deeper into the usability of lower deck scenarios and seat design. Use of a lower deck area, at least the cargo bay of a long-range aircraft, is not a totally new idea, but our focus turned to options to make it available for passenger use," explains Krousarlis.

The lower deck ideas are certainly not outlandish, as they do not involve alterations to the aircraft structure or any additional operational time in the airport.

"We have played with changing some cargo modules and replacing them with on-demand experience modules, with an easy way of attaching and detaching them without compromising crew operations and passenger comfort," says Krousarlis. "These modules could be hired for brands in a regular way or entirely customized, offering new experiences without disrupting operation of the aircraft."

The first lower deck scenario is intended to provide super economy passengers with a little more comfort and space, and more options during flight. This scenario creates a lower deck area with wider seats that passengers can retire to – for an additional fee – to enjoy "an atmosphere of tranquility and harmony".

The team has been a little more adventurous with the second lower deck scenario, exploring a variety of pay-to-access 'experiences', such as a children's play area, a rest area and a wellness area. Such ideas are a fairly extravagant use of expensive aircraft real estate, so the idea of partnering with successful brands in the Asian market is being considered as a means to subsidize the use of the space. Imagine a Panasonic IFE lounge, a Doraemon play area, a Shiseido wellness area: the

THE INDUSTRY PLAYERS

The consortium partners represent the entire value chain for new cabin designs. These are the roles of the six industrial partners:

▪ Airbus Group Innovations (AGI) will act as the technical and financial coordinator of the project, and will be the interface between the consortium partners and the European Commission. Together with its Design Studio Munich, AGI is also tasked with R&D and design innovation work in the concept definition stage, defining initial concept proposals and design drivers on cabin architectures and advanced onboard systems. In the next phase, AGI will further develop the concept and execute the design, driving formal implementation of selected concepts.

▪ Germany-based Bertrandt is undertaking cabin architecture integration assessment, applying its knowledge of materials certification and FAL requirements, and assessing cabin layout in terms of certification and benefit analysis.

▪ Stelia Aerospace is a France-based company that designs and produces aerostructures and premium passenger seats. Stelia is involved in the concept definition, integration and validation activities and acts as an advisor on seat concepts and their potential integration.

▪ The European Aeronautics Science Network (EASN) is represented in the project by EASN Technology Innovation Services (EASN-TIS), which works to inform relevant target audiences of achievements in the program.

▪ Mormedi, a design consultancy in Spain, is defining and illustrating the interior of the cabin through 3D visualization.

▪ Jamco is a Japan-based supplier of aircraft interior products including galleys, lavs and premium seats. In the trends and user requirement and concept definition phases, Jamco will provide its research and perspective of Asian passengers. Jamco will also provide prototypes of defined concepts.

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partnership prospects are as potentially profitable as they are numerous.

"In the end, we have decided to give the passenger a more immersive experience, in terms of the flight, the destination and the airline. A possible strong partnership with well-known brands will make the experience of flying special."

The lower deck ideas are interesting, but what has the consortium devised for the main cabins? In addition to giving their individual perspectives of the research and technology, every project partner, whether a commercial company or an organization, such as the universities, has created its own view of emerging technologies and how to implement them.

For example, the UK's Cranfield University has researched near-term technological possibilities for the cabin. Within this framework, the Cranfield team has designed what it believes is the best passenger experience, which can be adapted to each phase of the journey. From adaptive displays to adaptive foams, virtual and augmented reality, all of these technologies have the same objective: to make the passenger experience more comfortable.

The experience of Airbus as an OEM and Jamco as a seat and lavatory manufacturer means that the concepts for seating and integration of cabin architecture are relatively mature. However, Krousarlis admits that ideas being explored regarding IFE and integration of entertainment may be more conceptual at this stage.

"FUCAM is looking at ways to add Asia-specific features instead of replacing established concepts," adds Krousarlis. "By the end of this year, when we have to finalize our project, we want to have a clear view of the commercial aspects of our most mature concepts. And then convince operators that the increase in comfort comes at a fair price."

Asia light?

With eight European participants and only one Japanese partner, the EU-Japan project seems rather more European weighted than Japanese. Asked about this European bias for an East Asian cabin project, Krousarlis said, "We have gathered the significant expertise of eight research and industrial partners from six European countries and from Japan on an equal work share. The distribution of work share for the concept development between Japan and Europe sets the focus on space architecture-related concepts in Europe, and on complementary systems-related concepts in Japan. The core competence of the FUCAM team originates from the fact that its members represent the entire value chain when designing a new cabin or cabin interiors, from very upstream research to industrial end product. Furthermore, through widespread geographical roots and long experience in cooperation with Japan, the partners are able to represent the full diversity of the aerospace research in both Europe and Asia."

THE SUPER ECONOMY SEATS INCORPORATE PED HOLDERS, REFLECTING A GROWING TREND FOR BYOD

THE ACADEMIC PLAYERS

The nine consortium partners includes two academic institutes:

▪ Aalto Design Factory, part of Aalto University (AU) in Helsinki is an experimental co-creation platform for education, research and application of product design and development. AU leads the customer trends and user requirements phase, where the objective is to capture societal facts, future trends and user needs in East Asia and translate them into cabin requirements as input for concept development. Aalto has a focus on qualitative passenger and other stakeholder perspectives. It is gathering customer feedback (airline and passenger) on the initial concepts for further detail, and will carry out a final concept validation from user perspectives. In addition, AU will take part in the concept definition phase, facilitating the development work of the teams through organizing workshops and providing methods and tools for concept creation and evaluation work.

▪ Cranfield University (CU) in the UK will lead the technology scouting and assessment phase, contributing to the development of technology assessment criteria and methodologies for identification and analysis of current and emerging technologies in passenger-centered and passenger-friendly cabin architectures and systems, as well as evaluation of these technologies. In addition, CU will participate in the customer trends and requirements phase, contributing to the market analysis for investigating market trends, cultural and demographic developments in Asia, and using quantitative methods to define end users' requirements for the concept.

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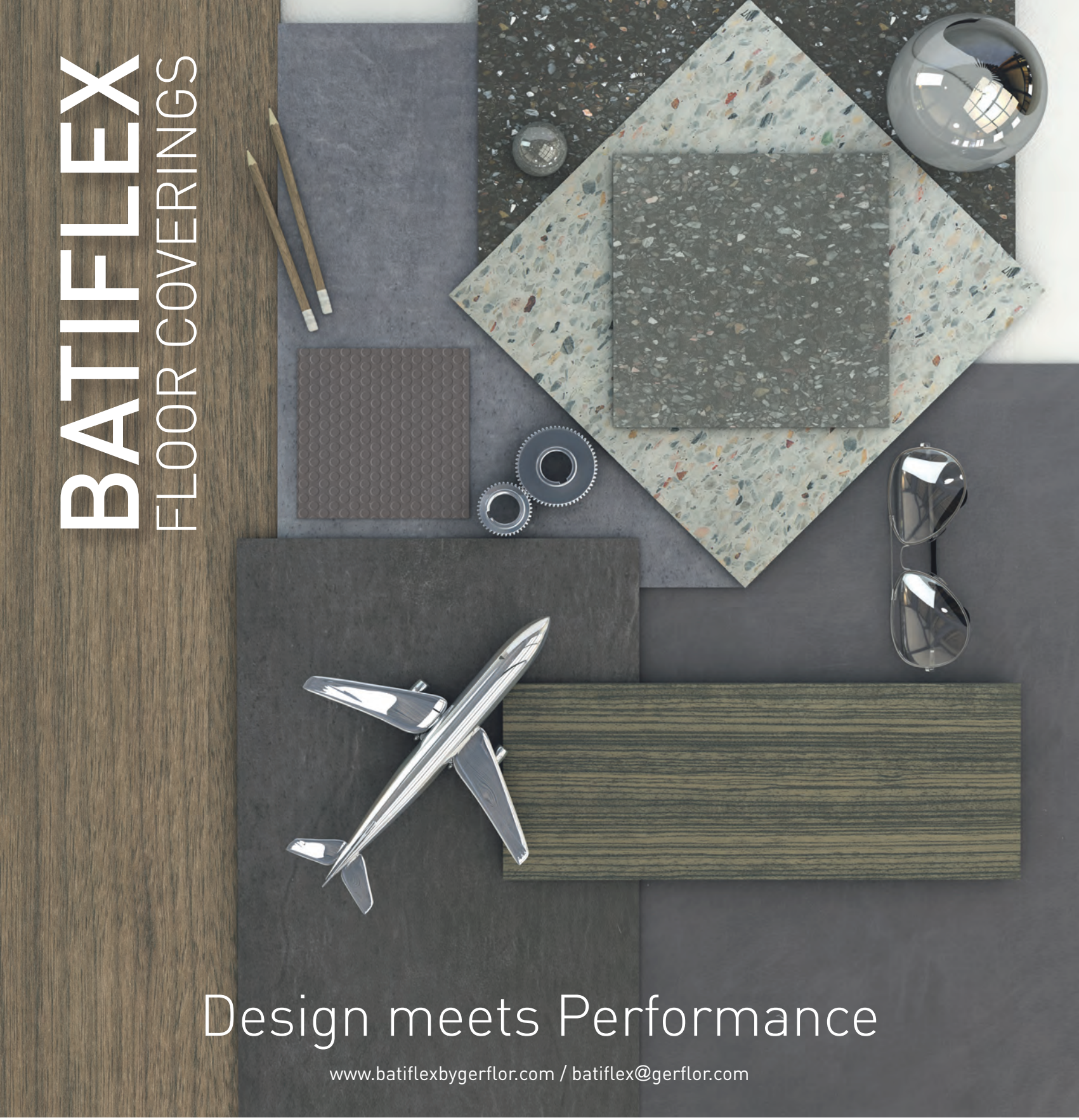

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A QUICK AND CLEVER SOLUTION TO PRESERVING ITS FLYING PROGRAM IS OPENING NEW CABIN DESIGN THINKING FOR VIRGIN ATLANTIC, AS DANIEL KERZNER, VP OF CUSTOMER EXPERIENCE, EXPLAINS

Words by Adam Gavine

A story about four ex-lease A330-200s joining the Virgin Atlantic fleet? Admittedly this deal is relatively minor compared with the 12 A350-1000s being delivered from early 2019 to replace the airline's existing A340-600s and B747-400s, but these A330s are an intriguing addition to the fleet. When these four ex-Air Berlin aircraft enter operations in November, they will not only help resolve operational issues relating to temporarily taking Trent 1000-engined Dreamliners out of operation following EASA's Airworthiness Directive – they will also increase the fleet size and present an opportunity for the airline to explore new ideas for Upper Class cabin design ahead of the introduction of the A350s in 2019, including new seating types and configurations – and double beds.

At the heart of the project is Daniel Kerzner, Virgin Atlantic's vice president of customer experience. We asked him what drew the airline to the Air Berlin aircraft in particular, given the wide range of leasing options.

"The aircraft have certain attributes that, for us, were really important," he explains. "The economy cabins have a very consistent and very solid, good economy seat product. The aircrafts' business class seats are all lie-flat and all have aisle access – attributes that our customers are looking for. The aircraft also come with wi-fi installed, which complements the rest of our fleet. Those attributes are what made these aircraft in particular attractive to us.

"We've got really exciting new products coming and coming on board the A330-200," he adds. So what's in store?

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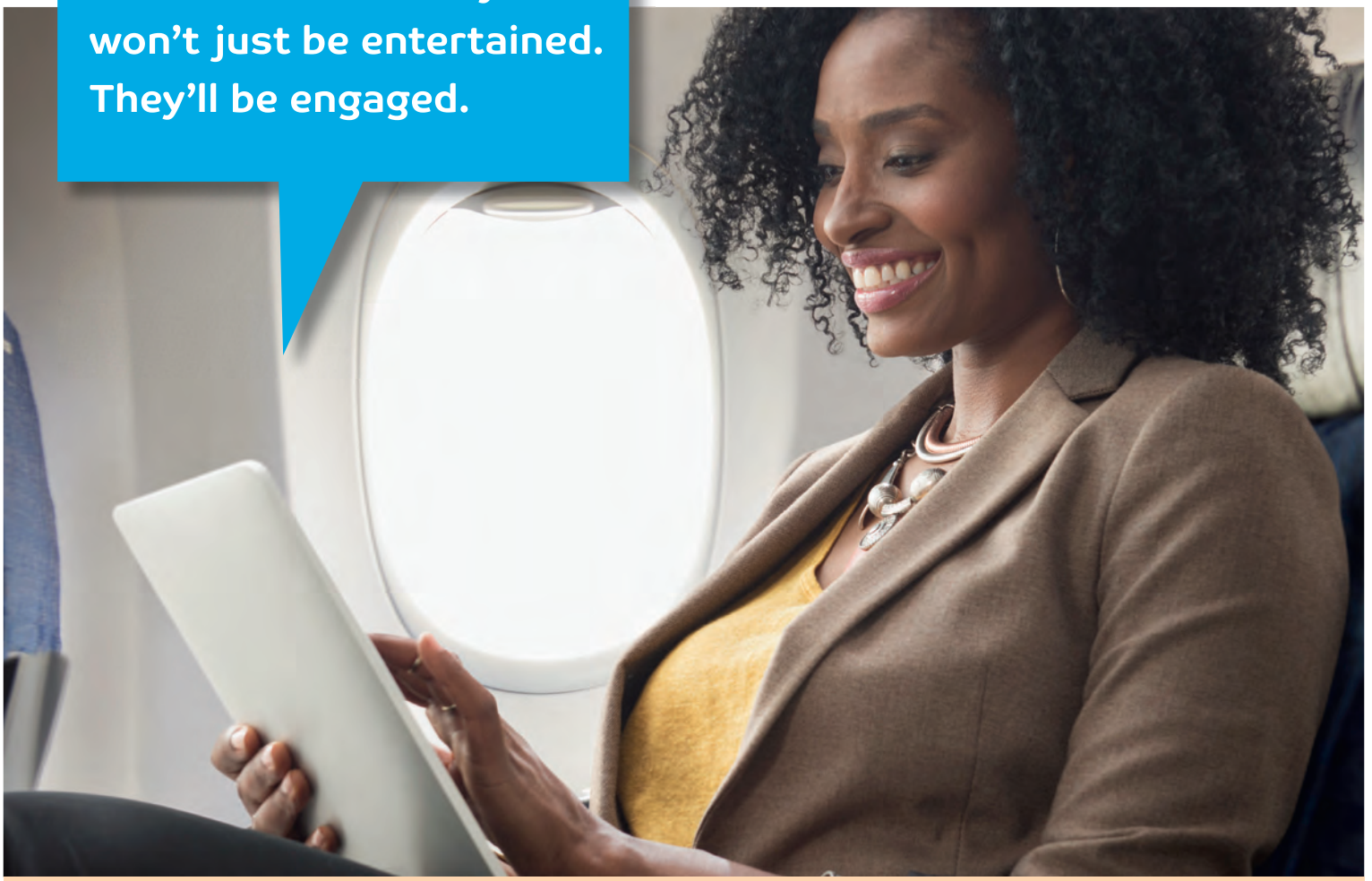

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You can almost fit an A330 inside an A350-1000 – the interior of the A350 is 221in across, while the exterior of an A330 is 222in

STRAIGHT, FORWARD SEATS

A new feature for Virgin Atlantic on the A330-200s is the installation of in-line seating rather than the herringbones usually found in the Upper Class cabins. The seats in question are the Solstys seat from Stelia Aerospace – a popular model that Air Berlin specified for these aircraft. However, while Virgin Atlantic has opted to retain this model for its operations, it is not retaining those specific seats. The airline could have refurbished the seats with its own trims and finishes, but instead opted to order new versions of the same model from Stelia. This decision raises two main questions.

Firstly, given that the airline has existing bespoke Upper Class seat designs flying on its A330 fleet, why has it not opted to fit them?

"The decision was based on what we could put on board in a short period of time [to sustain the flying program] that would to give our customers the best experience possible," explains Kerzner. "And of course there are various limitations for seat production in terms of speed to market. From my standpoint, given the options that are available to us for this aircraft, Solstys was the absolute best seat on the market that we could put on the aircraft.

"It was an opportunity to put a best-in-class seat on it that is that is consistent with the overall Virgin Atlantic experience across the fleet [once crew, service and cabin schemes are on board]. You might have a preference if you've experienced one seat over the other, but I think overall, from a customer perspective, they'll just see it as a really great premium seat that's consistent with the rest of our product."

The location of the galley further forward in the cabin also made the decision a little easier; there certainly wasn't time to move galleys to replicate the airline's existing A330 layouts.

The second question is, why install new seats and not just refurbish the Air Berlin models? "We're not looking for an easy or quick way; we're looking for what's going to provide the best experience for our customers. It's an opportunity to really think about it differently and invest in it, because it really pays off," says Kerzner.

ABOVE: THE FREEDOM SUITES OFFER EASY AISLE ACCESS

BELOW: THE BED IS DEPLOYED BY ACTUATOR RATHER THAN A MANUAL FLIP-OVER, AS ON OTHER VIRGIN ATLANTIC AIRCRAFT

LOOKING TO THE A350

The Air Berlin A330s have been a good learning opportunity for the Virgin Atlantic design team. Will any of the experience be applied in the A350s joining the fleet next year?

"There have been learnings that we wouldn't have anticipated a year ago. Going directly from a seated position into lie-flat, which is standard on most other airlines, is new for us," states Kerzner. "Is that something that our customers like or not? For us, having an incredible night's sleep on board is really important and this is helping us learn the behaviors of our customers.

"Having some variety in terms of the different types of suites is also giving us lots of learnings in terms of, if we can get the right customer in the right suite, does that provide a further elevated experience on board?

"So there's lots of learning that will influence for sure in terms of what we do in the future. We're not going to miss the opportunity to learn from this and use it, whether it's for the A350s or for refurbishments in the future. We're constantly looking at how we can lead the industry, how we can step change, how do we give our customers the best experience, and so without a doubt everything we've talked about will influence that decision in the future.

"Now, of course, the A350 is a multi-year project. I think we've already done a lot of great thinking for it, but we're always thinking about what's new and what's next, and this project just gives us more learnings from our customers in terms of how to do that.

"If we think about our A350 seats [Kerzner would not reveal details yet, but watch this space], those seats are a multi-year process in terms of development, design and certification in advance of launching next year."

achieving consistency

The new A330 interiors are clearly different from the rest of the fleet, yet distinctly Virgin Atlantic. How would Daniel Kerzner sum up this achievement?

"Although the product itself is different, the crew and the service, the amenities that we have on board, that's what our customers expect from a Virgin Atlantic experience, and that experience can be delivered with a different type of product.

"It's first and foremost our crew, who are obviously the same crew that you might have on any other Virgin Atlantic aircraft. It's the incredible service on board. It's the details and the finishes. It's the expectation around IFE and the expectation around wi-fi. It's all of those ingredients together that form the magic that I think is Virgin Atlantic, and I think that this seat in Upper Class, the introduction of the seat in premium economy, and refreshing the economy product, is giving our customers that consistent 'wow' experience that they expect."

Thus the seats are factory fresh, in Virgin trim and finish, with mild customization including additional table and stowage space.

DESIGN TWEAKS

The design team listened to customer feedback on things that they might like to see change within the seat, design tweaks which have been applied to the Solstys and which could feature in future seating product across the Virgin Atlantic fleet. For example, the cocktail table is "considerably lower" and around three-times larger than that of the usual herringbone seats in Upper Class, so that occupants now have a large table top beside them in addition to the tray table. The airline looked at how customers use the suites, and found they needed a flat surface for everything from books, laptops and cell phones, to drinks and snacks, and that having that personal space was really important.

"The seats we acquired with the aircraft didn't have that level of personal space. So we tried to take the things

ABOVE: THE LOVE SUITES ARE AN EXCITING LEARNING OPPORTUNITY FOR VIRGIN ATLANTIC

that our customers liked about the product that we acquired and some of the areas where we could enhance it even further, and that's what's that's what's coming on board with the new product," he explains.

The Solstys LOPA creates a variety of seat options in the cabin, which are being marketed using some fun names, namely Love Suites (the three doubles with central paired seats, which can form double beds), Corner Suites (window seats – Kerzner's personal favorite due to their greater privacy) and Freedom Suites (aisle seats). The

HOSTING A RAVE

The Virgin Atlantic team was happy with the RAVE IFE systems and wi-fi systems already fitted to the Air Berlin aircraft, so they are being retained, updated with Virgin Atlantic's content and GUI.

"They are great physical screens... and the quality of the system was very consistent [with Virgin Atlantic's current systems], even on the upper side of consistent. It wouldn't have been economical to change the IFE system or wi-fi on board," says Kerzner. "These were attributes that were sort of hard-coded into the aircraft, which we loved."


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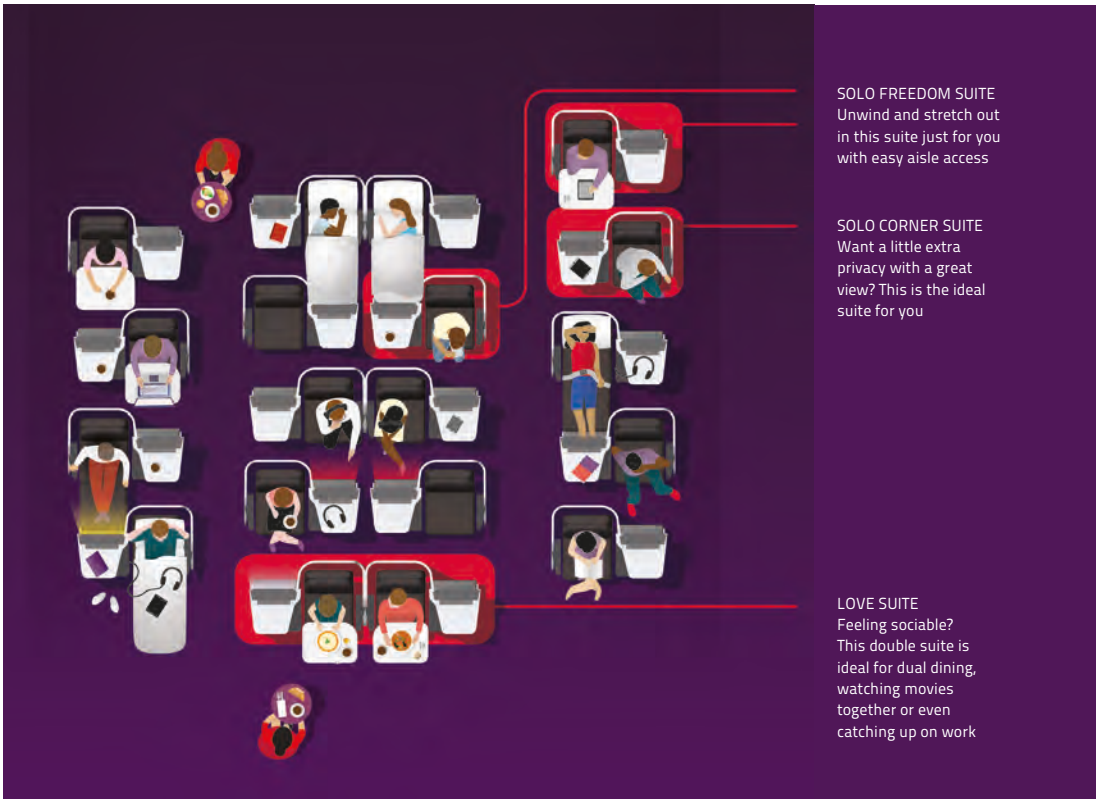

A330-200s will predominantly fly leisure routes, for which the Love Suites are well-suited as these routes have a greater proportion of couples traveling together than on its more business-focused pairs, giving a flexibility that the airline believes such customers are looking for. The airline has found that, on average, 17 customers per aircraft are celebrating a birthday within a week of travel and are probably traveling with a companion, making a more open seating design desirable.

"So how do we give them the experience that they're looking for to celebrate and enjoy their time together? The Love Suites have actually proved to be a really [popular] idea for those people traveling together with us for a special occasion," says Kerzner.

Aside from double beds being a new experience for Virgin Atlantic (apart from a brief period in 2004 – see *Back to Bed* below), going to bed is a different experience for all. The Upper Class suites on the rest of the fleet require the occupant to stand up and flip over the bed surface, but with Solstys the seat can be actuated directly into the flat position. According to Kerzner this feature has been "very well received".

The team has also found that trial customers like several other attributes of the seating layout, including the privacy of the corner suites, the forward-facing layout, and that window seat passengers have the windows right beside them, rather than at an angle.

THE A330-200 CABINS GIVE FLYERS MORE OPTIONS. THE FEEDBACK WILL BE INTERESTING FOR PLANNING FUTURE CABIN CONFIGURATIONS

"That variety was something that really struck a chord with our customers," says Kerzner.

"This is the absolute best solution we can offer our customers and offer our flying program, given the [supply] constraints that the industry is facing. So we're really proud of that because no one else is doing anything similar. We don't look too much at what the other airlines are doing – we just try to provide our customers with the best experience we can – but we haven't seen anyone else that's taking the steps we have to sustain a flying program and give a great customer experience."

SOCIAL SPACE

The double suites also help solve an inconsistency of these A330-200s compared with the rest of the Virgin Atlantic fleet: the lack of an onboard bar. Kerzner states that bars will remain a part of the Virgin Atlantic Upper Class experience for the foreseeable future, but fitting a bar to these particular aircraft was simply not feasible in the short timescale. However, couples traveling together can

BACK TO BED

The Love Suites are being introduced at a time when double beds in business class are becoming popular, being introduced by carriers including Singapore Airlines and Qatar Airways. However, Virgin was ahead of the curve, having launched the industry's first double bed in 2004 when it fitted four pairs of double Upper Class Suites on two of its B747-400s. The suites, located in the center herringbone section, remained separate until crew – upon request – unclipped the middle partition to create a 2m² shared space for seating or sleeping.

"It has been one of my long-held ambitions to have double beds on board our aircraft," said Sir Richard Branson, chairman of Virgin Atlantic, at the 2004 launch event of the doubles. These models weren't quite a true double bed – more of a double space – but Sir Richard should be happy with the new A330-200 equivalent.

enjoy each other's company more easily in these suites than the herringbone suites on the rest of the fleet, reducing the need for a social space.

"Typically at the bar you'll get those people who want to sit and engage or eat or work together and really enjoy the flight together. The Love Suites offer the opportunity to do all that. Couples or customers that want to have that social interaction can have it in the Love Suites and so I don't think [the bar area] is something that will be missed in the sense that you can still have that dual experience.

"That said, having a social space on board in a bar is something that we're definitely committed to – not now for the A330s, but as we think about our A350s and our flying program in the future, we're definitely not moving away from the idea of a bar or social space. It's something that has really separated us from the competition and we're definitely committed to the future of having a social space on board an aircraft [and considering] what it will look like, how it's evolving, how's it changing, and what our customers are looking for. That's something we remain committed to. In the case of the A330s it wasn't part of the formula, but it's something that I think we've made up for in other ways."

So what changes could we see in future social spaces? "Cocktails are a piece of it, food and beverage is a piece of it, but I think people want to have a comfortable space where they can relax, where they can have a conversation, where they can also customize the experience for themselves, whether that's reading a book or working, and using the wi-fi on board and making it an extension of the seat. "With social spaces I ultimately think about it as a continuation of that idea of how a space can be customized, whether it's the entertainment we have on board, whether it's the access to wi-fi, whether it's having different services that the crew make available to you. So I think the social space of the future won't just be a bar, it will be a space that can be used by different people in different ways at different times of the journey. Flying long haul, you're either flying overnight or you're flying during the day, and at different stages in that flight you might be looking for something different. We're really trying to curate that experience in such a way that our customers can ultimately customize it to have a different type of experience. So I think the future of social space won't be a bar, but it could be a bar if that's what you want it to be. But for someone else, it could be something different."

PREMIUM ECONOMY

One of the biggest changes to the ex-Air Berlin A330-200 cabins is that they will go from two class to three class, with a dedicated 35-seat premium economy cabin being retrofitted. Again, the airline's existing seat (a customized Zodiac Reverb model) has not been used, with the airline instead opting to fit the PC01 from ZIM Flugsitz. Seat pitch in premium economy remains 38in across the entire fleet, and customers also enjoy a dedicated premium economy food and drink offering.

"It's the first time we have flown ZIM seats and we are really excited to have this opportunity to try that seat. It's consistent with our other premium seats in terms of features, look and feel, and it's a top-of-the-line premium seat," states Kerzner.

The time constraints of the project mean the galleys will receive only minimal changes, so the Wanderwall self-service snack area introduced on the Dreamliner fleet won't feature. Kerzner gives his view of this inconsistency: "We're not changing the galleys so we won't have the Wanderwall, but we will have the Wanderwall items. What's really important for us is that service of having those items available."

RIGHT: THE PC01 SEAT FROM ZIM FLUGSITZ HAS BEEN WELL RECEIVED BY CUSTOMERS INCLUDING SINGAPORE AIRLINES

economy

The economy cabin is one of the simpler parts of the rebranding work, with the seats merely undergoing a refresh. The seats will feature seat covers in a Virgin Atlantic scheme, while the carpets, curtains and lighting are being changed, giving the cabin a look and feel consistent with other aircraft in the fleet.

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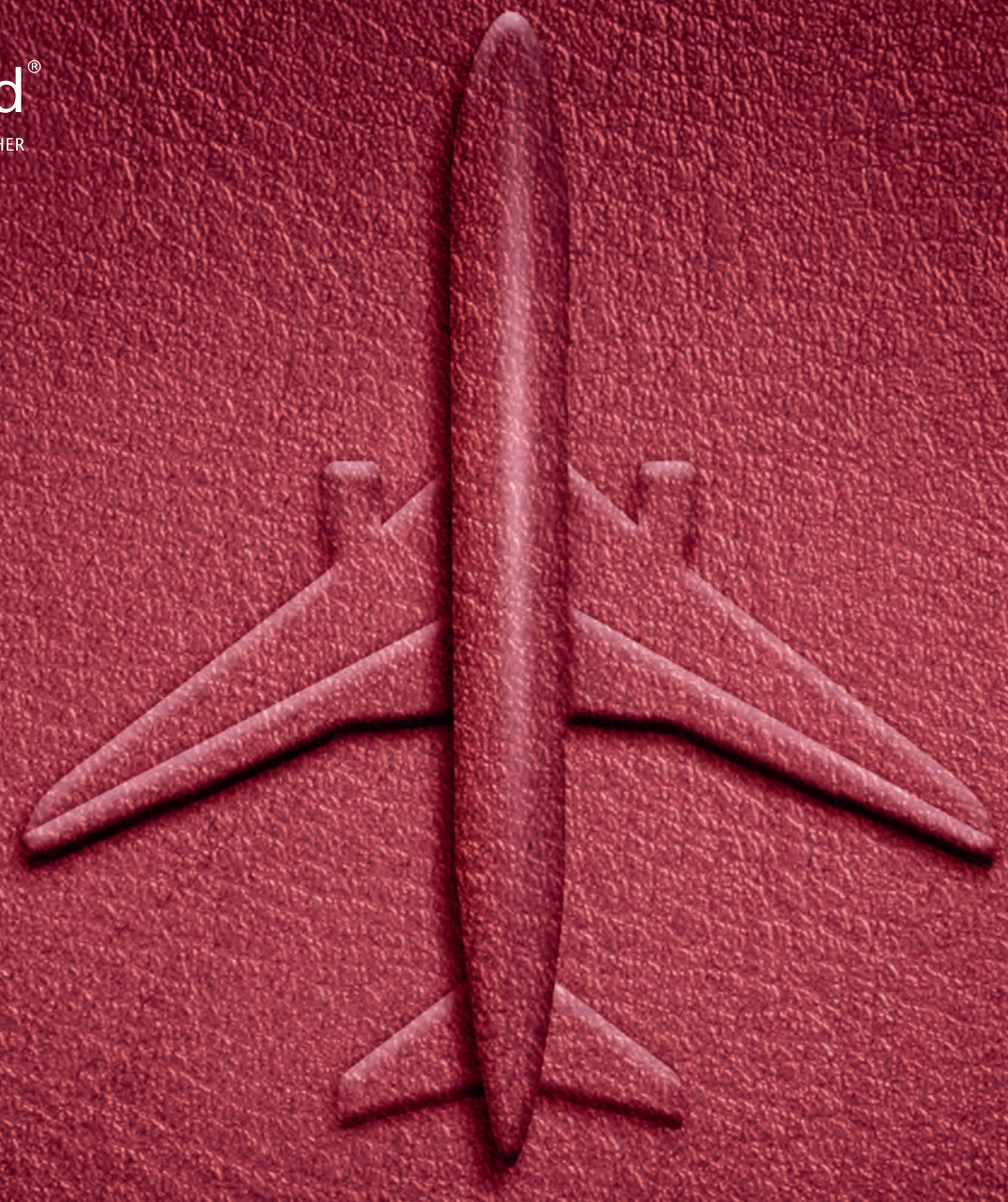

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smart monuments

Ross Burns, group industrial design manager at AIM Altitude views augmented reality (AR) as the future: "The innovation and progression of AR will have a huge impact on the way we view the aircraft and the information on board. AR has the potential to be used via passengers' personal smartphones and app technology to explore and gain information throughout the flight.

"The beauty of the technology is that the elements displayed to the passengers are not physically there, thus making this a space-saving technique for the airline. Smart monuments and discovery points could become information stops, informing the passengers of such things as vital flight information through a large revolving flight globe, nutritional data from the snack bar, or even airline facts relating to key brand features and statistics.

"The way we interact with our personal devices is the key to opening a new window of information to a wider audience."

ORIGINAL THINKING

No feature about moving maps is complete without mention of Airshow, the original system launched by Rockwell Collins in 1982. The system has been continually evolving for more than 30 years and now includes features such as the latest global satellite imagery, including a hands-on interactive map experience that can be viewed on PEDs, including a Panorama app, which can use a tablet's gyroscope functionality to see map views as if looking through a transparent cabin.

Further developments include a high-resolution 3D interactive map that can show everything from a preview of the flight path, 360° views around the aircraft; and view options including window seat or a HUD (head-up display) that pitches and rolls with the aircraft; a prayer room function that displays the Salat prayer times and an indicator that points in the direction of Mecca.

Rockwell Collins has ideas for the future Airshow road map, which include enhancing portable devices with AR maps showing major points of interest (POI) along the flight path, with the ability to accommodate street maps and themes. 3D will also play a big part, with a map engine due to be integrated to support 3D holographic projections of aircraft – customized to the airline – flying over the globe and its flight path, 3D POI pop-ups for major landmarks throughout the flight, and interactive navigation of the 3D hologram map via an app.

make it personal

Design studio Tangerine sees the interactive, holographic map as a way to create a playful environment that can use data from customer preferences to help them plan their journey, with personalized suggestions and POIs.

The studio envisages that popular destinations and social media activity from customers could also be shown on board to grow their brand community. The concept presents airlines with an opportunity to add additional revenue channels through online partnerships.

The idea also explores how a projected display system could show cabin and flight information in a interactive and stimulating way. The system creates a heads-up experience that encourages engagement between passengers and their wider environment. Running throughout the plane, the visual system provides interactive journey information, unlocking additional value from an otherwise underutilized space. It could also provide an opportunity for airlines to create a consistent brand across their aircraft.

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lose windows, gain maps

CCD is a London-based practice that focuses on understanding human behavior to improve design. Work includes systems, products and physical environments, with clients including Bombardier, British Airways and easyJet.

Challenged with creating moving map ideas, the studio came up with three schemes. First up was a window-based concept.

CCD noted that Emirates has begun to explore the idea of windowless first class, with the center suites in its new B777 cabins featuring screens that live-stream the outside view, giving the effect of a window. It has been suggested that this could be a starting point toward removing aircraft windows and replacing them with a system of screens.

"But how can we further revolutionize the concept of an aircraft cabin and advance the moving map concept while delivering an immersive, unparalleled passenger experience?" asks Chris Girling, head of wayfinding at CCD.

"We propose to replace all windows with screens live-streaming the view. AR will bring the moving map to life. As the plane passes over countries, POIs will pop up from the map, giving a sense of depth, and much more – the options are vast.

"This intervention is optional, personalized, and tailored to the user's needs and interests. This service would mostly benefit the window seat, meaning the carrier could charge a premium for it."

IMMERSIVE OLED

The second idea by the CCD studio is immersive OLED screens, which would enable passengers to experience a customized journey from the comfort of their own seats. Using OLED technology, passengers can experience a 180° augmented journey, bringing the moving map to life.

In CCD's vision, an OLED screen can be rolled down vertically from above the seat, then horizontally, and passengers can immerse themselves in both the moving map and the IFE system.

"As OLED is flexible, passengers will be able to warp the screen to suit their requirements. The use of holographic technology will also enable passengers to bring specific things to 'life' from the comfort of their seat," states Chris Girling.

"This also has the scope to be a truly sensory experience by including directional speakers, responsive air jets and even olfactory elements."

More immersive IFE ideas and insight on p112

innovation underfoot

CCD's third idea is a concept for the cabin floor. "The ceiling and floor midsections of plane interiors are underutilized spaces in the cabin," says Chris Girling. "Our concept proposes to use these in complementary ways to inform passengers of their journey progress and also to adapt their body clock in preparation for their destination."

The concept sees the ceiling act as a day-night sky simulator using screens paired with dusk-dawn simulation lighting. This would naturally and subconsciously aid passengers in adjusting to time zones.

A central strip of screens would also run along the floor to showcase the moving map. This would be a real-time representation of the flight progression and highlight the entirety of the journey from start to finish.

"While the overhead sky simulator will appear authentic to manipulate and sync passenger's body clocks, the moving map has been created in a less realistic style to avoid vertigo and fear," he says.

maps move their own way

"Airshow or moving maps have been an important feature for connecting passengers with the flying experience," says Cristian Sutter, a cabin design specialist at British Airways. "Having said that, it has been very much a captive feature, with no options for passenger interaction."

Sutter predicts that future moving maps will break the IFE dependency and become more standalone, being displayed over bulkheads at entrance or social areas via light projection technology.

Going a step further, he predicts that the use of AR will eventually replace in-seat embedded IFE and will allow images of landmarks the plane is flying over to be overlaid onto the windows and seatback areas. "Passengers will be able to interact with the displayed content and even transfer it to their personal smart devices," adds Sutter.

Making a booking at the ski resort you're flying over, or buying tickets for the London Eye while it is displayed on the approach to Heathrow, are just two examples of the endless ancillary revenue opportunities that his vision could facilitate.

"Regardless of the technology that will be used to bring them to life, future interactive moving maps will evolve from the current limited visual mapping feature to playing a pivotal role in the connected passenger flying experience."

HARMONIOUS THINKING

Airbus Corporate Jets (ACJ) has created Harmony, a wide-body cabin design concept initially proposed for the ACJ330neo, which builds on the Airspace cabin brand from Airbus's commercial aircraft operations and features a rather special idea for the future moving map.

A holographic globe, showing the aircraft's position, greets entering passengers. Harmony can also suit other Airbus wide-bodies, such as the ACJ350.

"Harmony is a timeless and elegant design concept, because we dare to break the conventions that are traditionally imposed on us as cabin designers," says ACJ head of creative design Sylvain Mariat. "Our creativity needs to be unique to fit the needs of our customers.

Quick thinking

James Tanner, an associate at Factorydesign, has had some ideas inspired by recent supersonic aircraft concepts such as Airbus's Concorde II concept, estimated to be capable of flying at almost twice the speed and altitude of the original Concorde.

After boarding, passengers would enjoy a glass of champagne as the safety briefing is conducted by a crew member (there would be no IFE system – too much unnecessary weight), and then begin the taxi to the runway.

Take-off would be like any other, as conventional jet engines ease you into the air. Once airborne the captain announces that arrival time will be in just under one hour, and to prepare for supersonic flight. The rocket engines deployed, the aircraft lifts its nose into a vertical ascent, taking it through the sound barrier.

Ramjets take over from the rockets as the aircraft levels out at an altitude of 98,400ft (higher than a U2 spy plane). As the aircraft accelerates up to four and a half times the speed of sound (3,500mph; 5,630km/h), your seat will rotate toward the window, revealing spectacular views of Earth below.

At this height you can see the line between day and night, and the only people higher than you would be the astronauts manning the ISS. You will have just enough time for another glass of champagne with the view (which would be supplemented with projected augmented reality information about the flight), before starting your descent.

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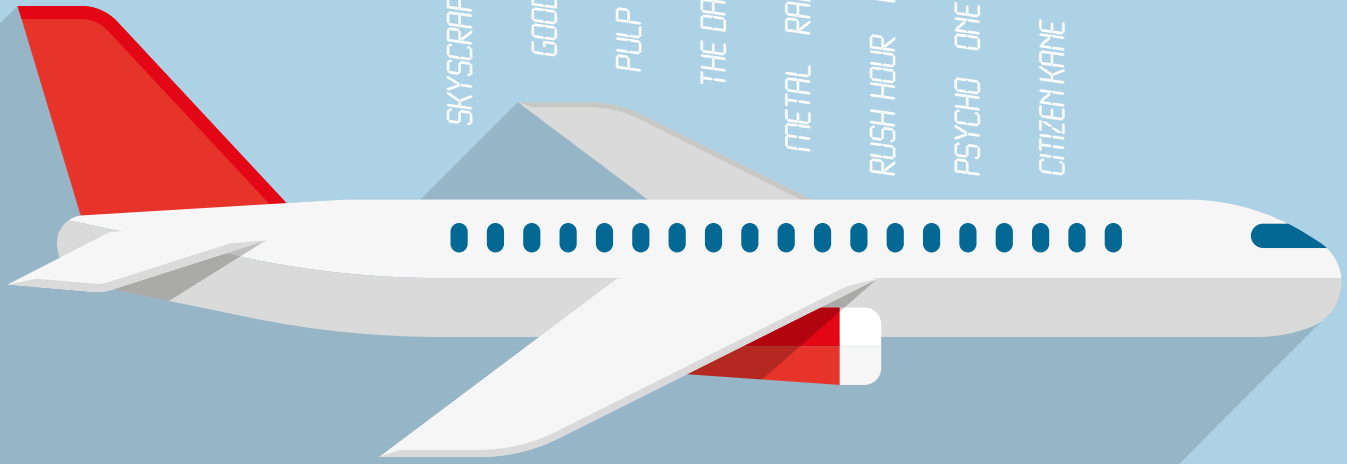
CLOUD COMPUTING IS BECOMING A MAJOR FACTOR IN IFE CONTENT DELIVERY. THIS IS THE INSIDE STORY OF THE POST-PRODUCTION PHASE OF A CLOUD-BASED IFE CONTENT DELIVERY SYSTEM, AS DESCRIBED BY ONE OF THE CONTRIBUTORS TO ITS ARCHITECTURE, MICHAEL CHILDERS

PSYCHO
ONE FLEW OVER THE
CUCKOO'S NEST ▶ JAWS IT'S
A WONDERFUL LIFE GOODFELLAS ■
BLUES BROTHERS GLADIATOR FIGHT CLUB
DIE HARD RUSH HOUR BRAVEHEART ▶▶ BACK TO THE
FUTURE ▶▶ APOCALYPSE NOW A CLOCKWORK ORANGE ♫
ROCK STAR WARS ALIEN 🎧 JURASSIC PARK ⏸ HOUSE THE DARK
KNIGHT ◀◀ E.T TAXI DRIVER TOY STORY INSTRUMENTAL CITIZEN KANE
THE SHAWSHANK REDEMPTION ■ CASABLANCA 📽 MOTION PICTURE
JAZZ REGGAE ▶ FORREST GUMP SCHINDLER'S LIST PULP FICTION ⏸
AVATAR INCEPTION TITANIC WAR HORSE METAL RADIO COUNTRY SAVING
PRIVATE RYAN MUSIC GREASE LINCOLN FUNK ⏸ INCREDIBLES POP ▶▶ SKYSCRAPER 🎧
CLASSICAL OCEAN'S 11 ▶▶ PADDINGTON ROCKY PULP FICTION MIRACLE ON THE HUDSON ♫
HIP HOP FLIGHT THREE BILLBOARDS OUTSIDE EBBING, MISSOURI THE SHAPE OF WATER GLADIATOR ♫
BLADE RUNNER HIP HOP GUARDIANS OF THE GALAXY DANCE THOR: RAGNAROK DISCO STAR WARS 🎬
🎧 ROCK WONDER WOMAN LA LA LAND MANCHESTER BY THE SEA ◀◀ HOUSE THE BIG LEBOWSKI
BLACK PANTHER IRON MAN ■ SINGIN' IN THE RAIN THE GODFATHER INSTRUMENTAL ▶ THE JUNGLE
BOOK ♫ THE WIZARD OF OZ METROPOLIS IT HAPPENED ONE NIGHT MOTION PICTURE SOME LIKE IT HOT
JAZZ ◀◀ THE LORD OF THE RINGS BABY DRIVER SLUMDOG MILLIONAIRE ⏸ FERRIS BUELLER'S DAY
OFF JURASSIC WORLD DIE HARD MISSION: IMPOSSIBLE HEAVY METAL RADIO COUNTRY
🎬 MEMPHIS BELLE MUSIC THE USUAL SUSPECTS MILLION DOLLAR ARM 📽 FUNK
TERMINATOR [illegible]LASSICAL THE RIGHT STUFF ♫ EQUALIZER COOL HAND LUKE

ng

SKYSCRAPER CLASSICAL LINCOLN OCEAN'S 11
GOODFELLAS POP BLUES GLADIATOR
PULP FICTION AVATAR INCEPTION ALIEN
THE DARK KNIGHT TAXI DRIVER TOY STORY
METAL RADIO COUNTRY SAVING PRIVATE RYAN
RUSH HOUR BRAVEHEART BACK TO THE FUTURE
PSYCHO ONE FLEW OVER THE CUCKOO'S NEST JAWS
CITIZEN KANE THE SHAWSHANK REDEMPTION TITANIC



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"Service providers are combining cloud storage and processing with increasing amounts of automated workflows"

IS THE CLOUD SECURE?

Is content secure in the cloud? The cloud moves content security into a virtual space, where locks, doors and security cameras are replaced by encryption, firewalls, and DRM-managed access controls.

While large amounts of content delivery to consumers have moved into the cloud in recent years, in-flight entertainment – which is consumed in a different kind of cloud – is delivered mainly on the ground. Although large multinational companies like the major US motion picture studios, and over-the-top (OTT) providers such as Netflix and Amazon Prime, are using the cloud to make content available to consumers anytime, anywhere, IFE content delivery is still largely stuck in the same old 45-60-day delivery cycle, using workflows that were established for physical delivery media.

But as the Airline Passenger Experience Association's (APEX) Technology Committee undertook a major content delivery ecosystem initiative in 2015 that moved the IFE industry to the cloud's doorstep, a group of companies – Amazon Web Services (AWS, a subsidiary of Amazon.com), castLabs, Venera Technologies and Lufthansa Systems – were being aggregated to a proof of concept to go to the next step by moving that ecosystem into the cloud.

For those who may still be a little cloudy in their understanding of the cloud, this term refers to a decentralized approach to computing. The cloud enables remote content storage and computing power in a connected environment. Some say that the cloud is a metaphor for the internet.

Essentially, it means that rather than storing and processing content entirely on a limited supply of hard drives and servers physically located in specialized post-production facilities – where, in IFE, most of the work is performed during a period of around one week each month –storage and processing are distributed among thousands of secure data centers where work can be easily spread for greater efficiency and faster processing.

A very important element of the on-demand cloud computing platforms – such as AWS – that have emerged in the past few years is that service providers are combining cloud storage and processing with increasing amounts of automated workflows and processes that increase speed and efficiency exponentially.

Media and entertainment companies were among the earliest adopters of cloud computing. Netflix, which began with postal DVD rental, was 100% cloud-based by 2012 and is among the largest customers of AWS.

Cloud computing is an IT concept, so it is easy to see why airline IT specialist Lufthansa Systems would look to the cloud for a content delivery network that supports its BoardConnect wireless IFE systems. Moving the entire IFE industry into a broader content delivery ecosystem was also a major objective of APEX.

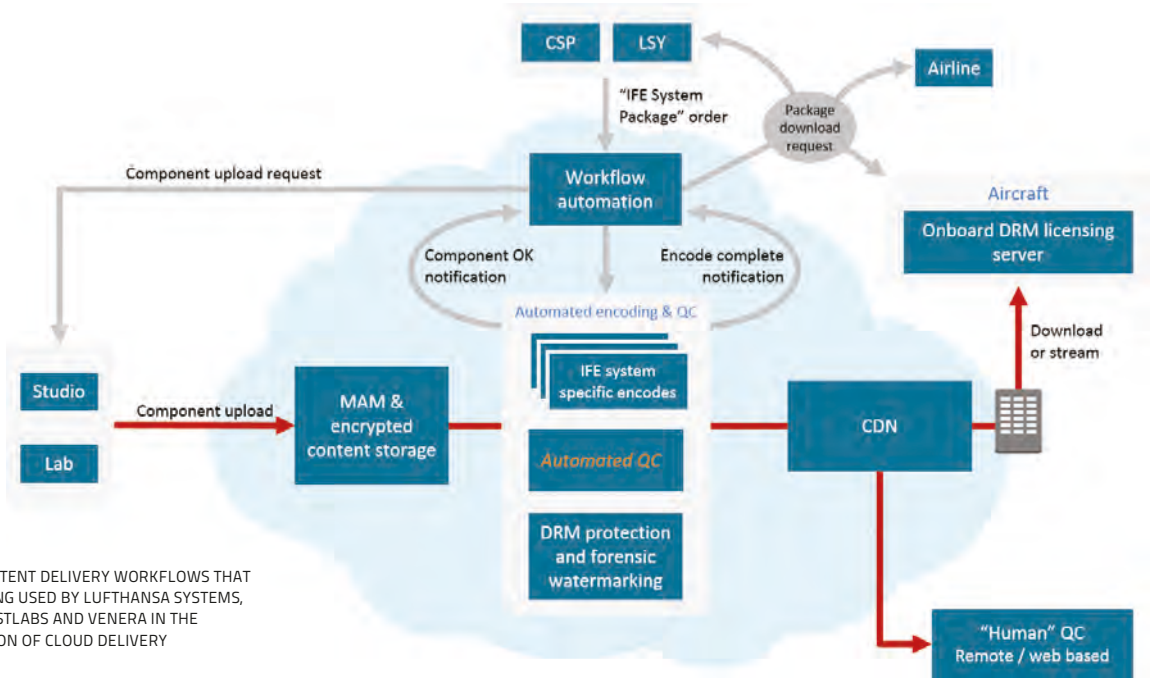
The development of the cloud-based content delivery ecosystem was undertaken at the same time that the APEX 0415 Working Group was establishing the new IFE content delivery specification that moved the industry into the use of the Common Media Application Format (CMAF) and into the broader content industry ecosystem. APEX 0415, the 'Media & Device IFE Ecosystem Specification', was completed in June 2017 and approved by the APEX board.

The first big step into the cloud, a convincing proof of concept, was soon achieved. For more than three years, Lufthansa Systems has implemented a cloud-based content delivery platform for some of its BoardConnect clients on which several hundred files each month are processed and delivered.

RUSH HOUR BRAVEHEART BACK TO THE FUTURE SKYSCRAPER CLASSICAL LINCOLN OCEAN'S 11
AS POP BLUES GLADIATOR
IGHT TAXI DRIVER TOY STORY

FOX TEAMS WITH AMAZON

In July 2018, 21st Century Fox announced it will use Amazon for the "vast majority" of its cloud operations. 21st Century Fox will use AWS as the primary platform to deliver over 90,000 titles on demand for key brands such as Fox, FX, National Geographic, 20th Century Fox Television, 20th Century Fox Film, and Fox Sports.



THE CONTENT DELIVERY WORKFLOWS THAT ARE BEING USED BY LUFTHANSA SYSTEMS, AWS, CASTLABS AND VENERA IN THE EXECUTION OF CLOUD DELIVERY

The content delivery process begins with the delivery of a 'mezzanine file' – a digital master that is used to repurpose the file into copies of video for streaming in accordance with the system specifications. The files are then transcoded (encoded to multiple bitrates) by castLabs, to optimize display on a range of devices, and sent via secure VPN to Lufthansa Systems' Content Integration Center.

With transcoding, the cloud helps in repurposing content on varied devices, improving content delivery on all mediums.

One of the first decisions that Lufthansa Systems needed to make was whether to use a platform like AWS in-house, or to utilize a service provider. AWS comprises dozens of services spanning a wide range including computing, storage, networking, database, analytics, application services, deployment, management, mobile, developer tools, and tools for the Internet of Things.

To make this decision, Lufthansa Systems held meetings with AWS during the NAB Conference in Las Vegas in April 2014, and subsequently with Michael Stattmann, CEO and founder of castLabs, a cloud services company founded in 2007 with offices in Berlin and Los Angeles. castLabs utilizes AWS, and was well-established with entities such as the Digital Entertainment Content Ecosystem (DECE), and other thought-leaders in IFE content delivery.

The two companies reached agreement to develop the necessary workflows among AWS, castLabs and Lufthansa Systems. Mezzanine files were obtained on selected

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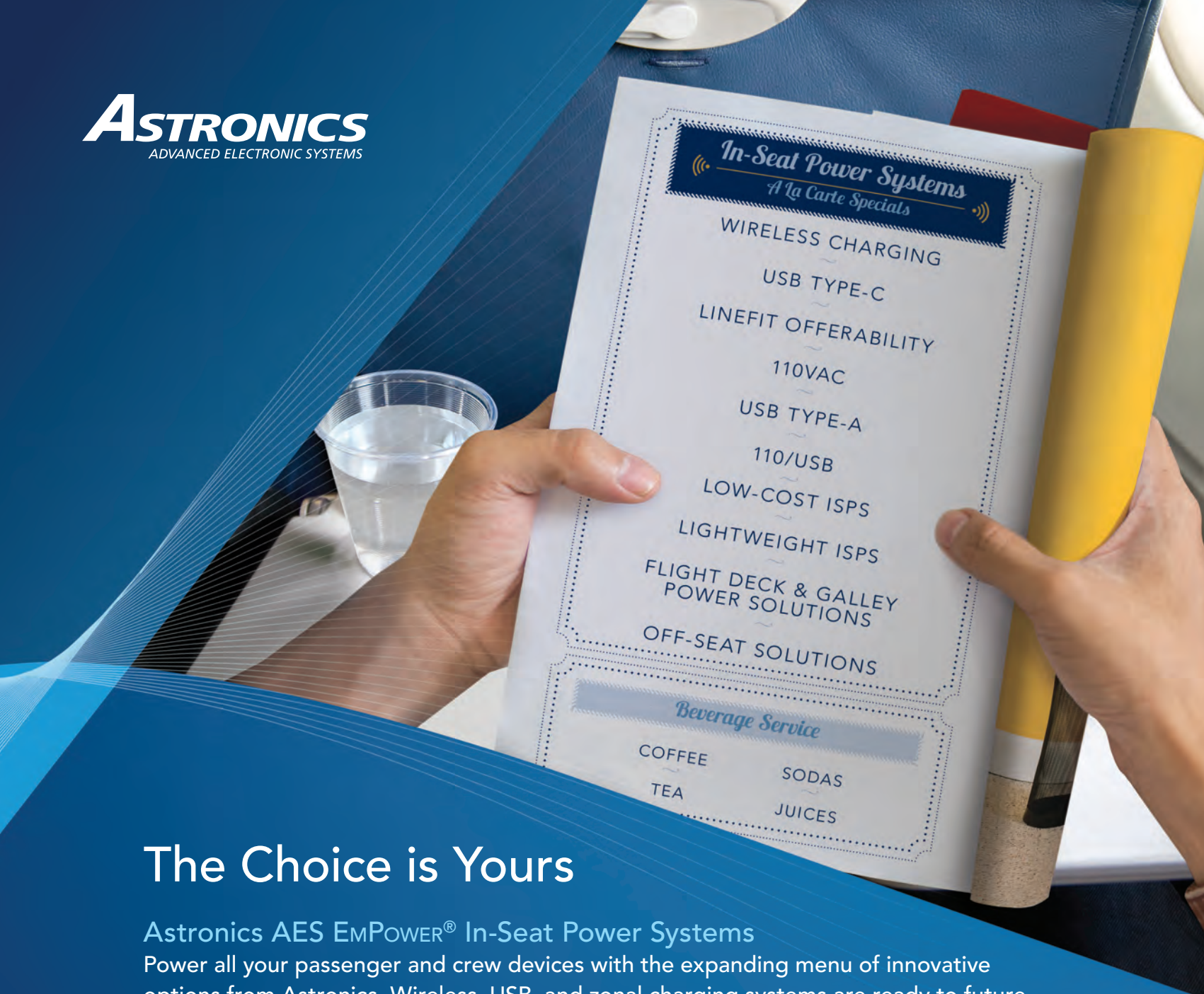

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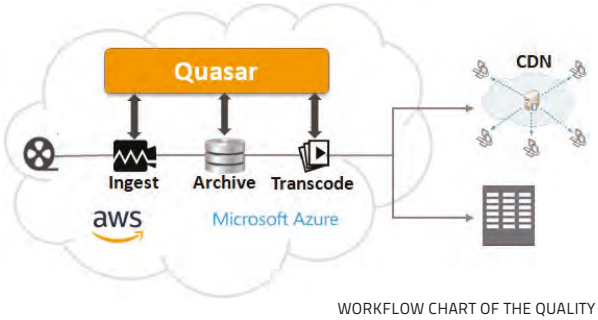
"The future will include increased automation of the supply chain"

ABOUT THE AUTHOR

Michael Childers launched LightStream Communications Group in 1996 with the objective of automating and integrating the IFE content delivery supply chain, and ran that organization as president and CEO for five years. He became an independent content management consultant in 2001, and between 2006 and 2009 was managing director for content and media strategy at The IMS Company. He has been chief consultant, content and media strategy for Lufthansa Systems for seven years. He is in his fifth year and third term on the board of directors of APEX and is chair of its Technology Committee.



WORKFLOW CHART OF THE QUALITY CONTROL PROCESS FOR CLOUD DELIVERY

content and sent to castLabs for transcoding into the BoardConnect profile. This began with the MPEG-4 codec and has continued via a migration into the MPEG-DASH codec. castLabs also provides a Digital Rights Management (DRM) licensing server (DRMToday) for content security, and has developed the media player used by Lufthansa Systems in its wireless offerings.

The high degree of automation that is involved from both AWS and castLabs quickly resulted in faster processing and lower costs. The cost of typical IFE files transcoded the traditional way is generally measured in the hundreds of dollars (or more), whereas the cost of the highly automated cloud-based transcoded files is measured in the tens of dollars.

Various approaches to quality control were trialled, mostly manual approaches at first. But as the APEX 0415 Working Group attempted to move IFE into the broader content delivery ecosystem, a few companies offering automated quality control services joined that effort.

One of these companies, Venera Technologies, founded in 2003, launched a cloud QC solution (Quasar) in 2016, which works seamlessly with AWS, Azure and Oracle, and with OTT workflows. Venera Technologies, castLabs and Lufthansa Systems are currently launching a trial for the integration and use of this cloud QC solution in the ecosystem. Mezzanines will be QC'd in the cloud prior to transcoding by castLabs, and the transcoded files QC'd in the cloud before being sent to Lufthansa Systems' Content Integration Center.

In June 2018, AWS, castLabs, Venera Technologies and Lufthansa Systems revealed their proof of concept to the industry during the APEX Tech conference in Los Angeles and will be discussing it further during APEX Expo in Boston in September 2018 at the pre-Expo Educational Day and on the exhibition floor.

So what's next? For the consortium of companies that has taken the first big step into the cloud, the future will include increased automation of the supply chain, more sophisticated data analytics, refined content metadata, and integration of more sophisticated advertising placement and delivery.

For APEX and the IFE industry, it means further streamlining of the IFE ecosystem and content delivery supply chain, including the ability to access the Interoperable Master Format (IMF) files from content providers, and the development of advertising delivery specifications for the industry. APEX will also work with the Consumer Technology Association – the organizer of the Consumer Electronics Show – to move the industry into the Web Application Video Ecosystem (WAVE).

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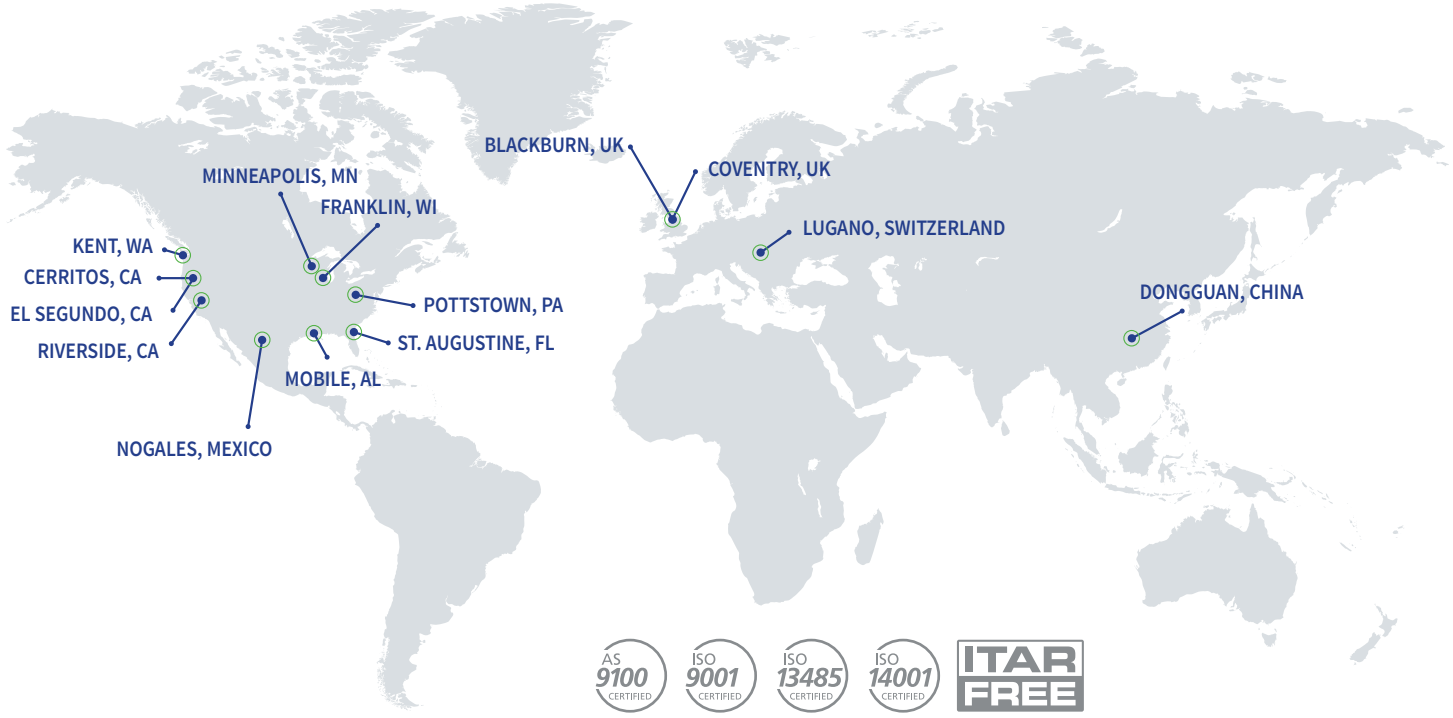

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THE OCTASPRING CONCEPT WON A 2017 CRYSTAL CABIN AWARD IN THE MATERIAL & COMPONENTS CATEGORY

Millions of people experience airline seat foams for hours and rarely give them a second thought, unaware that the foams in the pan, back and headrest of their seats comprise many carefully selected ingredients including hydrocarbon polymers, carbon dioxide and flame retardants.

All foams, sophisticated or not, begin with a polymer that is derived from oil and gas industry products. This polymer is a hydrocarbon, usually either a polyethylene or polyurethane. Polyethylene is the most common plastic, used to make items such as shopping bags and detergent bottles. It is an extruded plastic and for aircraft seating is used to create a plasticized foam, also known as a flotation foam, because it is buoyant and means that seat cushions can be used as flotation devices in the event of a water landing. Polyethylene has commonly been viewed as a heavy material, with James Barrett, vice president at seat cushion maker Aerofoam Industries, stating that its density is 2.2 lb/ft^3 on average, although his company has managed to bring that down to 1.39 lb/ft^3.

Polyurethane, on the other hand, is used for items such as shoe soles, electrical equipment insulation, artificial heart valves and non-flotation cushion foams. Whichever polymer is used, the density of the resulting foam is determined during manufacture by the amount of carbon dioxide (CO_2) that is pumped into the mix. The density will help determine the ILD and IFD characteristics (see p94).

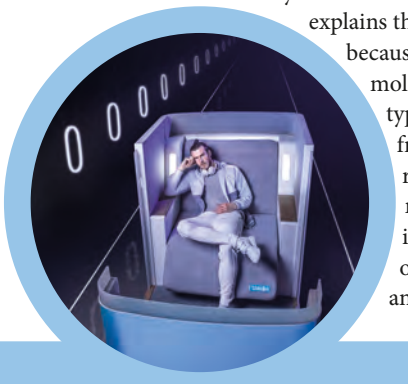
As Jocelin Laborde, president of seat component manufacturer Axyal, explains, "With more CO_2 there will be more pressure, and you will put less polyurethane or polyethylene product in, so you will have a lower density."

"There have been efforts to move from oil-based polymers"

BIOLOGICAL WARFARE

There have been efforts to move away from oil-based polymers to plant-based oils. A European Union project that ended in 2015 examined how to produce seat foam. Called FIBIOSEAT (FIre resistant BIObased polyurethane foam for aircraft SEATing cushions), it produced what its final report describes as "a green polyurethane foam containing 30% in mass of bio-based polyol".

Axyal was the company that led the work. Laborde explains that as well as a greener source of oil, because the foam cushion was injection-molded, there was less waste than the typical process when a shape is cut from a large mattress of foam, resulting in waste. The FIBIOSEAT manufacturing process involved injection-molding the plant-based oil, mixed with other key substances and pumped with carbon dioxide to



GARETH BALE'S SECRET

International sportspeople need consistent sleep for on-field performance, but they also do a lot of commercial air travel. Indeed Gareth Bale, a professional soccer player who plays for Real Madrid and the Wales national team, travels a lot between these areas, as well as many other international cities to attend games, and he needs sleep: more than most people, as research has found that sleeping for 10 hours per night can lead to nearly a 10% increase in shot accuracy and reaction times.

He expressed his desires to mattress manufacturer Simba Sleep, which saw an opportunity to create a technologically advanced inflight sleep experience. The result, after more than six months of prototyping and consultations with an in-house psychologist, is the engineering of the Simba Air-Hybrid, an advanced airline seat that promises the ultimate sleep environment for those with a demanding travel schedule.

The design combines the brand's mattress technology, featuring a fusion of 2,500 conical pocket springs and responsive memory foam. Gentle automatic adjustments recline the seat to a 'zero-g' position. This closely simulates weightlessness, which eases pressure on the back and spine while dissolving strain from the extremities. Blood can then move freely through the body, improving circulation.

According to Simba, the response to the mattress has been so positive that it has begun conversations with commercial and private airlines.

control the density. This is then allowed to cool down in the mold at a controlled rate.

The density and sponginess of the foam is not the extent of the science behind the perfect seat cushion, and there are ways to tweak the performance characteristics for a range of factors such as body heat. "Temperature regulating technology can be added that to the foam material so it acts as a heat-sink to regulate body temperature, preventing heat spikes or cooling spikes," says Barrett. However, this is typically only used for foams that are in business class, first class or premium economy.

ABOVE: THE AERAS ECONOMY SEAT PROJECT AIMS TO IMPROVE COMFORT BY REDUCING PRESSURE POINTS, STIMULATING THE BACK AND TRUNK MUSCLES, AND ALLOWING THE PASSENGER TO ADOPT ANY SITTING POSITION INTUITIVELY

BELOW: AEROFOAM HAS IMPREGNATED ITS CARBONADO VISCOELASTIC MEMORY FOAM RANGE WITH DIAMOND CRYSTALS DUE TO THEIR THERMAL CONDUCTIVITY PROPERTIES

STITCH PITCH

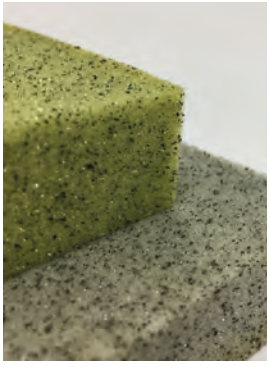
Comfort and materials specialists at Greiner Aerospace have been developing something slightly different in the seating sector over the past five years. The team, in cooperation with the Ludeke Design studio and Kobleder, a specialist in knitting technologies, have created the Aeras seat. What makes this seat different from other aircraft seats is that the high-tech knitted design is claimed to be approximately one-third lighter than a conventional cushion and cover combination.

At the same time, the partners say that passenger comfort is enhanced due to the seat's ability to adapt to various body sizes, shapes and weights, giving support in all positions while reducing pressure points. The knitted structure also offers good microclimate properties due to its air permeability.

THE ACADEMIC VIEW

Before sophisticated temperature control is applied, the main consideration in foam design is how it responds to the weight of a person. "Foams are polymers, made up of fundamental building blocks called monomers. These are generally joined together in long chains," explains Herodotos Phylaktou, a researcher at the University of Leeds School of Chemical and Process Engineering.

"The chains can be quite separate from each other with very little cross-linking, and this makes the polymer soft." This results in the foam flattening and seated comfort declining over time.



This structure can also be described as cellular, with vertical contact points from one cell to another through the foam from top to bottom. According to Phylaktou, the simplicity and limited number of links in this structure is controlled during the manufacturing process by the addition of new elements and the conditions of the manufacturing process, for example temperature or pressure. What is needed is a high level of cross-linking between the chains to make the material more resilient.

Another way of looking at this is that the aforementioned cell structure of the foam is non-uniform with many contact points between the cells. This is

Stacks of comfort

Many passengers do not realize that the foam they sit on is far removed from the airline seat of yesteryear. Back then, some seat suppliers were also domestic furniture makers, and the cushion materials in the aircraft cabin could also be found in people's living rooms. Foams for airline seats improved over time to better suit their use, with single foam pieces cut from manufacturers' large slabs to the shape of the seat's pan, headrest and back, in what was called a monolithic build.

"Back in the day, most cushions were a monolithic build, where they would just have a single ILD [indentation load deflection] or IFD [indentation force deflection]," explains James Barrett at Aerofoam Industries.

Improvements for comfort led to the application of a stack of foams, each of which would bring a different performance characteristic to the seat and the passenger's experience. "You have a progressive stack of varying ILDs to build comfort," Barrett explains.

It is the deflection of the foam material – how it deflects against the passenger's body weight – that is the basis for that sense of comfort. Another factor in seat comfort is simply the size of the pan. Creating comfort for a first class or business class seat is ultimately easier than in the economy cabin because the area is larger. "What happens up at the front of the airplane is you have more space to work in, so in theory, you could create more comfort," adds Barrett.

However, seats with lie-flat beds represent another foam challenge. If an airline uses conventional foam materials, the passenger may have comfort in the TTL position or in the lie-flat position. With more sophisticated foams, a seat can be comfortable in every position.

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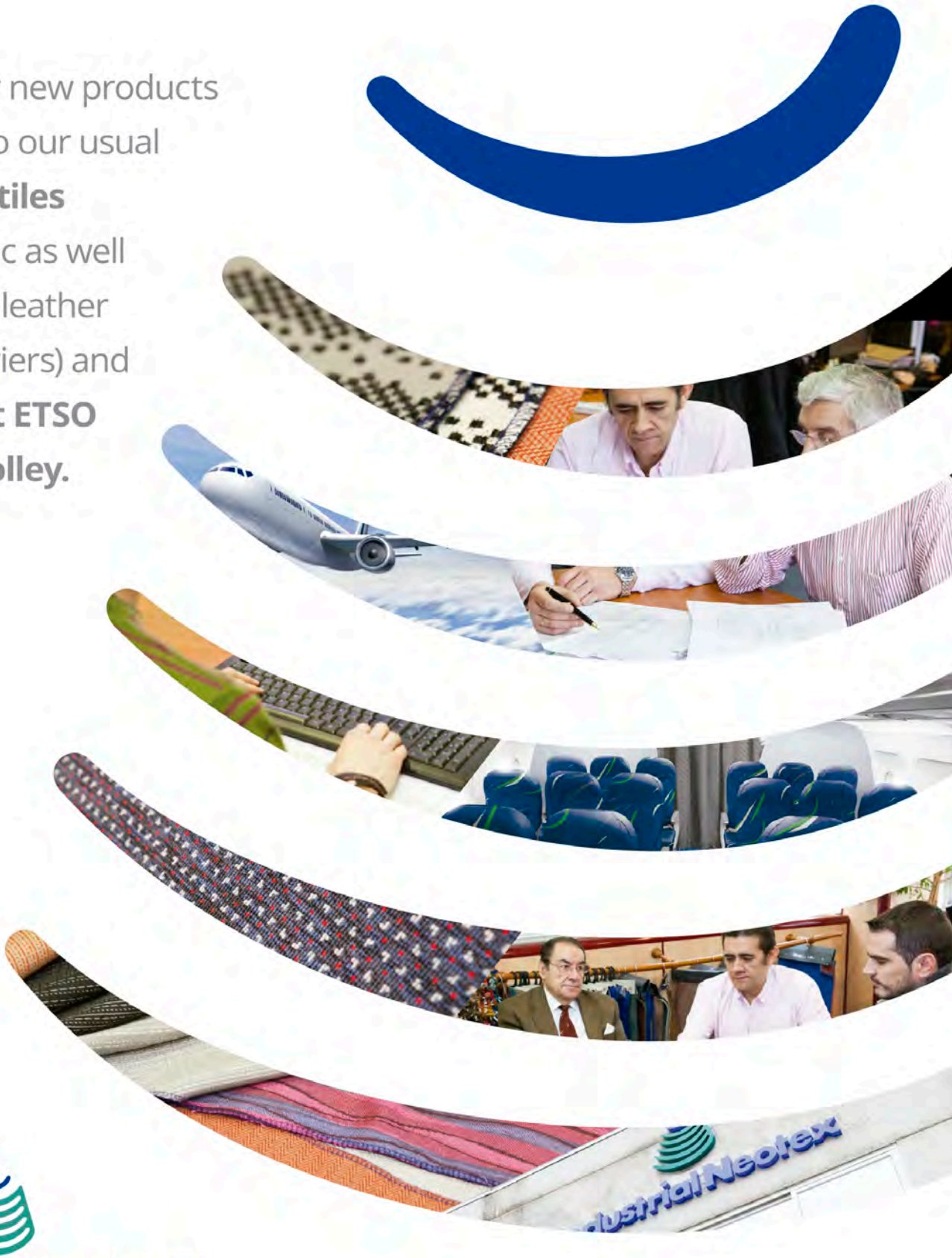

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THANKS FOR THE MEMORY

Polyurethane is the basis for a well-known foam developed in the 1970s with funding from NASA's Ames Research Center, to improve comfort for airline pilots and passengers. That foam is known as memory foam because it molds to the contours of the body pressing down on it, and then when the pressure is relieved, it returns to its original shape. It enhances passenger comfort because it distributes the body weight and pressure evenly over the entire contact area of the seat pan.

Another term for memory foam is viscoelastic, where the viscosity of the plastic affects the elasticity and therefore that all-important deflection effect. The foams that NASA developed had four grades and were heavy, with densities between 5 lb/ft³ and 7 lb/ft³.

James Barrett from Aerofoam explains that these foams also suffered from a phenomenon called 'shear', whereby as the occupant moves, if the foam does not have adequate tensile strength in terms of resistance to damage under tension, it breaks down at a cellular level, turning to dust. Barrett explains that today's more advanced versions are lighter in weight and do not suffer from shear.

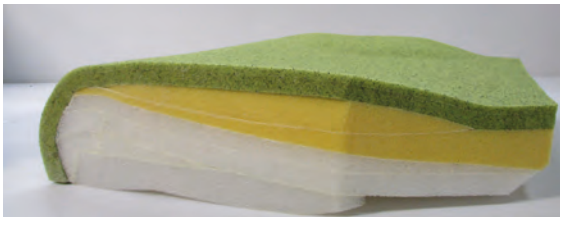
described as a high-resilience foam. "What makes the high-resilience structure unique is that the cells are scrambled; they're everywhere," says Barrett. "You have multiple touchpoints and it means that cushion has not only an initial higher level of comfort, but it actually breaks in, becomes more comfortable, and lasts for a longer period of time."

SAFETY CONSIDERATIONS

Another form of resilience is resistance to fire. Substances such as graphite are used as a fire retardant. "We use super-expanding graphite," states Barrett, explaining that it expands to create a blocking layer to stop a fire. "This isn't necessarily new, but the way we're using them is, together with memory foams and high-resilience foams, enabling us to get a very comfortable range of materials."

Graphite has also enabled Aerofoam to reduce foam weight, with the super-expanding graphite reducing the density of its memory foams to 3 lb/ft³.

Graphite was also tested with the FIBIOSEAT foam, but the hard carbon material presented problems for the project. "The problem is that graphite doesn't like to be mixed. It is very hard to mix with the normal machine because it's hard and somehow destroys a bit of the machine with each injection," explains Laborde.



ABOVE: THE AEROFOAM RANGE IS EXPANDING. SEALED AIR, A MAKER OF POLYETHYLENE FOAMS, IS NOW WORKING WITH THE COMPANY ON A FIRE-RETARDANT VERSION OF ITS ECOPURE FOAM. THIS FOAM IS PRODUCED FROM A BIO-RESIN MADE FROM RENEWABLE RESOURCES. THE FIRE-RETARDANT VERSION WILL BEGIN TESTING "SOON" ACCORDING TO THE PARTIES

BELOW: A PROGRESSIVE BUILD UP OF FOAM TYPES OPTIMIZES SUPPORT, THERMAL CONDUCTIVITY AND COMFORT

Barrett agrees that manufacturing foams using graphite is not easy. "Graphite-filled foams have been around for a while, but graphite-sealed memory foams are new to this market, and because this involves adding a third component, it is a difficult manufacturing process."

Once fire does take hold, smoke toxicity is a problem. "More than 60% of fire deaths are due to smoke toxicity," says Phylaktou. His research found that, when set alight, 1kg of foam without flame-retardant produces less toxic gas than the same amount of foam with no retardant. But, the idea of retardants is to give people time to escape, so they are not exposed to the toxic gas. Phylaktou does see a need for the industry to use other materials, however: "The plastics and polymers industry has been resisting any move toward that direction [of alternative materials] presumably because of additional costs."

Spring time

Industry newcomer Vanema has designed the Octaspring seat cushion in partnership with Airbus and Stelia Aerospace.

An Octaspring economy class seat cushion has been developed, which is claimed to save up to 150g per cushion and offer optimized comfort levels in high-density seating. For first class suites, Vanema and its partners claim to have "reimagined" luxury in seat cushions and mattresses.

In addition, Vanema's collaboration with seat component producer Aeroworks is seeing the development of a new type of seat pan.

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Heading to Aircraft Interiors Expo in Boston on September 25-27? Here's what you need to know...

Get in touch to meet the Aircraft Interiors International team at the Expo

STAND: 400

Italian style

Aviointeriors intends to showcase a whole range of new products in Boston, to demonstrate its strong commitment to the US market. The Italian supplier will present the Adagio business class seat, which has been further developed over the past 12 months. Adagio enables B777 and B787 operators to achieve an eight-abreast configuration with 100% direct aisle access, while still offering a flat bed function.

Boston will also see the launch of the Caravaggio premium economy seat, designed to address the increasing demand for premium economy seating on wide-body aircraft.

Caravaggio offers a deep recline position, good privacy levels, a large console, and the possibility to install a wide IFE monitor. The power, audio and USB ports are integrated into the center console, making them easily accessible without restricting the passenger living space.

Aviointeriors' economy product offering will also be represented, by Michelangelo, a recent addition to the range.

Michelangelo is a new long-haul economy class seat, a 27.5 lb (12.5kg) design that can be equipped with the larger IFE systems on the market (up to 13.3in), additional stowage spaces for personal belongings, and an innovative headrest concept. The seat model has already undergone a dynamic test program.

FINISHING TOUCH

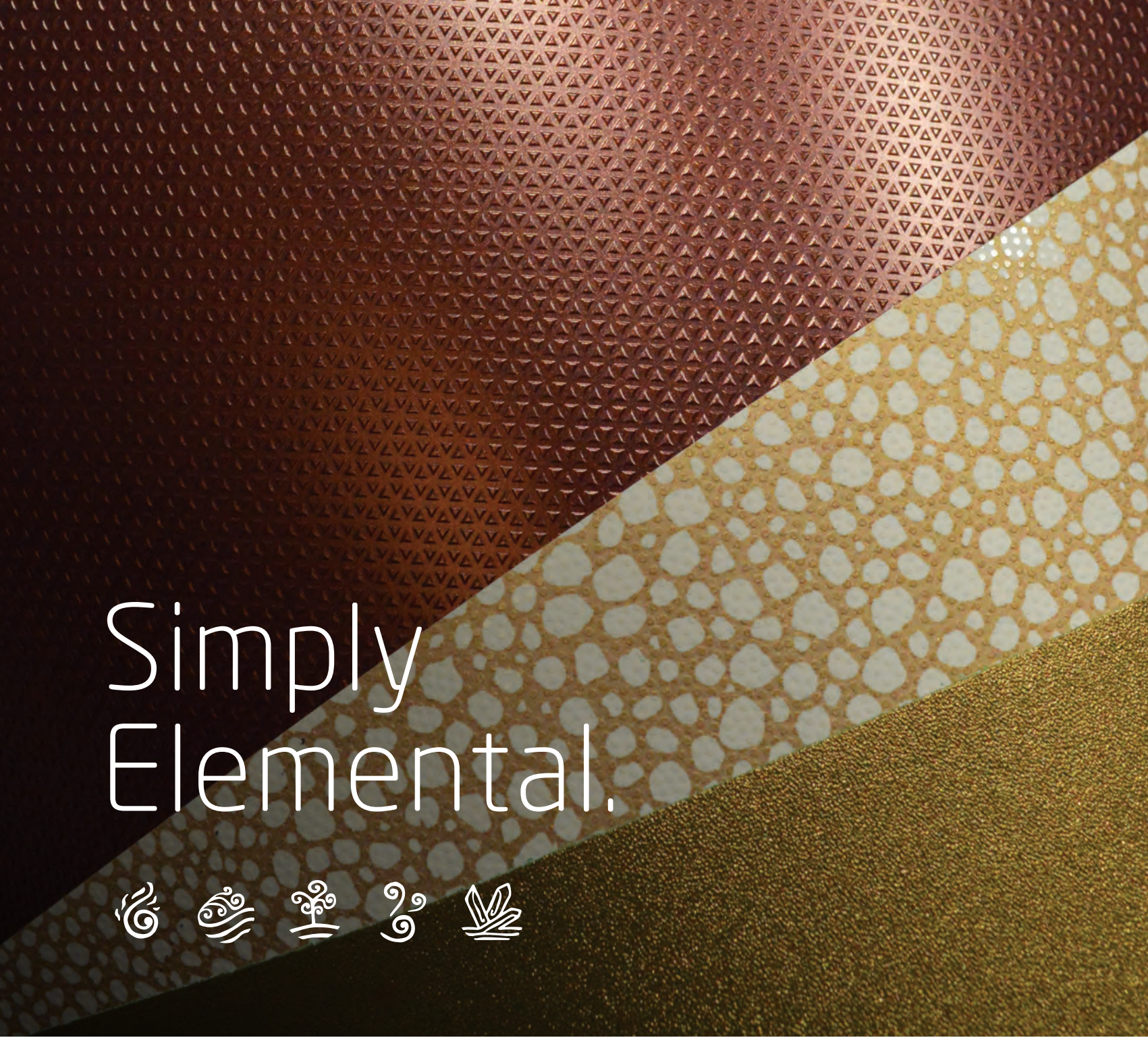
STAND: 904

UK-based eco-friendly materials technology company ELeather will be showcasing its new trend colors and textures for 2018/2019. Visitors to stand 904 will be able to see and touch the latest collections from the established aviation upholstery materials supplier, which has been bringing leather fiber composite to some of the aviation industry's leading brands for over 10 years.

The new trend collections are a result of extensive end-user research that focuses on colors and textures that resonate with an identified consumer set. ELeather has created a number of 'personas' with colors and finishes that reflect the ideals of these key consumers.

Not only will visitors be able to see the latest color and texture trends in aviation interiors today, but they will also see ELeather in a different kind of application that is sure to turn some heads.

ELeather takes unused traditional leather fiber and through a unique and patented process, engineers a high-performance, technically advanced leather fiber composite. Its products are designed and manufactured to provide exceptional characteristics, delivering an eco-friendly material that the company claims can outperform traditional leather, synthetic leathers and fabrics in terms of various operational aspects.



At the Aircraft Interior Expo in Boston, Schneller will feature our 2018 Design Collection, "Simply Elemental." The collection takes its cue from the natural world and five elements: fire, earth, air, metal and water. Experience the collection under Bruce Aerospace LED cabin lighting.

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SCHNELLER

STAND: 1100

THE PSYCHOLOGY OF COMFORT

Aircraft flooring company Lonseal has gathered aircraft interiors-specific research into passenger perception of the comfort experience. It has applied these findings in the design and launch of a new series of aircraft flooring collections: Axis, Cirrus, Halo and Mirage.

These collections consist of both embossed and smooth surfaces, with patterns and colors chosen to encourage feelings of peace and tranquility, the two biggest stimuli for passengers' well-being.

For example, the urban, earthy designs of the Halo collection help make cabins more relaxing, inspiring, and beautiful. The natural look of the collection is inspired by Japanese Zen, to reflect harmony and relaxation, while its color scheme incorporates organic accents. All flooring within these collections features Lonseal's Featherweight formulation, which reduces weight by up to a claimed 30% compared with standard flooring.

STAND: 600

Next-generation seating fabrics

The result of a collaboration between Tapis Corporation and Ultrafabrics, PromessaAV seat fabric was launched at the 2018 Aircraft Interiors Expo in Hamburg, offering what the partners say is the best aesthetic and haptic in the industry.

PromessaAV was born out of the well-established Ultraleather brand, but takes things to the next level, using a proprietary backcloth that provides greater durability, dimensional stability and recovery.

The manufacture of the new fabric uses Takumi Technology, a process that combines four layers into one unified system, ensuring enduring bond strength and longevity without risk of delamination. This means years of active use, enduring the demanding rigors of daily travel without compromising on softness, making it arguably the most comfortable seat cover material on the market.

PromessaAV is set to become a preferred seating solution for airlines and seat manufacturers worldwide. It has been selected as the standard non-leather alternative for the LIFT B737 Tourist Class Seating, made in collaboration with Boeing. The first of these B737 Tourist Class Seats has entered into service with LOT Polish Airlines on the first of its six B737 MAX aircraft.

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INNOVATIVE CABIN MATERIALS...

STAND: 610

Bolder branding

As thermoplastics open new doors for branding opportunities in aircraft interiors, Boltaron will demonstrate how Boltaron 9000 and Boltaron 4000 Series materials can be customized by a variety of in-house methods to create interior components that bring an airline's brand to the forefront.

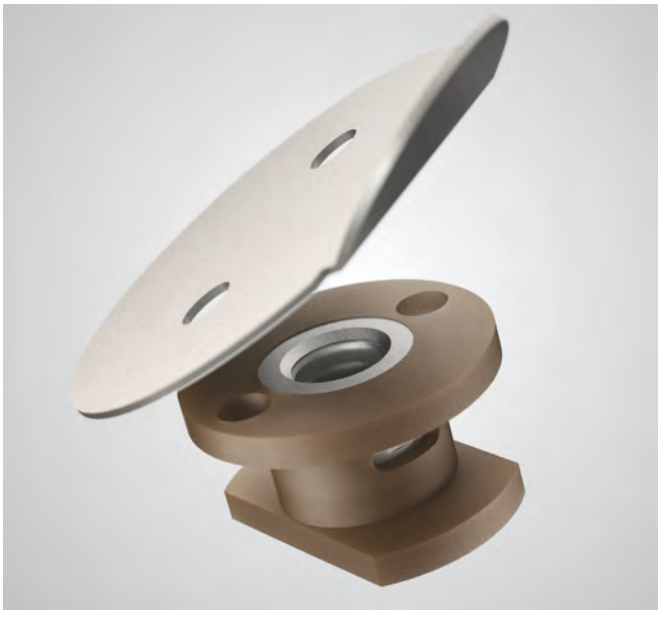
Visitors can see how a translucent thermoplastic panel on display is elevated by embedding a brand pattern between several layers of textured material, resulting in a functional privacy panel with a sophisticated effect.

For material, another spotlight is a pearlescent panel that has been thermoformed using Boltaron's new logo pattern to give the part a dynamic 3D dimensional impact.

"We want designers and airline brand managers to know that if they can imagine up a creative way to show off their brand inside the cabin, we want to work with them to find innovative ways to use our material and manufacturing methods to make it happen," says Adam Mellen, CSO.

Whether it's a soft, elegant, and sophisticated brand story that you're telling, or a loud, bold, and colorful one, Boltaron's eye-catching textures, metallic and decorative prints make it possible to bring any brand to life.

Boltaron will be presenting its new designer sample box at the show, as well as giving away more of the popular Infinite Design Possibilities metallic tote bags.



Look out for a special feature on fasteners in the November issue of Aircraft Interiors International

STAND: 203

Investment in fasteners

The latest news from Clarendon Specialty Fasteners, a stocking distributor for the aircraft interiors industry, is that it has set up a new facility in California, to better serve the North American interiors market. A large stock of the most common aerospace fasteners used in the assembly of aircraft seats and cabin monuments has been put in place in California, along with an innovative VMI system with a RFID twin-bin system that is now available for the US market and will be on display at the Expo.

STAND: 501

CREATIVE CABIN MATERIALS

BASF is helping the aerospace industry accelerate production and customization with their new additive manufacturing materials for lightweight functional components and high-temperature tooling.

The company's growing portfolio includes thermoplastics (Ultrason PESU/PPSU, Ultramid PA, and Elastollan TPU), composites, stainless-steel 316L, and photopolymers. 3D-printed structures and components weigh much less than those produced by conventional processes, and are just as functional if not more so.

For a lightweight alternative to injection-molded plastics, Contoura combines Acrodur acrylic resins with a variety of non-woven fiber reinforcements producing a prepreg composite ready to be formed into its final shape.

Available in custom thicknesses, densities and mechanical properties, the Contoura product can be formulated to meet 60-second vertical burn per FAR 25.853, custom colored, and designed specifically for use in aircraft cabin interior components.

Our November issue will feature all the latest materials innovations

Epianka has been fitted to the first A321neo ACF, delivered to Turkish Airlines

STAND: 708

Epianka on show

TSI Aviation Seats will present its Epianka economy class seat for narrow-body aircraft at the show. The company has been delivering this seat model for A320neo and B737 Max line-fit projects with Turkish Airlines since May 2018.

In the design criteria for Epianka, TSI established a platform for a new economy class seat, one which the company says expands the creativity, competitiveness and comfort of economy seating and puts it among the best models available to airlines.

The design of Epianka offers comfort, usability, reliability and cost effectiveness, says TSI.

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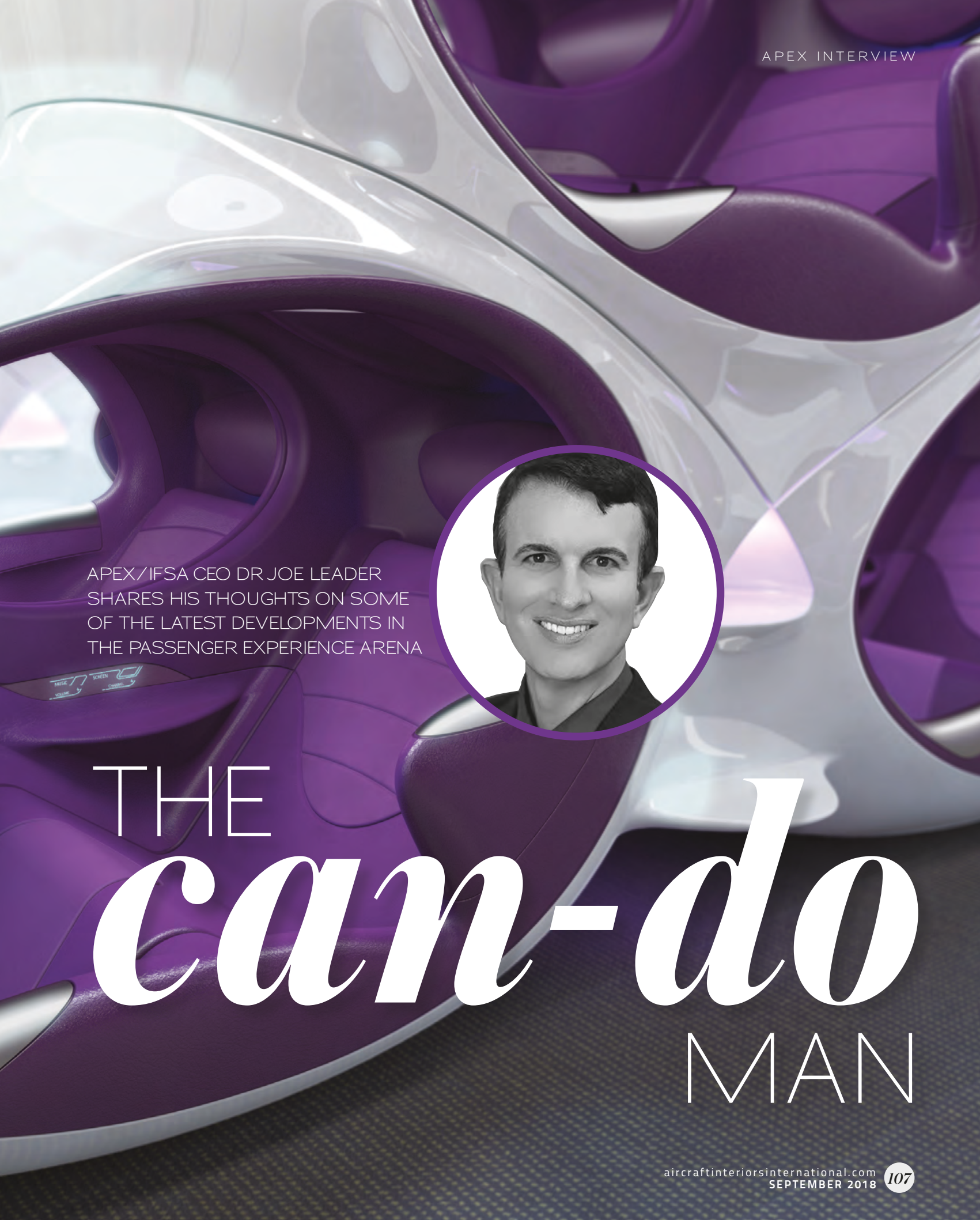

APEX/IFSA CEO DR JOE LEADER SHARES HIS THOUGHTS ON SOME OF THE LATEST DEVELOPMENTS IN THE PASSENGER EXPERIENCE ARENA

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With a broad aim of improving the air travel experience, the scope of APEX (the Airline Passenger Experience Association) is equally broad, encompassing everything from the ease and clarity of travelers' online flight searches, to the quality of their arrival at the destination. With every major airline in the world on its membership books, and the potential to include every single airline, this is a major organization. Dr Joe Leader, CEO of APEX (and IFSA, the International Flight Services Association), shares his thoughts on recent developments in the airline world…

APEX COLLABORATED WITH THE CRYSTAL CABIN AWARDS TO CREATE THE BEST CUSTOMER JOURNEY EXPERIENCE PRIZE. WHY HAVE THE SCHEMES COME TOGETHER?

APEX has an incredible partner relationship with the Crystal Cabin Awards, arranged by Hamburg Aviation. APEX Media's director, Maryann Simson, has hosted the awards for the past two years. Last year, Hamburg Aviation announced the awards application period during APEX Expo, and APEX returned the favor this year at Aircraft Interiors Expo in Hamburg. APEX is honored.

WHAT IS YOUR VIEW OF THE ROLE OF 5G IN THE PASSENGER EXPERIENCE?

5G will provide a new, competitive landscape in airline passenger experience connectivity options. APEX Tech's

ABOUT JOE

Joe Leader was appointed CEO of APEX in September 2015, having been selected from more than 600 high-profile applicants. Prior to joining APEX, he served in executive roles at aviation and technology companies for over two decades. He worked as the president of an international aviation association, led the advancement of aviation booking technology expansion at a multibillion-dollar GDS company, and served in the international leadership of advanced technology companies. With a passion for education, Leader's business PhD dissertation research focused upon accelerating the passenger adoption of new aviation technology."I came forward to the board with a plan to advance APEX as a beacon to the industry working in partnership with others," Leader explains. "Commercial airline experience triggered me to jump from high-tech to aviation nearly a decade ago. I advised the CEO and head of marketing of one of the major airlines in the USA on passenger experience and loyalty, and that interaction inspired me to affect a much broader world, as afforded by APEX's incredible community."

ABOVE: JOE LEADER WOULD LIKE TO SEE BETTER USE OF THE VERTICAL SPACE IN THE CABIN. A GREAT EXAMPLE IS THE AIR LAIR CONCEPT BY FACTORYDESIGN

Connectivity Working Group is leading this charge with our airlines, connectivity providers, and the new Seamless Air Alliance. This will be a key point of focus on the Monday of APEX Expo, with discussions from airlines and the CEO of the Seamless Air Alliance. [See p48 for John Walton's feature looking into the potential of 5G in aircraft interiors.]

FLYERSRIGHTS' PLEA TO THE FAA TO ESTABLISH MINIMUM SEAT PITCH STANDARDS WAS REJECTED. WHAT IS YOUR VIEW OF THE FAA'S RESPONSE?

APEX believes that passengers should be able to pay for the airline passenger experience that they desire in their seats, but safety must always remain at the forefront. FlyersRights was completely within its rights to request the safety review. Airlines would not consider a seat unless it meets all safety standards for emergencies and evacuation. The FAA is correct that the major bottleneck in emergency situations is caused by the evacuation doors. As an industry, we could better focus our safety energies on preventing passengers collecting their bags during emergency evacuations.

DO YOU THINK SUPER-LONG-HAUL FLIGHTS REQUIRE DIFFERENT APPROACHES TO INFLIGHT COMFORT AND ENTERTAINMENT, OR JUST MORE OF THE SAME?

Super-long-haul flights require that we enhance the inflight experience for the well-being of passengers. It is in the best interest of the airlines, flight crew, and their customers.

SOCIAL MEDIA IS INCREASINGLY HIGHLIGHTING POOR PASSENGER BEHAVIOR, WHETHER IN TERMS OF AGGRESSION, MANNERS OR HYGIENE. DO YOU THINK MORE CAN BE DONE TO MAKE PASSENGERS MORE CONSIDERATE OF THEIR FELLOW FLYERS?

These types of incidents have always occurred, unfortunately, but passengers now have social media-connected video cameras on their phones. Those cameras help to make people more aware of potential for their actions to be recorded, but that alone is not enough. To encourage passenger consideration, I would applaud airlines including their customer-centric service values alongside tasteful passenger edict rules in seatback pockets. We should be an industry that sets a positive example in customer engagement and civility.

IF YOU COULD GO BACK IN TIME AND FLY WITH ANY AIRLINE, ON ANY OF ITS AIRCRAFT, WHICH WOULD IT BE?

Since I got to fly on the Concorde, I would choose to fly on Pan Am B747 Flight 50, which circled the world via the North Pole and the South Pole. I never had the opportunity to fly Pan Am, and that particular flight was one of the rarest gems ever offered to airline passengers.

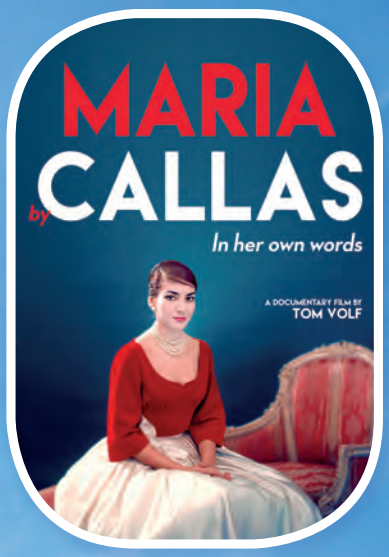
BELOW LEFT: JOE LEADER WOULD HAVE ENJOYED THE STYLISH AND HIGH-QUALITY PAN AM PASSENGER EXPERIENCE, ESPECIALLY ON THE 54-HOUR POLE-TO-POLE FLIGHT 50. PHOTO: JOHN ATHERTON

IS THERE ANYTHING THAT YOU WOULD LIKE TO SEE INTRODUCED INTO THE PASSENGER EXPERIENCE AS A DISRUPTOR?

I would love to see better use of space on board aircraft with more dynamic seating options. I believe that in the next few years, by using the vertical space on the aircraft, we will see better angled-flat options for premium economy and, hopefully, economy.

DO YOU THINK ECONOMY CLASS SEAT DESIGN HAS REACHED A PLATEAU?

No. Bold airlines will finally enact some bold new economy class designs. There are great innovations that could be implemented, but the airlines have placed their innovation focus too much on the front of the cabin. An airline that sets a new standard in economy class could become the thought leader for our industry.



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Getting real

VIRTUAL REALITY SEEMS ON THE CUSP OF ENTERING THE IFE SECTOR, BUT CONCERNS HAVE BEEN VOICED, RANGING FROM HEALTH AND SAFETY TO A FEELING OF ISOLATION. LET'S SEE WHAT DEVELOPERS AND AIRLINES HAVE TO SAY ABOUT THE POTENTIAL OF IMMERSIVE IFE

Words by Tomás Romero

The airline industry buzz about immersive IFE reached fever pitch this past year with the announcement that Air France, Joon, Corsair and a handful of other forward-thinking carriers worldwide had taken the plunge and introduced virtual reality (VR) headsets in flight. Coupled with the 360° VR experience being offered by Emirates online and via its mobile app and by Etihad in its airport lounges, it would seem that after years of breathless anticipation, VR has finally hit the mainstream. Or has it?

For a while the virtual tours offered by some carriers are fun and appealing – especially for passengers interested in checking out the first class cabin, for instance, before buying an actual ticket – and the benefits of VR and AR (augmented reality) on the training and operational front are already proving to be a boon for airlines around the world. But for the most part the jury is still very much out on immersive IFE.

And though the carriers mentioned above have been fairly tight lipped on how their immersive IFE solutions are faring with passengers, a white paper released this past April by immersive IFE pioneers SkyLights – which, admittedly, has more than one dog in this fight – generated some interesting findings. Key among them was the fact that, based on 1,400 passenger questionnaires distributed in flight among 10 different airlines, SkyLights VR IFE solutions have a 90%-plus recommendation rate. Not bad at all for newish tech.

EUROPEAN AVIATION

Flying Further

Founded in 1989 European Aviation currently owns a number of aircraft and has previously operated and modified interiors on Boeing and Airbus aircraft.

The organisation has operated a Formula 1 team, a charter airline and has bases in Ledbury, Bournemouth and Indianapolis in the USA.

The organisation supplies Passenger Aircraft, Aircraft Spares, Aircraft Interiors, Executive Aircraft and CFM56 Engines.

In 2018 we have purchased a large number of A340 aircraft which will enter service later this year, and further growth with a number of innovative projects is forecast.

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ENGAGE WITH THE FLIGHT

Lufthansa is the first airline to trial VR glasses linked with real-time data relevant to the flight. The airline is working with 3spin, a German digital innovations company, to develop a VR glasses-based system that enables passengers to view the mountains, lakes and cities their plane is passing over – whether it's day or night, sunny or cloudy.

Even better, if something catches the user's interest, they have the option of diving deeper by activating 360° photos or videos.

The capital outlay is low, merely requiring a smartphone to be slid into a pair of Samsung Gear VR glasses. A smartphone app then accesses an onboard server – there is no need for satellite internet on board.

ABOVE: THE CAPABILITIES OF LUFTHANSA'S TRIAL SYSTEM ARE HIGH TECH, BUT THE TECHNICAL REQUIREMENTS ON BOARD ARE SURPRISINGLY SIMPLE

SkyLights' white paper also cites another survey of 202 passengers, which found that 72% of those questioned said they would be willing to use VR "instead of current entertainment systems" – a number that increases to 80% when passengers who fly monthly are included. But the report's surprisingly frank assessment that "in the short term, VR devices will probably not replace traditional seatback systems, which are still widely used and expected by passengers, particularly on long-haul flights", is telling.

So the question remains: Is immersive IFE ready for prime time? "No," says Andrew Mohr, head of innovation at Panasonic Avionics. "We're not ready for mainstream implementation. Even terrestrially, VR and AR remain a novelty for the majority of people and applications."

Mohr cites a laundry list of fairly sizable obstacles to widespread immersive IFE implementation – meaningful applied solutions, the size and weight of viewing devices, motion sickness, content creation and availability, unit and ecosystem cost, unit reliability/ruggedness, hygiene, seclusion with respect to airplane system notifications and emergency announcements, interactivity paradigms, and simply the feeling that one looks silly when wearing most VR products. Though many of these issues are being addressed for the terrestrial market, optimum solutions for the airline industry are just not there yet.

"We think that meaningful applied solutions will be the most difficult hurdle to overcome for immersive solutions … as they try to gain mainstream adoption on the ground or in the air," adds Mohr. "Finding or developing that 'killer app' that sets immersive solutions apart from other solutions, creating that 'must have it' need, remains elusive [and] until this is found these items will remain novelties offering minimally useful, temporarily engaging, exploratory solutions."

And that, for better or worse, seems to be the way many carriers still view the current crop of VR for IFE.

THE AIRLINE VIEW

"We dabbled with VR in the past when we launched a new aircraft; our marketing and digital teams developed a video where you could put on a headset and take a look around inside the new aircraft and that was really neat," says Michelle Agnew, manager of brand partnerships and entertainment PR for US LCC, Southwest Airlines. "We've got 700 aircraft and it takes quite a while to retrofit a fleet, whether it's new seats or a new livery, so you might not experience that rebrand right away. [VR] was a great way for our customers to experience it without actually being able to fly on a new plane."

expanding content

SkyLights, and movie distributor mk2, are partnering to bring more VR content to passengers, and have signed what they describe as "the most significant agreement to date for worldwide rights to exhibit VR content in flight".

The news comes in light of the rapid increase in high-quality VR releases that are well-suited to enjoy on board. Mk2 has been a film exhibitor and distributor for 42 years, but only branched out into VR film distribution last year following the success of its permanent VR venue. However, it has expanded in this genre quickly, offering a diverse portfolio of VR titles, and is keen to add airlines as the company views airlines as a 'promising' new channel to distribute its VR portfolio and develop its expertise in the VR IFE market.

"Up until 2017, the vast majority of VR content was of relatively poor quality and was not suitable to view in an environment where space and movement are restricted. Since then, appropriate VR content has taken off", said Laurence Fornari, SkyLights' head of sales and marketing.

LEFT AND BELOW: MOVIE DISTRIBUTOR MK2 IS STRIVING TO IMPROVE THE QUALITY OF VR CONTENT OPTIONS

See p82 to get the inside story on how VR IFE content can be delivered via the cloud

Southwest has also ventured into the VR concert realm by making a VR recording of an episode of its popular onboard music series 'Live at 35', available to passengers via airline-provided Google Cardboard headsets. But as far as full-blown immersive IFE goes, Agnew suggests that only time will tell.

"AR and VR is an area we haven't really dabbled in a whole lot yet," admits Agnew. "But I think there's probably a lot of opportunity there and I'm sure our marketing and digital teams are thinking about it."

THE IMMERSIVE EXPERIENCE

One-hit-wonder novelty item or not, immersive IFE solutions are already flying on several carriers around the globe. So what's it like, especially for passengers who, like myself, are prone to motion sickness?

"We have studied Cardboard and Samsung Gear VR in flight and didn't have too much trouble," says Panasonic's Mohr. "Keep in mind, however, that we only wore the devices for short periods of time. Results will vary with these devices depending on which cell phone is used, and the quality and type of content being viewed. But from Panasonic's perspective, motion sickness remains a barrier to inflight use and, for some, on the ground as well. Improvements to frame rates, jitter and resolution are helping, but the problem is still very real, as is the fact that some people simply can't visually interpret a 3D VR program due to lack of vision in one eye or other physical or neuropathic issues. For short viewing times motion sickness likely won't be a huge issue but it certainly limits longer engagements. We've partnered with our automotive group in the past to explore motion sickness, and we hope to engage again on this topic once we have a new, meaningfully different round of product improvements and entrants."

CUT OFF FROM REALITY

Another issue is the isolation factor, not just from fellow passengers, but also from aircraft system alerts and crew.

"Unlike headphones, with immersive devices basic visual clues are obscured. The user won't notice a 'fasten seat belt' sign, or catch a crew member's signal out of the corner of their eye," says Mohr. "Lack of these visual clues will make the immersive product user more isolated from mundane as well as emergency cabin interaction."

First-hand VR experience

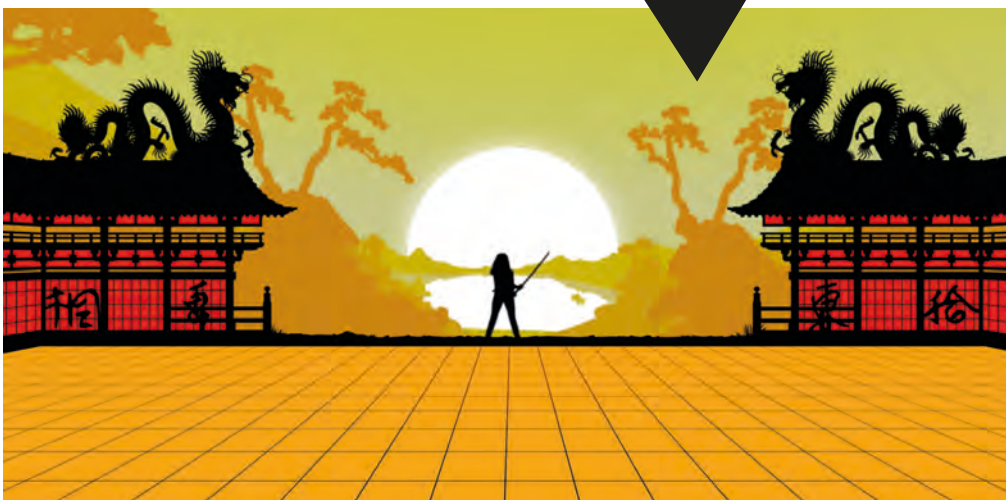
Tomás Romero has tried out several VR systems over the years. This is his first-hand account of the experience.

Speaking as someone who gets motion sickness from playing Minecraft or sitting in the backseat of cars on long road trips, I must admit that when I first heard about it, the very concept of immersive IFE had me reaching for the air sickness bag quicker than you can say Dramamine. And though the first immersive IFE headset I tried out at an APEX Tech in Newport Beach in 2015 turned my stomach and left me literally reeling, subsequent demos over the years have been far kinder to my equilibrium.

A VR headset solution I tried in 2016 – which offered a spectacular virtual tour of one particularly posh carrier's first class suite – was, despite its somewhat chilly veneer, totally gorgeous. It didn't look exactly real, more like a very lifelike video game, but it was real enough to dazzle the senses and probably have the desired effect of encouraging economy passengers who tried the headset at the gate to upgrade on the spot. And though this demo was undertaken from the safety of a stationary chair on a showroom floor, it was light years away from the nausea-inducing VR I had tried just a year before. Time had definitely been kind to this tech.

Subsequent adventures in immersive IFE headsets have had varying degrees of success. Some were good, some were great, and a few of the most recent headsets to hit the market have been pretty spectacular. But my main gripe with most headsets I've tried is that they leave me feeling constrained and cut-off from the world.

Even in an era when most passengers (myself included) travel with their faces buried in their devices and/or seatback IFE screens, the potential for real human contact and engagement is always there. You aren't forced to chat with your hipster neighbor with the smelly vegan snacks, or that sweet but dreadfully boring person across the aisle, but if you really wanted to you could. Which is not to say that I crave contact with strangers when I fly but, as clichéd as it sounds, getting there really is half the fun. Maybe that's just my adult onset FOMO (Fear of Missing Out) flaring up, but I'll take the subtle audio-visual indignities of real-world air travel over the glossy, isolated perfection of life under the VR helmet any day.



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And though Mohr says that some of this can clearly be mitigated through appropriately designed software algorithms and applications, he also points out that in many cases isolation is the whole point of VR.

"Being isolated from all that surrounds you lets you experience a new, fully immersed experience free from distraction, accompanied with heart-thumping surprises beside, behind, or above and below you. For short spurts this isolation can be awe-inspiring and for the most part isolation isn't a factor. For longer periods the isolation begins to be noticeable as you try to interact with others or try to share an experience, clip or whatever it might be. But in the end the feeling of isolation is largely a personal thing. Some dislike the feeling; others embrace it."

THE VR MAKERS' VIEW

Danny Belch, VP of marketing for STRIVR, a Silicon Valley-based VR firm that started out using VR to train elite athletes at Stanford University and which has since worked for companies like Walmart, BMW, Chipotle and JetBlue, as well as sports teams including Dallas Cowboys and the US Ski Team, seems to concur.

"I think an airplane is definitely a tough place to do VR," says Belch. "Bumps can happen out of nowhere and overall it's probably not the smoothest environment. Passengers might already feel a little uneasy in the air as it is, so introducing something where their brain now thinks they are somewhere else is a lot for an airplane flight. While not all VR makes you nauseated or dizzy, there is definitely a chance that passengers could use VR on a flight and feel less-than-stellar afterward. And I don't think airlines want their passengers to be feeling that way.

EMIRATES HAS BEEN GIVING LOUNGE VISITORS AT DUBAI INTERNATIONAL AIRPORT THE OPPORTUNITY TO TRY VR ENTERTAINMENT. FEEDBACK IS BEING GATHERED TO SEE IF IT SHOULD BE CONSIDERED ON BOARD

The key here, for an airline that offers VR as IFE, is to make sure the content is vetted to ensure it is 'good' VR – yes, there is such a thing. This will minimize the risk of any passenger using VR for IFE feeling sick afterward."

And lest you think that 'good' implies A-list Hollywood content, Belch is quick to point out that the best 'good' VR is VR experienced in short, snackable bursts of 360° awesomeness.

"I have never seen anyone use a headset for longer than 10 minutes. VR is not meant for long-form consumption, so I don't believe we'll be watching movies in VR soon," says Belch. "I don't think it's isolating, but after a short while your body and mind just want to be back in the real world, no matter how compelling the content. But when experienced in short bursts, VR can be cool and powerful. If airlines want to offer VR, they should understand its power and leverage it accordingly."

The very real space limitations in the cabin itself are another practical barrier to fully immersive IFE.

"Another thing to keep in mind is the main cabin," Belch says. "VR is great because you can look around 360°,

"Some dislike the feeling of isolation; others embrace it"

STABLE REALITY

Seetroën glasses aren't VR glasses, but they are clever. French car maker Citroën has teamed up with Boarding Ring, a tech start-up that has developed glasses that could help eliminate motion sickness – a condition suffered by 30 million people in Europe and a growing problem as more passengers read on devices during travel.

The solution, originally developed for sailors, is soft-touch plastic glasses without lenses that feature moving colored liquid in the frames around the eyes, both along the frontal axis (right/left) and sagittal

axis (front/back), the glasses recreate the horizon line to resolve the conflict between the senses that causes the affliction.

Sensitive travelers should put on the glasses as soon they experience the initial symptoms, and after 10 to 12 minutes, the glasses enable the mind to resynchronize with the movement perceived by the inner ear while the eyes were focused on an immobile object such as a smartphone or a book. Once cured – the glasses have a claimed efficacy rate of 95% – the user can simply take the glasses off and enjoy the rest of their journey.

72% of pax are willing to try

SkyLights has released a report that looks at the opportunities and obstacles of implementing VR IFE. According to the findings, it is unlikely VR IFE will replace seatback screens on long-haul flights in the short term, but it does offer advantages as an additional service to add value and differentiate the customer journey. Similarly, it suggests VR IFE and W-IFE can be combined for a low cost/high value entertainment offering.

The paper references a survey which found that 72% of passengers are willing to adopt VR IFE, particularly millennials and frequent flyers, at 75% and 80%, respectively. With this in mind, the report argues that VR IFE can enable airlines to 'stand out from the crowd and secure a competitive advantage'.

SkyLights' study concludes that, thanks to advancements made in VR technology and content over the last three years, VR is now ready to deploy in-flight.

"There are two common objections to VR IFE. The first is VR sickness, which is resolved by offering a fixed-screen, cinematic experience, or curating the increasingly abundant VR films that are suitable to view in flight... The second obstacle is passenger safety, which can be circumvented by enabling the cabin crew to pause VR headsets to make an announcement," said Rateb Zaouk, SkyLights' head of operations.

but in the main cabin there is not much room for passengers to be looking all around. You're already crammed in and it's hard enough to even turn around to the seat behind you. This poses a major problem to experience VR well. So it might be a first-class cabin-only thing and then only when first class has a lot of room, such as on long-haul flights," explains Belch.

"The bottom line is that I think every passenger having headsets to wear is at least five years away. There is just too much to figure out. Early movers like Air France are right for wanting to see how VR can apply to their business and their guest experiences, but I am not sure the technology is truly ripe for an airplane," says Belch.

ABOVE: THE ALLOSKY HEADSET BY SKYLIGHTS IS ALSO BEING EVALUATED BY JAPAN AIRLINES (JAL), WHICH HAS BEEN OFFERING CINEMATIC VR IFE TO CERTAIN VIP GUESTS TO GAUGE FEEDBACK

IBERIA TRIALS 'NEW FORM OF IFE'

After successful tests at a Madrid passenger lounge and evaluations undertaken on a return flight between Madrid and Tel Aviv, Iberia is preparing for further testing of the VR IFE system developed by Inflight VR, a new company that took part in Hangar 51, IAG's global startup accelerator project launched to promote collaboration with disruptive companies that can revolutionize the aviation industry and improve the customer experience.

The VR platform allows many different third-party application integrations, ranging from VR storytelling to destination-based content such as city sightseeing tours or shopping. Indeed, according to the company, the platform has the potential to be an entirely new form of IFE that generates revenue for airlines.

And despite the current popularity of VR with early-adopter gearheads and jet-setting hipsters alike, Panasonic's Mohr seems to agree.

"We certainly see niche use cases and expanded experimentation in our industry. We also see and have seen for quite some time a 'trough of disillusionment' in our not-so-distant future, where the promises and excitement of immersive solutions have not fully been realized. The market recoils a little while technologies and use cases mature and the market consolidates, and finally the sector rebounds with renewed excitement around what will become that killer app enabled through improved technical solutions. We see this cycle consuming the better part of a decade."

That said, Mohr adds that if the immersive product market does indeed mature we should expect to see industry adoption similar to portable media players.

"Market adoption begins primarily with passengers bringing their own devices, along with a few airline trials – which are happening and have happened – followed over a moderate time period by self-contained hand-out solutions and associated servicing solutions, then hybrid solutions mixing personal devices with hand-out solutions using some sort of embedded gateway to content," explains Mohr. "Ultimately, once these products fully mature, we will start to see creative, fully embedded solutions. Again, this process likely spans the next eight to 10 years, assuming we successfully cross the 'trough of disillusionment'."

Which, even wearing a shiny, first-class cabin VR headset, seems like a pretty big trough to cross with most carriers.

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APEX EXPO 2018

Just a few highlights of the passenger experience enhancements that await visitors to APEX Expo in Boston, September 24-27

STAND: 343

A WIDE RANGE OF NEW TECHNOLOGIES

Astronics will be displaying a variety of power and connectivity solutions designed to improve passenger experiences and aircraft operational efficiencies. For passenger and crew connectivity, Astronics will demonstrate its newly certified FliteStream SatCom antenna system, plus the Summit Line IFE hardware.

The company will also preview a new intelligent bin-sensing solution, which provides bin capacity data and other information to crews for increased operational efficiency.

In the power solutions area, visitors can also try out a range of new EmPower in-cabin products for use by passengers and crew, including a wireless charging module and a USB Type-C passenger power system. The SmartTray passenger PED holder will round out the offerings.

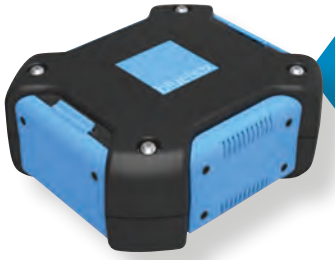
During the show, visitors who tweet a photo from the Astronics stand with the hashtags #Astronics and #APEXexpo will be entered to win an iPad complete with an Apple Store gift card to enjoy IFE content on the way home. View all these solutions and enter to win on Stand 343.

MORE THAN 3,000 INDUSTRY PROFESSIONALS, INCLUDING NEARLY 100 AIRLINES AND 300 SUPPLIERS, WILL DESCEND UPON BOSTON FOR APEX EXPO

STAND: 117

SENSORY COMFORT

Mills Textiles has developed a sensory comfort range of products intended to help promote a sense of relaxation and refreshment. These products can be filled with natural grain such as wheat, or cherry stones, and infused with an aromatherapy scent, which is tailored to help sleep or awaking. The products can also be branded or themed, depending on airline requirements.



STAND: 1142

Portable IFE

With favorable economics, ease of deployment, and a growing variety of content types available for shorter routes, portable wireless IFE platforms are coming into their own, with regional and low-cost carriers eager to tap into an opportunity to differentiate their inflight service or IFE as a channel for ancillary revenue generation.

This is Bluebox's area of expertise, and from attracting a slew of new customers for the Bluebox Wow portable wireless IFE system, to winning a coveted Crystal Cabin Award for Bluebox aIFE (an iPad-based accessible IFE system for visually impaired passengers), 2018 has already been a banner year for the company. But there's more to come, especially for Bluebox Wow.

"With the momentum that's been building for us this year, we expect even more excitement in Boston," says Kevin Clark, Bluebox's CEO.

"We're working hard on seven new Bluebox Wow deployments – and hope to be able to reveal some of these to customers in time for the Expo. Most of these airlines have never offered IFE before, proving that portable wireless IFE is a game changer for both LCCs and regional carriers."

Bluebox won a 2018 Crystal Cabin Award for its work with accessible IFE

digEcor's in-seat power seat spar mod kit will be on show at APEX Expo

STAND: 713

GAINING POWER

Everyone is talking about in-seat power – and in particular, USB power. Passengers are asking for it, seat makers are integrating it, airlines are installing it – and digEcor is delivering it. The digEcor passenger power solution is a modular, affordable installation, designed with reduced components to achieve a lighter weight, lower cost and minimal installation time. And with a reversible USB outlet, passengers don't have to endure the frustration of figuring out which way to connect their cables.

digEcor collaborates with a growing number of seat makers to deliver customized seat modification kits that adapt to each seat design and mount to the seat spar, with little to no impact on passenger leg room. digEcor's USB power solution is being installed across a fleet of more than 130 narrow-body aircraft later this year.

STAND: 707

Making connections

With airlines adopting wireless IFE, there is a significant demand for USB power, so IFPL will be showcasing its power, audio and interface products. IFPL has engaged its customers and will be demonstrating new products that support USB-A and USB-C that can be seamlessly integrated into airline seats. In addition, IFPL's latest Bluetooth audio jack technology will be on display.

IFPL has also developed an inductive charging unit that delivers wireless charging at the seat, and once again these units have been designed to enable seamless integration into the seat. IFPL will show supporting design concepts for seatback portable electronic device (PED) holders and trays that provide USB and/or inductive charging.

In addition to developing its own products, IFPL works with customers to turn their ideas into reality.

How does the cloud fit into IFE delivery? Get the inside story on p82

STAND: 637

AWARD-WINNERS

Turner Inflight Services will showcase the very latest content at APEX Expo, including 2018 Emmy nominated Cartoon Network shows Adventure Time, Steven Universe, Teen Titans Go!, and We Bare Bears alongside established hits such as Ben 10 and Powerpuff Girls. Additional new shows from TBS and TNT are available such as hit new comedy The Last O.G. (starring Tracey Morgan) leading the pack with the global phenomenon and Emmy nominated Adult Swim series Rick & Morty (Seasons 1-3). As ever Turner bring the latest in business news, world sport, lifestyle and current affairs content from around the world with CNN International, along with short form content from Great Big Story, the Emmy nominated cinematic storytelling channel. Meanwhile, COPA90 is the newest addition to the fold, with over a billion views on its online channel. COPA90 provides soccer news, player interviews, documentaries and fan culture shows – all about the beautiful game – and is available exclusively to inflight from Turner.

STAND: 429

Bring outside inside

Latécoère, an expert in aerostructures and interconnection systems, designs and builds a full range of airborne video systems. From the cockpit to each passenger's seat, the company can help bring the feel of the outside on board. Discover its latest innovation at the Expo: a window to the world for every passenger. Most passengers try to get a window seat when they check-in. Even VIP passengers in first or business class are frustrated if they don't have an external view during their flight.

A developer of HD landscape cameras, Latécoère is introducing its new idea: side-view cameras, a simple selection via the IFE screen that provides the passenger with a direct view of take-off and landing. Additional options also offer a left and right view of the aircraft throughout the flight.

This smart camera, which is easy to install anywhere on the airframe, enables any passenger to enjoy a window seat experience with HD views of the external panorama.

ZODIAC INFLIGHT INNOVATIONS

ZODIAC AEROSYSTEMS
Connected Cabin Division

ZODIAC AEROSPACE

MORE IFEC INNOVATIONS

STAND: 750

Clever content

PXCom is taking a major step forward in bringing editorial content to the IFEC industry, with the company preparing to release "groundbreaking features". The company's flagship end-to-end solution – XPLore by PXCom – currently enables all kinds of content to be brought on board by airlines and their partners. Initially focused on comprehensive destination sections, then extended to meal menus and corporate sections, it now offers a full digitization capability of content which used to be limited to inflight magazines only. Creating new digital spaces, PXCom natively integrates editorial content, sponsored materials, and even 'call to action' extensions offered to passengers during their entire journey (pre-, in- and post-flight) in a consistent way throughout all available media channels, whether mobile, web or IFEC platforms.

PXCom will also showcase Travelwell at the Expo (in partnership with Charlotte Dodson TV), a lifestyle platform for the health-conscious, which provides passengers with pre-, mid-, and post-flight customizable wellness content. The content elevates the passenger experience while generating new ancillary revenue streams.

APEX Expo will be co-located with Aircraft Interiors Expo (see p98) and IFSA Expo

STAND: 333 & 549

Aviation broadband

Inmarsat's eye-catching exhibition stand has become a firm favorite of APEX Expo attendees in recent years and will return to the event once again in 2018.

The satellite communication provider, named the World's Leading Inflight Internet Service Provider at the World Travel Awards, will be showcasing its next-generation solutions for GX Aviation – which is commercially available with a growing list of airlines, such as Lufthansa, Qatar Airways and Singapore Airlines – and the much-awaited European Aviation Network (EAN), scheduled to enter commercial passenger service later this year.

In addition, Inmarsat will be shining a light on its SwiftBroadband-Safety (SB-S) platform, which entered service in April as the first global aviation broadband system for operations and safety communications, providing airlines with secure visibility into their operations.

Frederik van Essen, senior vice president of market and business development at Inmarsat Aviation, says: "The vast potential of the connected aircraft is becoming more apparent. The latest study conducted by the London School of Economics (LSE), in association with Inmarsat, highlighted the significant operational and commercial efficiencies for airlines, and our recently released Passenger Survey shows demand for connectivity is exceeding supply."

STAND: 921

Personalization platform for IFE

Global content agency Spafax is introducing new features to Spafax Profile, its entertainment personalization platform. With this platform, airline passengers can learn what entertainment will be available on their upcoming flight, and discover more in-depth information about each program, all via a highly interactive web experience.

New personalization features on the platform include passenger login, content tracking and recommendations. Once logged in, a user can manage their favorites list and receive personalized recommendations.

Kevin Birchmore, director of sales, technical products and solutions at Spafax, says: "We're continuously looking to extend our digital product suite in ways that will enhance the passenger experience. The new personalization features for Spafax Profile will allow our clients to bring a new level of service to their in-flight entertainment offer."

Since launching Spafax Profile in 2016 with Lufthansa, Spafax has added five new airline clients to its portfolio digital product, including American Airlines, British Airways and Scandinavian Airlines.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STAND: 504

Power technology

A rapid increase in wireless IFE systems and the growing demand to power PEDs, POS credit card readers and other electronics, has left airlines in need of reliable USB and wall-outlet power.

True Blue Power's line of FAA- and EASA-certified inverters, converters and USB charging ports deliver all of the necessary power in small, economical, easy-to-install packages. Typically installed as a minor alteration, the True Blue Power range already provides uninterrupted power to the passengers and crew of more than 50 airlines worldwide.

The TI250 Series DC-to-AC Inverter is ideal for electronic flight bags and the power-hungry electronics found in the cockpit, and one TC280 AC-to-DC converter delivers enough energy to power 18 single-port or nine dual-port USB chargers. The sealed USB units offer water-resistant protection against spills and surface-cleaning solutions.

For more details on True Blue Power technology, see p137.

THE TC280 VOLTAGE CONVERTER CAN POWER 18 SINGLE-PORT USB CHARGERS

See p137 for more details about True Blue Power's technologies

SEE P107 FOR AN INTERVIEW WITH APEX CEO JOE LEADER

STAND: 753

Next-generation BoardConnect

Lufthansa Systems will introduce a new generation of its BoardConnect Portable system, with a new prototype on show. To create the efficient and robust portable IFE hardware, the company applied its experience of operating a portable IFE solution globally and for large fleets with over 100 aircraft. This hardware has been designed to reduce the handling efforts of the IFE solution and at the same time allow more use cases for the digital aircraft.

The Mobile Streaming Unit (MSU) corresponds to a real server platform, including all necessary access points, while size and weight (less than 2kg) remain the same. Each MSU provides sufficient high-quality streams to support a typical single-aisle aircraft without any service degradation.

The BoardConnect Portable system has a modular structure and can be configured according to airline needs. Airlines can tailor their offerings regarding content, advertisements, retail and entertainment, or simply let Lufthansa Systems' partners monetize the IFE for them. On request the system can also be supplemented with low-bandwidth connectivity using Iridium NEXT (BoardConnect Portable/Link). The required antenna can be installed in a smart position of the cabin, with no STC required.

Besides messaging services the solution enables online payment and many other e-commerce use cases. The smart STC-free service is part of the Lconnect product range by Lufthansa Technik and only requires a minor modification.

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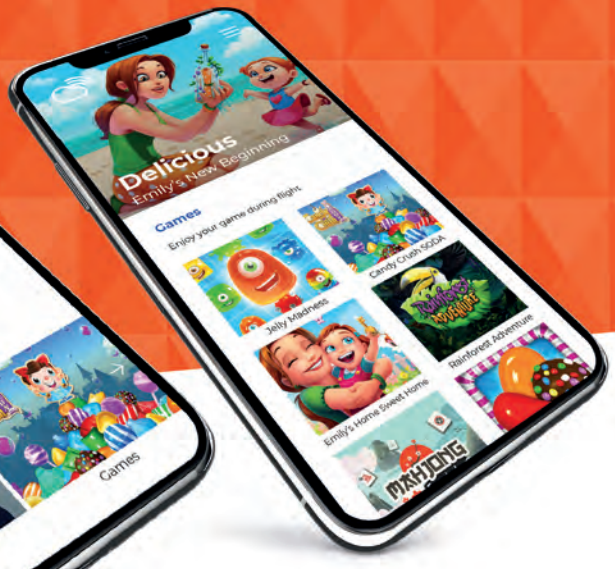

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ODE TO PHIL

Jennifer Coutts Clay pays tribute to Philip George, one of the world's most influential airline design specialists

Read Jennifer Coutts Clay's fascinating Concorde story on our website

BELOW: PHIL GEORGE'S GROUNDBREAKING PAN AM CLIPPER CLASS CABIN IDEAS RAISED THE GAME IN BUSINESS CLASS TRAVEL. IMAGES COURTESY OF PAN AM/ GEORGE DESIGN STUDIO

Philip George's specialist comments appear in *Jetliner Cabins*, Jennifer's e-book app, available on Amazon, Apple iTunes and Google Play. More information at www.jetlinercabins.com

With the recent passing of Philip George – known to all as Phil – the aviation world has lost one of the most important and influential airline design specialists of the jet-age era.

Press reports have focused on his designs for famous restaurants, but Phil's permanent legacy lies in the aviation sector: for decades his achievements have been emulated by airlines globally.

At Pan Am, Phil had many pioneering ideas, including the first use of giant letters for the livery scheme; introducing luxurious leather-and-sheepskin covers for the first stretch-out seats in first class; the launch of Clipper Class, the first dedicated, branded business class cabin; and the first business-style cabin treatment for economy class (instead of tourist-type furnishings).

Full disclosure: as general manager of product design and development at Pan Am, my responsibilities included the implementation of Phil's innovative concepts. I am indebted to Phil and his wife Gail; it was a privilege to work alongside them.

Phil's background encompassed engineering, architecture and US Air Force service. At Braniff he introduced the first all-leather seat covers throughout the aircraft, along with amazing color combinations for furnishings, lighting, uniforms and airport facilities. At Air Florida Phil incorporated riotous tropical-plant patterns in the interior-design schemes – directly challenging the dark brown, military-style treatments used by Eastern, the rival airline at Miami. Other exciting designs by Phil flew on airlines in the Middle East and Caribbean.

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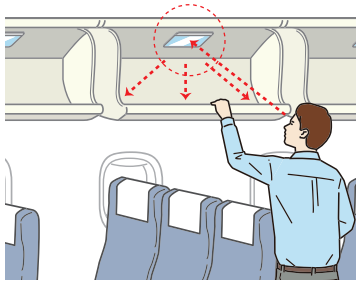
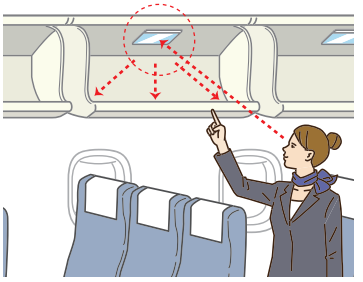


Shorten Aircraft Turns



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BETTER THAN THE REAL THING

Introducing the newest addition to Lonseal's range of aircraft flooring: Loncontrail wood effect

The Loncontrail flooring range will officially launch in September 2018

The Cirrus Collection by Lonseal comprises a variety of intriguingly realistic wood looks for aircraft flooring. From the intricate grain details to the unique characteristics of real woods, Lonseal develops flooring that is luxurious in style and delivers high performance and quality. The Cirrus Collection brings the timeless beauty of wood to the air cabin space, enhancing the aesthetic environment.

Loncontrail is the newest addition to the collection. It has the appearance of a natural striated wood, with a thick, combed design. The continuous brushstroke provides a soothing effect in the cabin environment, which can be a space of anxiety and stress. Loncontrail creates order in a demanding space and brings in a sense of harmony.

This new sheet vinyl flooring product visually expands the cabin space, but is also easy to keep clean and to maintain. Scuff marks are easily camouflaged and the deceptively smooth surface makes it relatively straightforward to wipe away evidence of spills and splashes.

Loncontrail is available in four colors, designed to add luxury to the cabin: 9401 Spiced Wine, 9402 Knight's Armor, 9403 Hickory Nut and 9404 Charcoal Blue.

The flooring material also meets key FAA requirements, including FAR 25.853a (12-second vertical flammability test) and FAR 25.793 (factor of sliding friction).

Lonseal became a leading company in the aviation industry because of the 'featherweight' nature of its aircraft flooring collections, which it claims are up to 30% lighter than standard NTF products. The lightweight materials and high strength-to-weight ratio of Lonseal's aircraft flooring ranges mean they are specified by many aircraft designers and airplane manufacturers.

FEATURES
(nominal data)

Roll width: 6ft (1.8m)
Roll length: 60ft (18.3m)
Overall thickness: 0.08in (2mm)
Wear layer thickness: 0.02in (0.5mm)
Weight: 72oz/sq yd (2,441g/m²)

LONCONTRAIL HAS A NATURAL AND LUXURIOUS APPEARANCE AND OFFERS AIRLINES SEVERAL OPERATIONAL ADVANTAGES

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To request more details from Lonseal, visit **www.ukimediaevents.com/info/aim**

HIGH-PERFORMANCE FABRIC

PromessaAV has been developed as the next generation of seating fabric

Ultrafabrics, which makes intelligent performance fabrics for commercial upholstery seating, launched PromessaAV through Tapis Corporation at Aircraft Interiors Expo to great fanfare, with what the company claims to be the best aesthetics and haptics in the aerospace industry.

PromessaAV was borne out of Ultrafabrics' well-established Ultraleather brand, but takes things to the next level, using an exclusive, proprietary backcloth that provides greater durability, dimensional stability and recovery.

Manufactured using proprietary Takumi technology, a process that engineers mastered performance directly into four layers, the process combines each into one unified system, assuring enduring bond strength and longevity without risk of delamination.

The foundation of a TR twill substrate delivers high performance, dimensional stability, and ease of upholstering. A unique, open-cell polycarbonate foam layer provides structure for added softness and enables moisture transfer for thermal comfort and body climate regulation. The top-skin layer is created using premium-grade polycarbonate resins, engineered for maximum hydrolysis resistance and strength. A protective surface layer adds extreme durability, in addition to providing ease-of-care and low maintenance.

This combination of benefits ensures years of active use, enduring the rigors of daily travel without compromising on softness.

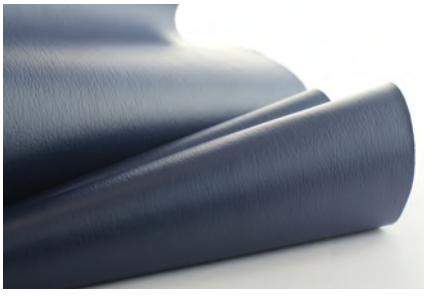
Tapis will be exhibiting at Aircraft Interiors Expo in Boston (stand 600)

PromessaAV can be engineered to achieve customer-specific requirements such as custom grains, colors, finishes and technical specifications. This includes adjustments to gloss level, weight, breathability, thickness and enhanced inherent properties such as an ink and stain protection for seating applications – a process that has the ability to resist the toughest stains, including denim dye transfer and ink.

With 40 years of successful collaboration between Tapis and Ultrafabrics, the companies lead the aviation industry in innovation, design and customization. From innovations to bespoke solutions, Ultrafabrics provides limitless opportunities, showcasing what it does best: reshaping performance fabrics – one surface at a time. Tapis' proprietary FR technology is applied through a state-of the art finishing process to successfully fire-treat Promessa AV products and offer a total solution package tailored to specific project needs.

PromessaAV has been selected as the standard non-leather alternative for the 737 Tourist Class Seating, developed by LIFT by EnCore in collaboration with Boeing. The first of these 737 Tourist Class Seats has entered into service with LOT Polish Airlines on its B737 MAX fleet.

In order to meet specific customer demands, Ultrafabrics is launching a global quick ship/stocking program to better assist those customers faced with fast turnarounds and short lead times. Six aviation-specific colors will be stocked in the USA, UK and Japan, dramatically reducing lead times compared with custom alternatives.



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POWER BROKER

USB and wall-outlet power is fast becoming a passenger expectation. True Blue Power has developed some enabling technologies

BELOW: THE TA102 DUAL USB CHARGING PORT

BELOW LEFT: THE TI250 DELIVERS 250W OF AC POWER

True Blue Power will be exhibiting at APEX Expo 2018 in Boston

From accessing charts and up-to-date weather data, to downloading passenger information and assisting with food and drink selections, pilots and flight attendants are increasingly turning to tablets, electronic flight bags (EFBs), point-of-service card readers and other electronic devices. This reliance on technology, plus the traditional need to power galley equipment – including coffee makers and conventional ovens – has pilots and crew members in need of reliable USB and wall-outlet power.

True Blue Power inverters, voltage converters and USB charging ports are the answer. They supply this much-needed power and are designed to be compact and highly efficient. FAA/EASA certified, and typically installed as a minor alteration, True Blue Power products offer non-stop productivity on the fly, providing power to the crew and passengers of more than 50 airlines worldwide.

250W OF WALL OUTLET POWER

True Blue Power's TI250 delivers 250W of AC power from the aircraft's 28VDC input. The 250W inverter is TSO/ETSO certified and is ideal for electronic flight bags and power-hungry electronics found in the cockpit. Engineered to run cooler and featuring a fanless design, the highly efficient TI250 saves energy and reduces weight.

BELOW: THE TA202 HIGH-POWER USB CHARGING POINT

2,000W OF WALL OUTLET POWER

The TI2000 inverter provides 2,000W of wall-outlet power to cabin and galley equipment, including PEDs, microwave ovens and coffee makers. This 2,000W, TSO/ETSO-certified inverter is smaller, lighter and more efficient than competing products.

2,000W OF DC POWER

The TC2000 delivers 2,000W of DC power for in-flight entertainment systems, interior and exterior lighting, and in-seat, cabin USB power. Just one TC2000 can power more than 100 single True Blue Power USB charging ports. This voltage converter is TSO/ETSO certified, light weight and easy to install.

280W OF DC POWER

Weighing just 2 lb (0.9kg), the TSO/ETSO certified 280W voltage converter delivers enough energy to power 18 single-port or nine dual-port USB chargers. The TC280 is installed on board several B737 aircraft, supplying power to LED cabin lighting, and can be found on board many European airlines, providing power to in-seat USBs on A320, B767 and B757 aircraft.

USB CHARGING PORTS

The TA202 high-power USB charging port provides a cutting-edge power source for current and next-generation devices. With the option of single and dual, USB Type-A and Type-C configurations, each unit delivers 3.0A per port.

The TA102 USB charging port can simultaneously charge two USB devices at full power. Tablets and electronic flight bags stay fully charged and connected. Sealed units offer water-resistant protection against spills and surface cleaning solutions. True Blue Power's USB charging ports are TSO/ETSO certified and RTCA DO-160G qualified.

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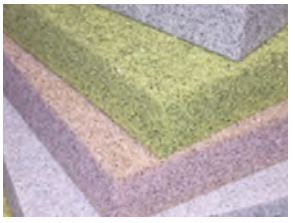
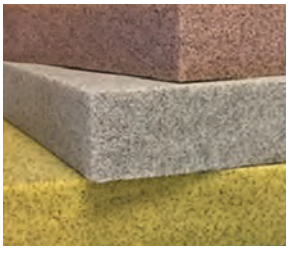
CUSHION COMFORT

For optimal seated comfort, thicker is not always better. The right blend of high-tech materials can ensure comfort in every class of travel

More seat foam insight in our feature on p90

AFI'S RANGE OF MATERIALS CAN BE COMBINED IN DIFFERENT WAYS TO OPTIMIZE COMFORT





Being in the business of supplying seat cushions and covers to carriers and seating OEMs around the world, the team at Aerofoam Industries (AFI) is well aware of three factors that play a role in operations: pricing, weight and comfort. Pricing and weight are easy, as they are based on actual values, and with a range of foam materials to choose from, finding a suitable product is relatively easy.

Comfort, on the other hand, is subjective and requires an understanding of a number of areas, including material sciences, human factors and ergonomics. You cannot simply rely on tools such as pressure mapping to determine comfort. There is a bit of science involved in foam selection to achieve optimal cushion comfort. Anyone can take off-the-shelf foams, shape them into a cushion profile, apply fire-block material and call it a seat cushion, but we have all sat on one of these at some time in our lives and found that park benches are more appealing.

Proper cushion design starts with a clear understanding of customer requirements and expectations, and each customer and requirement is different. Some projects allow the construction of a 4in-thick seat cushion, while others are limited to 1in. This is where it is critical to have not only the right selection of foam materials, but an understanding of foam density and indentation load deflection and how they interact together also comes into play. The end result should be the same: providing maximum comfort for each application, regardless of cushion thickness and/or seat design. This holds true whether the seat is in first class or economy. For example, an airline customer approached AFI with a project where cushion thickness was not a limiting factor with regard to design. The design criteria was that a 50th percentile male or female passenger must be comfortable in the seat regardless of seat position, which included full lie-flat without the use of any additional mattress pads.

For this project a wide variety of highly resilient materials and memory foam materials were coupled with laminated dress covers to achieve maximum comfort in all positions. This seat ultimately went on to win a Crystal Cabin Award and is widely discussed on social media in terms of its comfort.

At the other end of the scale are 'slimline' economy class seats. With these seats less is more, with the aim of increasing passenger living space. However, the initial perception of most passengers is that these seats can't be comfortable because thicker cushions are better than thinner ones. But even with these factors working against the team, AFI has been able to provide unmatched comfort using highly resilient and memory foam materials, all while staying within the limited 'slim' design envelope. This allows the seat to do what it was intended to do: provide the passenger with optimal living space, even at a 28in pitch. The difference with the AFI cushion system is that it can also provide the passenger with maximum comfort, even on long-haul.

SMOOTH OPERATOR

Ebco has designed a tray table with a clever deployment concept for Essenza, Geven's latest comfort seat

Ebco is certified in accordance with DIN EN 9100 quality management

Ebco is an experienced supplier of tray tables for well-known manufacturers of aircraft seating. In 2017, long-time Italian customer Geven challenged Ebco to design a tray table for its new Essenza seat – and to make sure its guidance function was perfectly smooth. The passenger should be able to slide the tray table in using just one finger, without any resistance. The challenge was accepted!

The partnership between the companies allowed them to work out a concept that meets the brief, while maintaining Geven's motto of 'essential in design, substantial in reliability'.

Ideas and concepts could be quickly implemented due to the companies' common philosophies of having an uncomplicated approach, flat hierarchies,

and motivated employees who work with a spirit of personal responsibility and willingness to compromise.

After a short but intensive development stage, a tray table concept with integrated literature pocket was implemented; it can now be used on board ATR and Lufthansa Group aircraft, among others. The table is made from Ebco's special lightweight and dimensionally stable yet hard PUR filler foam, with a good price-performance ratio and a long lifespan.

"It was a real pleasure to develop such a concept as part of a very goal-oriented and friendly collaboration with the Geven development team, and we are very proud to be a small part of Essenza," says Ebco sales manager Michael Graf.

Geven's Essenza was presented at a joint press conference between Lufthansa Group and Geven at Aircraft Interiors 2018 in Hamburg.

LONG-TERM RELIABILITY

Stephanie Poetter of TQ Aviation discusses the importance of obsolescence management in aerospace electronics

How can companies with electronics engineering and manufacturing services best embrace the aerospace industry? Stephanie Poetter, product marketing manager at TQ Aviation, will be explaining to attendees at Aircraft Interiors Expo Americas in Boston on September 25-27.

"When it comes to electronic solutions for the aviation industry, security is often a key aspect. For companies that operate in electronics engineering and manufacturing services (E²MS), it is vital to understand what this means in the long run.

"The ongoing trend of shortening product lifecycles in both B2B and B2C electronics does not work with aircraft packed with electronics. The lifecycles of aircraft, and the myriad electronic devices contained in their interiors, remain long compared with other industries."

So what do you do when the microchip at the heart of your aviation application becomes obsolete? When a three-year production run comes to an end, yet the application has to operate for decades to come?

"This is where the obsolescence management (OM) comes into play," says Poetter. "For any E²MS company wishing to be a reliable partner to the aviation industry, OM is an absolute necessity. One that needs to be taken into account from the very beginning of the development process.

"Only when strategic OM is in place can suppliers ensure that the follow-up generation of a component is punctually available and fully compatible with its predecessor."

As a certified ADOA, POA and (soon) MOA technology company, TQ is a partner to aircraft manufacturers, airlines and suppliers. It offers a complete spectrum of aviation products and services, from design, development, production and assembly, through to maintenance and strategic OM.

COMMODITIZING LOGISTICS

Kuehne + Nagel considers whether the logistics involved in the aircraft interiors sector are a commodity

Increased aircraft production rates are putting pressure on an already strained supply chain. Even more challenging is the fight over passenger loyalty. Airlines are looking for a competitive advantage by adding technologies to enhance the customer experience. As a result, the pace of cabin interior upgrades and modernization is moving faster than ever before.

Supply chain and logistics management is the foundation of any aircraft interior and cabin program, whether it is inbound into the production line, or in support of a refurbishment program.

Kuehne + Nagel has an established track record in the aerospace industry, and continuously challenges the status quo with logistics advances developed in close cooperation with customers. With KN InteriorChain, the company has launched an integrated logistics innovation that is designed to actively address the challenges of the cabin interior industry, with specific solutions designed to service the needs of particular segments.

Kuehne + Nagel works to keep aircraft OEM production lines running without interruption. For leasing companies, effective transition can be enabled between operators. For refurbishment programs with airlines and MROs, the operational excellence enables them to minimize downtime.

In the simplest terms, Kuehne + Nagel can make sure a shipset of new interiors is available where it needs to be, ready for installation. The company can even manage delivery and staging within the hangar, and environmentally dispose of the unusable material.

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Emirates A380

The A380 is an extraordinary aircraft, an aircraft that found an equally extraordinary operator in Emirates, which has embraced its unique capabilities like no other airline. Launch customer Singapore Airlines offered a luxurious A380 experience, but when Emirates followed with its three-class configuration in August 2008, it revealed an experience much closer to the hyped capabilities of the superjumbo. The suites in first class did not break new ground – that honor went to Singapore Airlines – but the rest of the customized premium upper-deck certainly did, boasting onboard showers in first class, lounges front and rear, a unique cabin lining, and custom mood lighting.

"I had the power behind me to make special requests of Airbus," said Jacques Pierrejean, Emirates' designer for the upper deck. "This would not have been possible if the airline had only ordered a few aircraft – but as Emirates is Airbus's largest [A380] customer, it made it easier for me to pursue some of my ideas."

The airline's bold initial order for 58 aircraft certainly showed strong buying power and earned it strong bargaining power for cabin customization – and with its A380 fleet now accounting for nearly half of the world's production of 226 A380s, it remains in a strong position.

The showers are particularly worthy of mention, as they were a major talking point at launch and still excite passengers a decade on. Akin to the excitement Virgin Atlantic has noted when passengers discover their flight has a bar (even economy passengers who cannot access it), flying on such a well-appointed airplane creates excitement. One might say you cannot put a price on such positive public sentiment, but in this case you can: the showers require an extra 25% of water to be carried, amounting to an extra 500kg, stored in auxiliary potable water tanks in the center wingbox two decks below.

Certifying the showers was clearly problematic, but the eventual solutions were surprisingly simple: fitting a grab handle in case of turbulence, and installing a drop-down oxygen mask system in the ceiling between the shower and the door, in case of sudden decompression.

ABOVE: THE MOST COMMON A380 SIGHTING IN THE WORLD, BUT NO LESS AMAZING FOR IT

BELOW: AIRBUS WAS CONVINCED TO INCREASE THE HEIGHT OF THE CEILING ABOVE THE OUTBOARD SUITES IN FIRST CLASS IN ORDER TO ENSURE THEY HAVE THE SAME FEELING OF SPACE AS THE CENTER SUITES

Water was again an issue when Emirates insisted on a 'waterfall' feature above the buffet counter in the first-class social zone. This feature is even more fanciful than the showers, but Pierrejean felt the "immediate feeling of relaxation" the feature gives made it worth fighting for. Airbus was concerned that wiring could come into contact with the water, but a self-contained, self-recycling system allayed their fears.

The marketing department salivated over the luxury appointments while their colleagues in accounting and engineering fretted, but Terry Daly, Emirates' SVP of service delivery, was confident in the decisions, stating at launch, "I don't think there's anything wrong in investing in a competitive first-class product.

"We're just as cost conscious as any other airline – we do not have access to extra cash as some people seem to believe. However, we do have a very strong principle that we do not wish to take away from the customer – we will look for better efficiency within the company, but we have no plans to suspend our investment in further product development," he added.

That showers are still being fitted in Emirates A380s 10 years later, with more than 80% of long-haul first class customers having used them, shows Daly's confidence was not misplaced.

Emirates did have an eye for efficiency in the economy deck below, however, with a simple feature deletion – the footrests on the seats – saving about 1kg per seat. This saving, combined with removing most printed inflight media, when multiplied by hundreds of seats, helped claw back substantial weight.

"It's been 10 extraordinary years since the first Emirates A380 flight took to the skies," stated Sir Tim Clark, president of Emirates, at the 10-year celebrations in August, adding that the upper-deck innovations have "redefined air travel". He might just be right.

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